



Inland Seas Angler

# GREAT LAKES BASIN REPORT<sup>©</sup>

## Special Report – Lake Huron & Lake Superior

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## Highlights of the Annual Lake Committee Meetings Great Lakes Fishery Commission proceedings held in Ypsilanti, MI

This fourth – and last of a series of annual special reports is an extensive summary of the Lakes Huron & Superior annual Lake Committees. These Lake Committee reports are from the annual Lake Committee meetings hosted by the Great Lakes Fishery Commission of March 2009.

We encourage reproduction with appropriate credit to the GLSFC and for the agencies involved. Our thanks to the USGS, Great Lakes Science Center; GLFC; USFWS and the State DNRs for their contributions to these science documents. While they are abridged and have been edited for brevity, we have submitted extensive information that gives an overview of the status, conditions and prognosis of the Great Lakes and our fish.

We especially thank the following for their assistance in getting us the many electronic documents, graphs, tables and reports: Jim Johnson, Michigan DNR; Bob Adair, Heather Dawson, Dale Hanson and Mark Holey, USFWS; and Jackie Savino, USGS Great Lakes Science Center; and their respective support staffs. Thanks also to the Great Lakes Fishery Commission, its staff and Marc Gaden & Chris Goddard, for their efforts in again convening and hosting all the Lake Committee meetings in Ypsilanti, MI.

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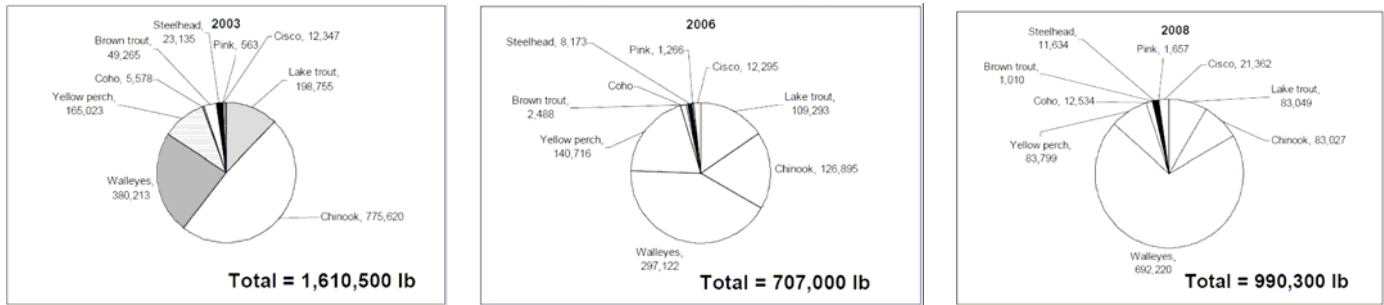
## Lake Huron

### Recreational Harvest Summary, Lake Huron, 1987–2008

We monitored trends in the offshore, traditionally trout/salmon ports by focusing on 10 “Index” ports – the 10 ports on the Main Basin of Lake Huron that receive the most consistent sampling from year to year. Trends in Main Basin harvest and catch rate are based on these 10 ports. Total catch and harvest composition in 2008 are based upon all ports sampled in 2008. We also used two ports on Manitoulin Island for trend monitoring because these ports

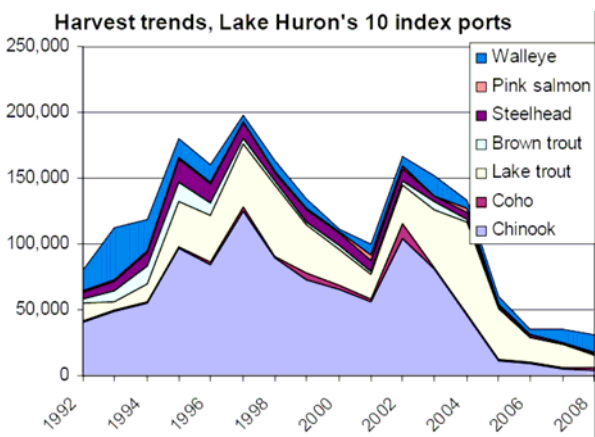
offered the best time series available for Ontario waters.

The collapse of alewives in 2004 precipitated pronounced change in harvest trends and fishing behavior for the Lake Huron recreational fishery. Since 2003, walleyes have replaced salmonids as the leading species harvested in Michigan waters, even at Main Basin ports, which had traditionally been the focus of the salmonid fishery (**Fig 1**).



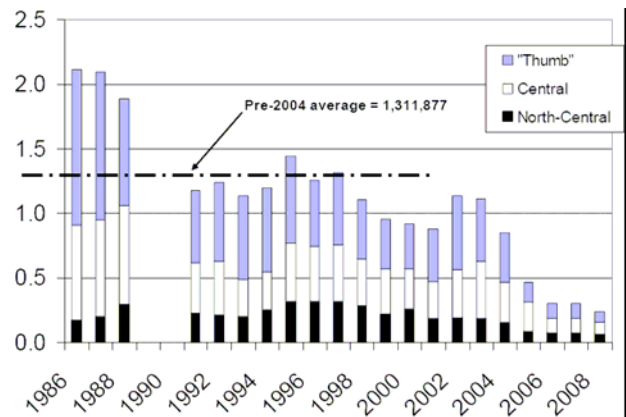
**Fig 1** -Trends in species composition of Michigan recreational harvest, Michigan waters of Lake Huron, including Saginaw Bay. Walleyes have replaced salmonids as the dominant species in the harvest, even at the deepwater, traditionally trout/salmon ports

While walleye harvest increased, harvest of trout and salmon species declined (**Fig 2, Table 1**). The decline in Chinook salmon was dramatic and led to a sharp reduction in angler hours at Michigan’s 10 index ports of Lake Huron (**Fig 3**), where trout and salmon had been the mainstay of the fishery. Alewives had been suppressing walleye reproduction, and following the alewife collapse walleyes produced the largest year classes on record in Saginaw Bay. By 2006 walleyes of the massive 2003 year class reached harvestable size, which precipitated a switch in targeting for both the Charter and Recreational fisheries. Walleye harvest in Saginaw Bay is now nearly a quarter million fish annually.



**Fig 2** -Trends in catch of major species. Salmonid species declined sharply after 2004, the year of alewife collapse

While fishing pressure has been in steady decline at Main Basin ports, fishing effort has declined comparatively slightly on Saginaw Bay, probably because of the attraction of its recovering walleye population. Yellow perch are at all-time low levels in the recreational harvest, even in Saginaw Bay where they had once dominated the harvest (**Fig 5**). The decline in yellow perch, combined with rising fuel prices, probably explain the slight decline in fishing pressure in Saginaw Bay. Yellow perch have recovered in the Les Cheneaux Islands, due principally to the control of the archipelago’s cormorant population.



**Fig 3** - Trends in Chinook salmon harvest at the 10 Index ports, Michigan waters of the Main Basin.

Chinook declined sharply after the 2004 alewife collapse, which in turn caused a loss of over 1,000,000 hours of fishing at these deepwater ports, with significant impacts to local economies.

Chinook harvest reached a record low in 2008 (**Fig 3, Table 1**). Chinooks were rare in the harvest at ports south of Alpena on the Michigan side of Lake Huron. Even at Oscoda, which is the second largest stocking site on Lake Huron, the harvest estimate was only 126 Chinooks. The decline in 2004 was more dramatic in Michigan waters (**Fig 3**) than in Ontario (**Table 1**). But in 2008 there was a pronounced decline in harvest at the Ontario index ports, perhaps caused by a combination of low numbers of Chinook and declining effort. Even as Chinook harvest has declined, the proportion of hatchery origin has remained small. Wild fish composed an average of 81% of Chinooks examined at Michigan and Ontario ports from the 2000–2004 year classes and made up 89% of the weaker 2006 and 2007 year classes.

Brown trout harvest also reached a record low in 2008 and Michigan has consequently chosen to end its program of stocking approximately 300,000 spring yearlings per year in favor of an experimental stocking of 90,000 larger fall yearlings at three sites.

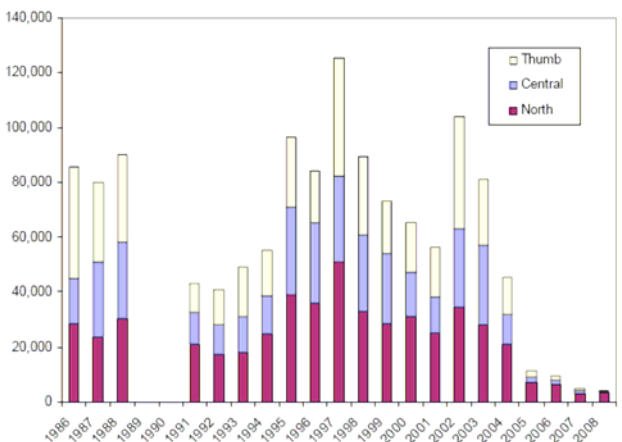
**Table 1** - Estimated recreational harvest at sites on Manitoulin Island; shown because they represent the best time series for Ontario waters of Lake Huron

SPC	1995	1998	1999	2000	2001	2002	2003	2005	2006	2007	2008
Pink salmon	2348	378	694	747	1413	730	44	80	270	50	63
Coho salmon	106	238	493	300	116	174	5	128	129	91	80
Chinook salmon	7,824	2,780	3,650	5,799	4,600	5,393	7,139	2,627	2,491	2,235	130
Rainbow trout	761	281	812	624	634	801	240	905	379	326	89
Atlantic salmon			8	30	146	12	8		29	20	22
Brown trout	79	18	161		5	31					
Lake trout				125	621	557	672	631	333	1068	336
Salvelinus sp.	363	165									
Lake whitefish							9		11	7	
Yellow perch										21	
Total	11,481	3,861	5,818	7,625	7,535	7,697	8,117	4,369	3,641	3,818	719

✧

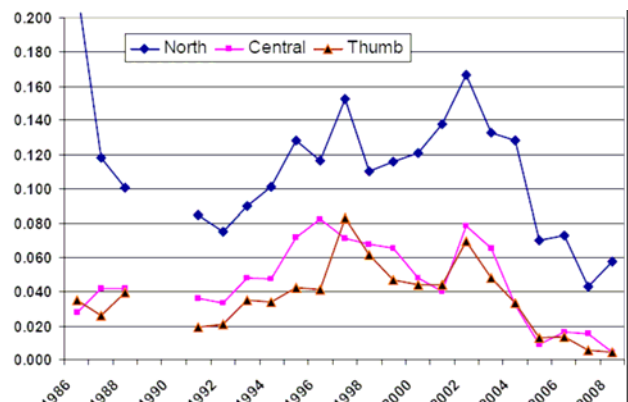
### Trends in the Chinook Salmon Fishery of Lake Huron, 2000–2008

The Michigan Department of Natural Resources (MI DNR) has monitored trends in the Chinook fishery by estimating harvest and catch rates at 10 “Index Ports” on the west shore of Lake Huron. Chinook salmon abundance in Lake Huron, as indicated by catch statistics from these index ports, declined sharply after the alewife collapse of 2004 (Fig 1). The decline in Chinook abundance was especially pronounced in the central and south portions of Michigan’s Main Basin, as indicated by catch rate trends (Fig 2).



**Fig 1**– Chinook salmon harvest estimates for 10 “Index” ports, Michigan waters of the Main Basin of Lake Huron

The alewife collapse led to declines in nutritional status and recruitment in Chinook salmon. Weight and condition of Chinook returning to the Swan Weir in north-west Lake Huron declined sharply after 2003 and reached record-low levels in 2007. In 2007 eggs collected from Swan Weir were of such poor quality they were not used for fish culture that year. Condition of the spawners and egg quality recovered somewhat in 2008. Recruitment also declined sharply after 2003, as indicated by declining harvest and catch rates (Figs 1 and 2) and by low fall return fisheries at Michigan stocking sites (Table 1).



**Fig 2** – Catch per angler hour of Chinook salmon, Michigan’s 10 Index ports; catch rates declined most at ports south of Alpena

Port	2008 harvest	September–October harvest	2005–2007 average annual stocking rate
St. Marys River	1,378	726	26,667
Detour	1,637	111	0
Les Cheneaux	352	11	0
St. Ignace	546	64	110,854
Rogers City	2,119	390	561,580
Presque Isle	814	127	0
Rockport	686	30	0
Alpena	653	343	0
Harrisville	117	84	159,207
Oscoda	126	7	277,745
Tawas	15	13	38,409
Pt Austin	90	0	152,796
Harbor Beach	114	13	241,733
Port Sanilac	187	17	0
Lexington	14	0	51,083

**Table 1** - Chinook salmon season-long harvest totals and Sept – Oct harvest, compared with annual stocking rates, by port or area, Michigan waters, 2008

Although Chinook salmon declined in both number and physical condition, natural reproduction continued to account for most of the salmon observed in the fishery. All

stocked fish were marked in 2000–2003 and 2006–2008. Michigan’s fish were marked with oxytetracycline and Ontario’s with fin clips. Ontario Ministry of Natural Resources and MI DNR collected vertebrae from each of these cohorts by sampling fishing tournaments. The 2000–2003 year classes, produced prior to the alewife collapse, were comprised of 81% wild fish (lakewide average). The incidence of wild fish of the 2006–2008 cohorts, produced after the alewife collapse, averaged 89%. Mean 2005-2007 stocking rates at each port (**Table 1**) accounted for little of the variation in harvest between ports. Only one stocking site, Swan Bay (near Swan Weir), produces a significant

fall return fishery.

In summary, Lake Huron’s Chinook salmon appear to have reached a tenuous equilibrium in response to the alewife collapse. The species has declined to a fraction of its previous abundance in the central and southern waters of the Main Basin, but continues to produce attractive sport fisheries in northern waters of the Main Basin and in Georgian Bay. Body condition and size at age remain very low. Upwards of 80% of Chinooks harvested are of wild origin and stocking contributes little to the fishery. ✧

### Fish Stocking Summaries, Lake Huron, 1968-2008

In general, stocking activity rose during the period 1968-1986, stabilized for a time, then tended downward after 1992. Reductions in stocking were due to a decision by Michigan Department of Natural Resources to cease stocking Coho salmon in 1990 and to successive reductions in Chinook salmon stocking in 1991, 1999, and 2006. Strong wild year classes of walleyes were measured in Saginaw Bay, beginning in 2003. Good reproduction, and the emergence of VHS and its implications to fish culture

activities, led to a decision by MI DNR not to stock walleyes in the Main Basin of Lake Huron during 2004-2008. CORA and MI DNR continue to stock walleyes in the St. Marys River. Lake trout stocking rose after 1992 as Ontario Ministry of Natural Resources converted hatchery production from backcross to lake trout and initiated new rehabilitation stocking strategies, most of which were focused on Georgian Bay and the North Channel.

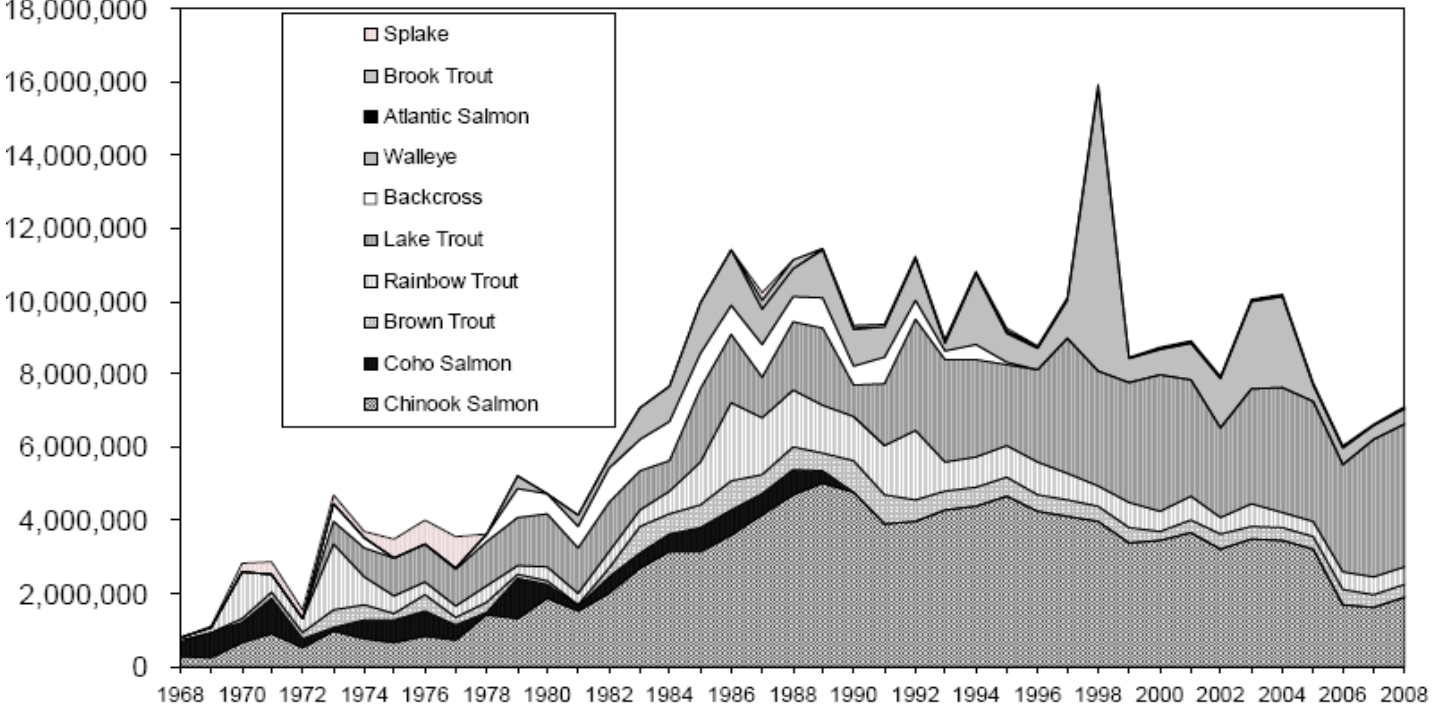


Fig 1 – Stocking activity, Lake Huron

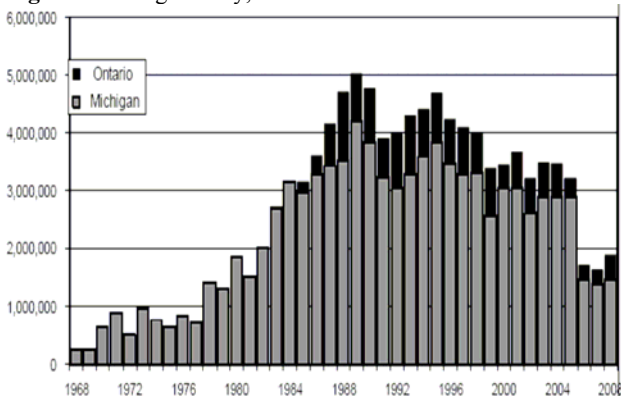


Fig 2 – Chinook stocking, Lake Huron

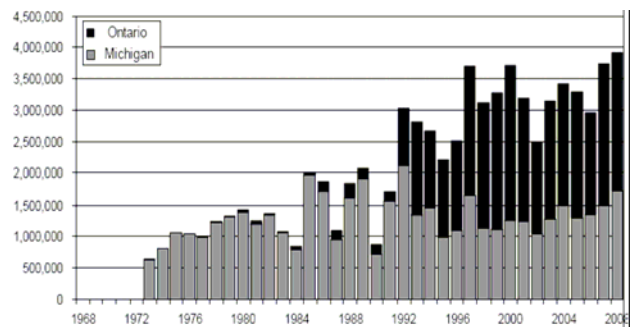


Fig 3– Lake Trout stocking, Lake Huron

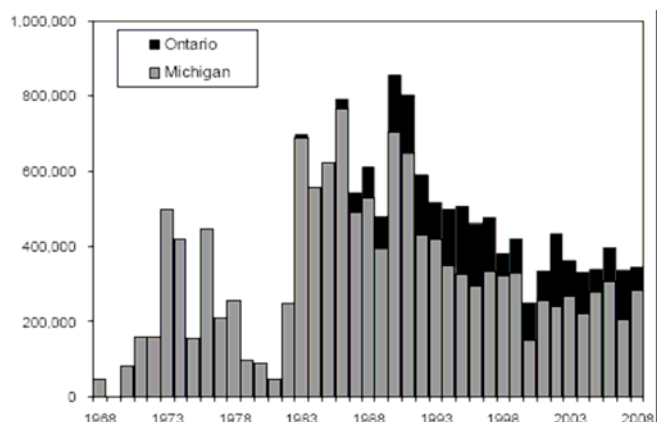


Fig 4 – Brown Trout stocking, Lake Huron

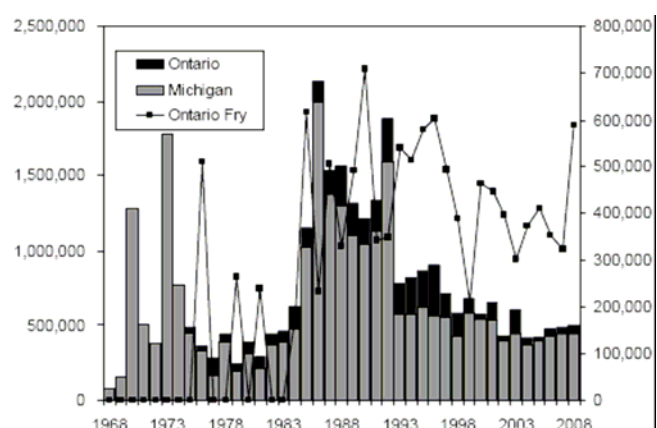


Fig 5 – Steelhead/Rainbow trout stocking, Lake Huron

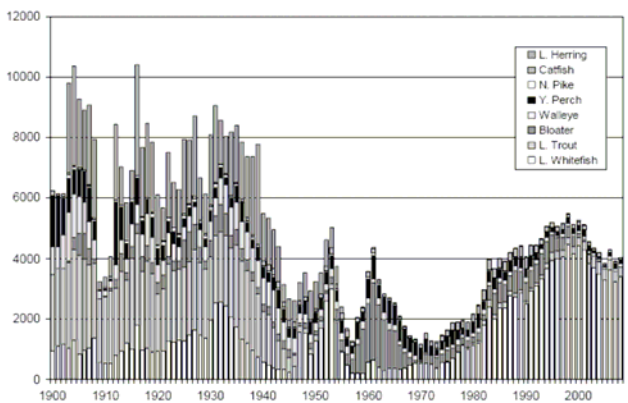
Table 1 - Total number of predators stocked into the Lake Huron basin, 1968-2008

Year	Chinook Salmon	Coho Salmon	Brown Trout	Rainbow Trout	Lake Trout	Backcross	Walleye	Atlantic Salmon	Brook Trout	Splake	Total
1968	265,000	402,000	45,000	70,000	0	0	0	0	0	0	782,000
1969	250,000	667,000	0	151,020	0	0	0	0	0	35,410	1,103,430
1970	643,000	571,000	81,870	1,280,666	0	0	0	0	0	247,422	2,823,958
1971	894,000	975,000	159,291	507,022	0	0	0	0	0	321,350	2,856,663
1972	514,545	249,046	160,000	378,877	5,000	0	0	0	0	258,300	1,565,768
1973	967,330	100,026	496,552	1,779,304	631,915	486,000	0	0	0	250,754	4,711,881
1974	776,294	500,048	420,109	770,840	796,000	250,000	0	0	0	190,354	3,703,645
1975	655,484	627,362	155,025	487,615	1,055,500	0	0	0	0	523,099	3,504,085
1976	830,536	690,529	446,842	364,014	1,027,000	0	0	0	0	658,107	4,017,028
1977	733,430	415,568	210,014	286,167	998,000	38,564	0	0	0	879,004	3,560,747
1978	1,417,578	84,176	258,232	445,400	1,232,000	174,500	25,000	0	0	0	3,636,886
1979	1,325,033	1,082,216	98,000	246,700	1,327,226	798,489	334,427	0	1,500	0	5,213,591
1980	1,877,645	375,130	90,000	393,013	1,428,500	560,515	9,989	0	0	0	4,734,792
1981	1,522,745	135,132	45,000	293,443	1,244,560	604,318	294,656	0	0	0	4,139,854
1982	2,000,787	452,589	250,000	443,381	1,360,142	925,610	269,540	0	0	0	5,702,049
1983	2,695,800	425,138	697,477	464,050	1,078,500	855,948	869,390	0	0	0	7,086,303
1984	3,146,997	470,051	555,520	627,411	840,626	1,069,961	947,796	0	8,000	0	7,666,362
1985	3,140,892	671,733	623,067	1,152,152	2,008,397	988,181	1,382,754	0	0	0	9,967,176
1986	3,609,052	675,259	791,766	2,137,372	1,870,014	787,925	1,518,319	0	14,848	0	11,404,555
1987	4,143,730	581,649	541,102	1,535,768	1,095,872	901,428	972,734	0	242,939	196,749	10,211,971
1988	4,693,327	702,034	609,804	1,566,438	1,847,007	689,796	757,777	0	252,900	0	11,119,082
1989	5,017,748	350,097	479,800	1,317,263	2,082,575	837,357	1,318,362	18,596	0	0	11,421,798
1990	4,767,931	0	855,852	1,208,997	870,005	522,342	1,011,977	33,235	67,024	0	9,337,363
1991	3,897,944	0	802,652	1,334,684	1,719,154	724,230	797,757	32,804	48,500	0	9,357,725
1992	3,975,852	0	588,636	1,883,732	3,040,178	518,068	1,159,912	42,203	0	24,790	11,233,371
1993	4,290,811	0	516,733	778,021	2,819,272	245,415	188,271	70,164	0	45,700	8,954,387
1994	4,403,507	0	497,468	823,244	2,671,519	399,001	1,963,970	33,275	0	37,493	10,829,477
1995	4,678,127	0	503,959	863,142	2,202,115	87,383	802,138	68,066	0	37,500	9,242,430
1996	4,236,069	0	461,250	905,941	2,514,921	0	573,421	43,725	0	50,271	8,785,597
1997	4,095,744	0	476,156	717,522	3,702,626	0	1,038,833	43,568	0	30,480	10,104,929
1998	3,990,079	0	382,722	581,195	3,119,271	0	7,765,755	52,174	0	32,600	15,923,795
1999	3,390,984	0	420,090	679,370	3,284,912	0	642,269	26,185	0	34,000	8,477,810
2000	3,441,989	0	249,038	574,269	3,711,141	0	681,589	46,220	0	30,000	8,734,247
2001	3,657,505	0	335,343	654,811	3,186,613	0	1,024,913	35,909	3,000	30,820	8,928,914
2002	3,200,453	0	433,837	427,231	2,484,111	0	1,328,369	29,313	0	32,200	7,935,514
2003	3,487,722	0	363,767	605,328	3,148,904	0	2,391,662	18,065	0	32,900	10,048,349
2004	3,469,027	0	332,693	418,461	3,421,360	0	2,487,983	24,811	0	33,600	10,187,935
2005	3,206,496	0	338,772	425,546	3,294,143	0	431,911	29,665	0	37,500	7,764,033
2006	1,706,984	0	396,800	473,355	2,965,167	0	420,440	38,032	0	37,500	6,038,278
2007	1,636,498	0	336,629	488,162	3,749,027	0	375,997	20,437	0	28,700	6,635,450
2008	1,883,476	0	345,583	503,583	3,914,775	0	390,304	29,079	0	37,500	7,104,300

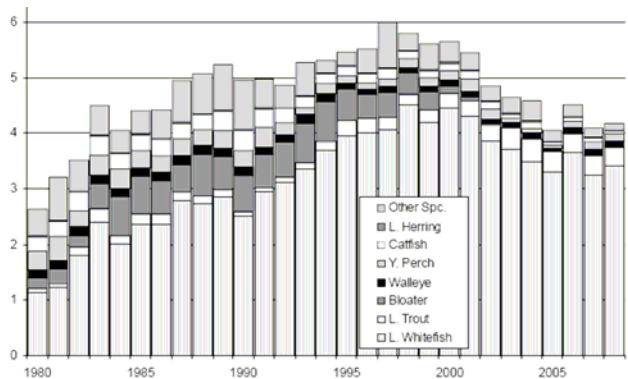
## The Commercial Fisheries of Lake Huron to 2008

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

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 up slightly in 2008 relative to 2007, but was still below the lake-wide average for the past 30 years.



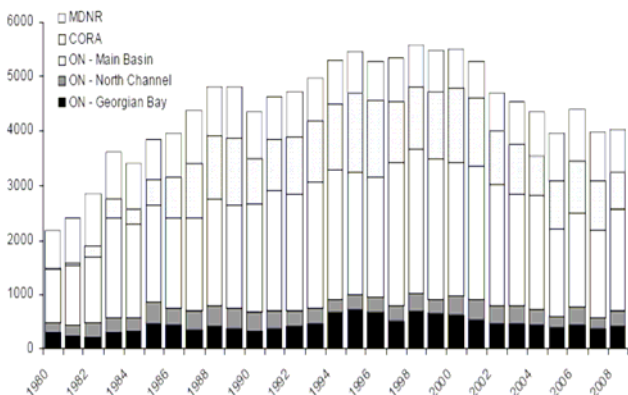
**Fig 1 - Total lake-wide commercial harvest by species, 1900-2008**



**Fig 2 - Total lake-wide commercial harvest by species, 1980-2008**

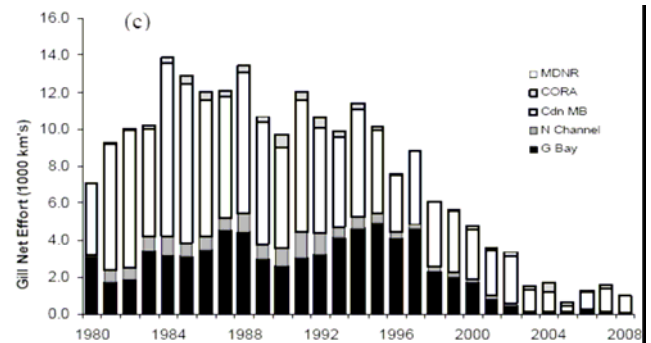
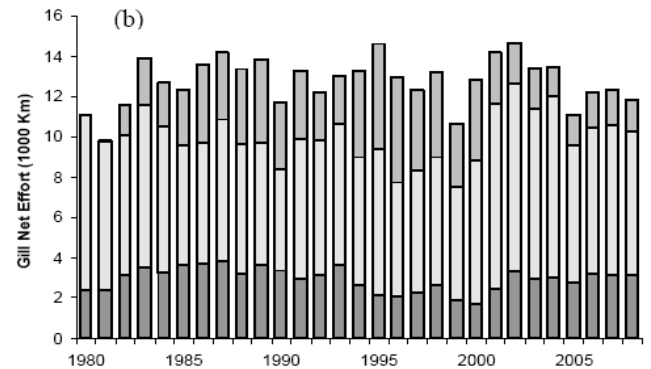
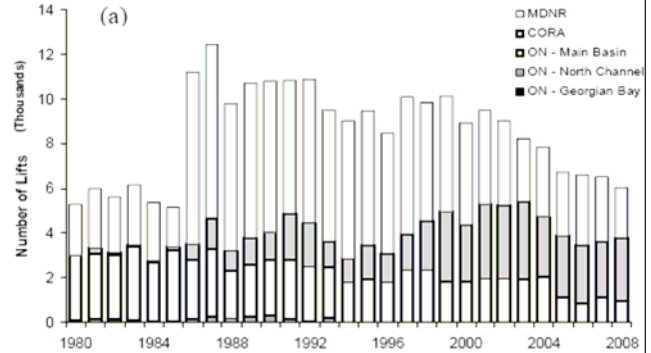
### Current Harvest versus Historical Harvest

Lake-wide harvest continues to be below levels reported in the first half of the 20<sup>th</sup> century but still noticeably higher than the period between 1940 and 1980 (Figure 1). The current species composition continues to be dominated by Lake Whitefish with other species contributing less than 20% to the overall harvest. This is markedly different than historical species composition when lake herring, deepwater chub, and lake trout were large components of the Lake Huron commercial fisheries landings.



**Fig 3 - Total lake-wide commercial harvest for all species by management agency and lake basin, 1980-2008**

### Recent Trends in Commercial Fishing Effort



**Fig 4 - Total lake-wide commercial effort by management agency and lake basin for trap nets (a), large mesh gill nets (b) and small mesh gill nest(c), 1980-2008**

- Trap net effort was down again in 2008, continuing a downward trend that extends back to at least the 1990's
- Despite the lake-wide reduction in trap net effort, the effort reported from the CORA licensed fishery actually increased in 2008
- Large mesh gill net effort (4.5-5.5" stretch measure) continues to be the dominant gill net gear in Lake Huron
- Large mesh gill net effort was down slightly in 2008, but has been relatively stable since 2005
- Large mesh gill net effort has not shown the same decline as both trap and small mesh gill nets

- Most of the large mesh effort continues to be deployed in the Ontario waters of the main basin and the North Channel
- Small mesh gill nets (2.25”-3.75” stretch measure) continue to be used on a very limited basis
- Most all of the small mesh effort deployed in 2008 was by Ontario fishermen targeting yellow perch in the southern main basin.
- There continues to be limited small mesh effort targeting lake herring and round whitefish in the northern part of the main basin.
- Virtually all of the commercial fishing activity licensed by MDNR is conducted with trap nets.

### Recent Trends in Lake Whitefish Harvest

- Harvest of lake whitefish was up slightly in 2008 relative to 2007
- Largest increase was reported from the Ontario side of the main basin and the North Channel
- Harvest continues to be above the levels reported throughout most the 1980’s

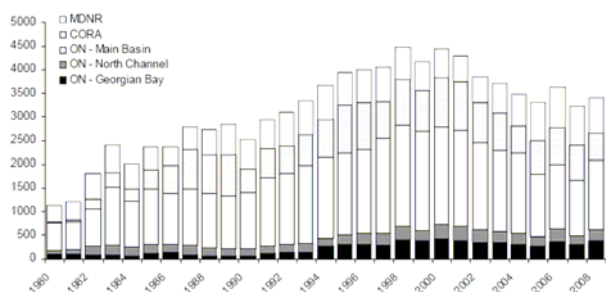


Fig 5 - Total lake-wide commercial harvest (1000 kg) of lake whitefish by management agency and lake basin, 1980-2008

### Recent Trends in Lake Trout Harvest

- Harvest in 2008 was down relative to 2007
- The largest decrease was reported from the Ontario side of the main basin
- The harvest from Georgian Bay has steadily declined since 2004
- Lake-wide harvest continues to be well above any harvest reported between 1980 and 2000

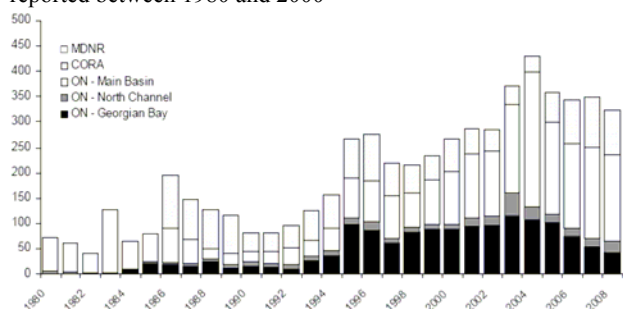


Fig 6 - Total lake-wide commercial harvest (1000 kg) of lake trout by management agency and lake basin, 1980-2008

## Status and Trends of Pelagic Prey Fishes in Lake Huron, 2008

### Abstract

Main Basin estimates of pelagic fish density and biomass were higher in 2008 compared to surveys in 2004-2007 because of increases in both age-0 and adult bloater. Native species now comprise the majority of the Main Basin biomass. We also observed substantial increase in the abundance of threespine and ninespine sticklebacks, although they contributed little to total community biomass increase due to small size. Rainbow smelt densities and biomass appeared similar to other years, and both alewife

### Recent Trends in Yellow Perch Harvest

- Overall, the 2008 harvest of yellow perch was down slightly from 2007, but is still noticeably higher than the period 2003-2005
- Virtually all of the yellow perch harvest was reported from the Ontario side of the main basin
- Yellow perch harvests from the North Channel and Georgian bay have been very low since the mid 1990’s
- Michigan’s yellow perch harvest (from Saginaw Bay) reached a record low level in 2008

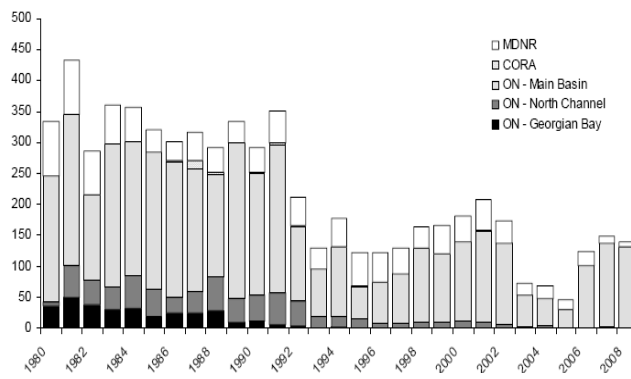


Fig 7 - Total lake-wide commercial harvest (1000 kg) of yellow perch by management agency and lake basin, 1980-2008

### Recent Trends in Walleye Harvest

- Overall, the harvest of walleye in 2008 was down slightly from 2007, but is still noticeably higher than the period 2003-2005
- Most of the walleye harvest was reported from the Ontario side of the main basin although the harvest reported from CORA fisheries in 2008 was higher than any previous year

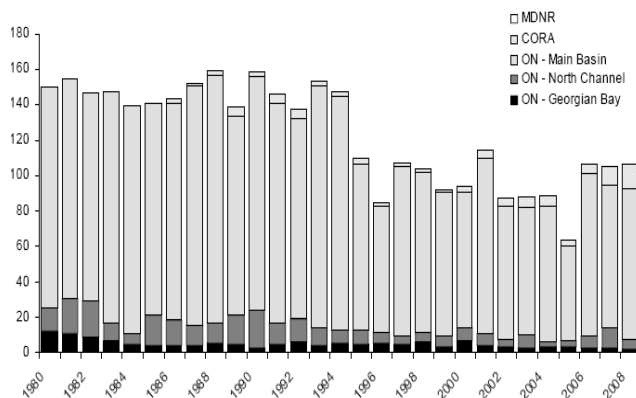


Fig 8 - Total lake-wide commercial harvest (1000 kg) of walleye by management agency and lake basin, 1980-2008

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and emerald shiner were scarce. Also notably absent was cisco which historically were an important pelagic prey fish in Lake Huron. Unlike previous surveys, we did not observe differences in fish density or biomass among Lake Huron’s basins; during 2008 both density and biomass in the North Channel, Georgian Bay, and Main Basin were similar. This appeared to be a result of increases in the Main Basin and not declines in other areas. Main Basin prey availability for salmonids will depend largely on the extent of their predation on bloater which now comprise the

majority of the prey biomass there. The Georgian Bay prey biomass had almost equal proportions of bloaters and rainbow smelt, while the North Channel pelagic biomass remained dominated by rainbow smelt. The present situation in Lake Huron where bloater is relatively abundant but alewife and other prey are scarce may result in dependence on bloater as the primary prey for salmonids.

**Alewife**

Alewives were an important prey species in the latter half of the 20th century, but have been scarce in recent years. Since 2004, we have captured few alewives, and of those nearly all were age-0 fish. Age-0 alewives were captured during 2008 at densities comparable to 2005 or 2006, but main basin density and biomass remained low. Age-0 alewife density was not significantly different among 2005, 2006, and 2008, but densities in those years were significantly higher than 2004 or 2007 (Fig 1),

Age-0 alewife biomass was significantly higher in 2005 and 2008 compared with 2004 and 2007; however, it was chronically low between 2004 and 2008 in the sense that alewives never comprised more than 2.5 % of main basin pelagic fish biomass. Furthermore, age-0 alewives appeared to have low survival because we captured no adults between 2004 and 2008.

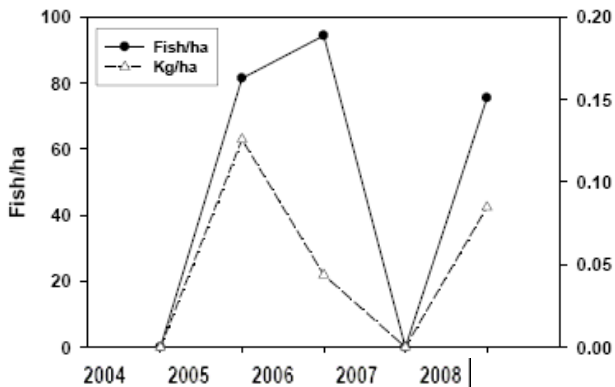


Fig. 1 - Acoustic estimates of age-0 alewife density and biomass in Lake Huron's Main Basin, 2004-2008

**Rainbow Smelt**

Both density and biomass of yearling and older smelt in 2008 were similar to what we observed in 2007 (Figs 2 & 3). Among all years, both density and biomass were significantly lower in 2006 than in other years (Figure 3).

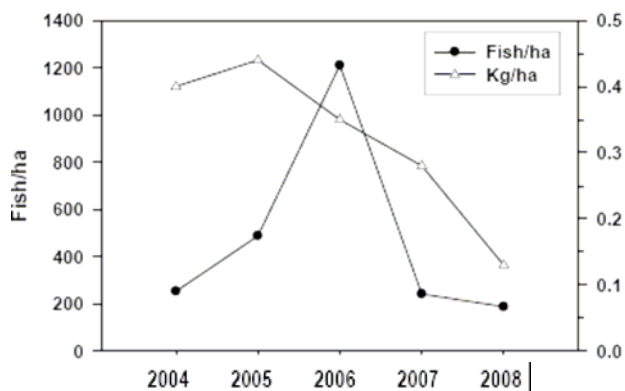


Fig. 2 - Acoustic estimates of age-0 rainbow smelt density and biomass in Lake Huron's Main Basin, 2004-2008

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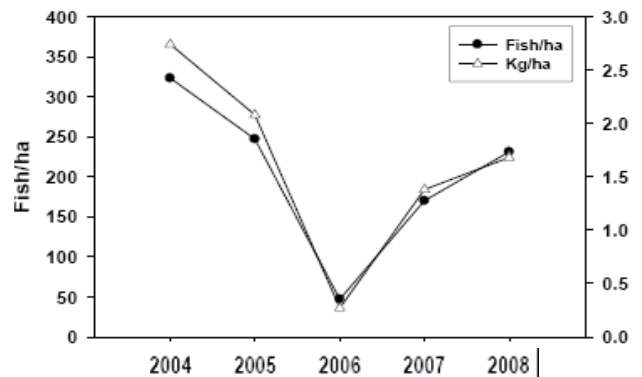


Fig 3 - Acoustic estimates of yearling and older rainbow smelt density and biomass in Lake Huron's Main Basin, 2004-2008

**Bloater**

Main Basin bloater densities increased during 2008. Age-0 density increased almost nine-fold, with a fourfold increase in biomass (Fig 4). Both age-0 density and biomass were similar in '05 and '07 and had significantly higher values during '04 and '06, but 2008 values were higher than all other years. We also observed density and biomass increases in both yearling and older bloaters (Fig 5). Main Basin density of yearling and older bloaters was higher during '07 and '08 compared with other years. Furthermore, biomass was significantly higher during '08 compared with 2004-2006, but did not differ from the '07 estimate.

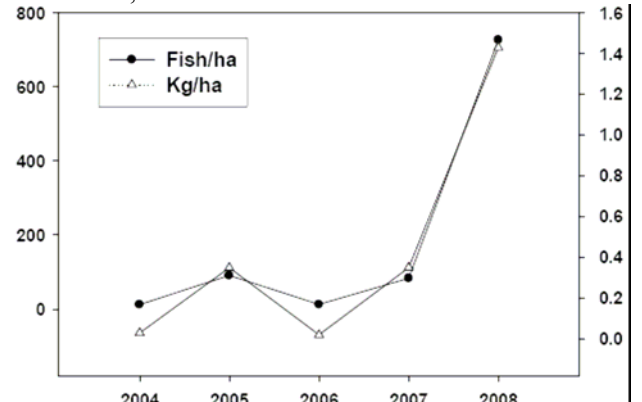


Fig 4 - Estimates of age-0 bloater density/biomass, 2004-2008

Higher yearling and older bloater abundance was likely the result of recent recruitment because those bloaters captured in trawls ranged only 120-144 mm length and represent the large year classes observed in the '05 & '07 trawl surveys.

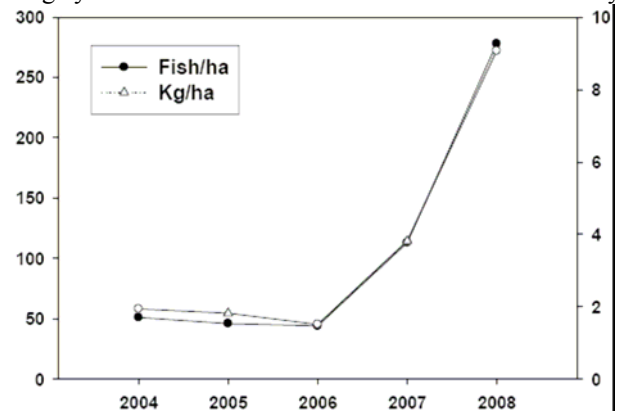


Fig 5 - Acoustic estimates of yearling and older bloater density and biomass in Lake Huron, 2004-2008

**Emerald shiner**

Emerald shiners were collected in all years except 2004. Main Basin density and biomass were lower during 2008 compared with 2007 (Fig 6). Density and biomass varied significantly among years; density was significantly higher in 2006 compared with other years, and densities were similar in 2005 and 2007.

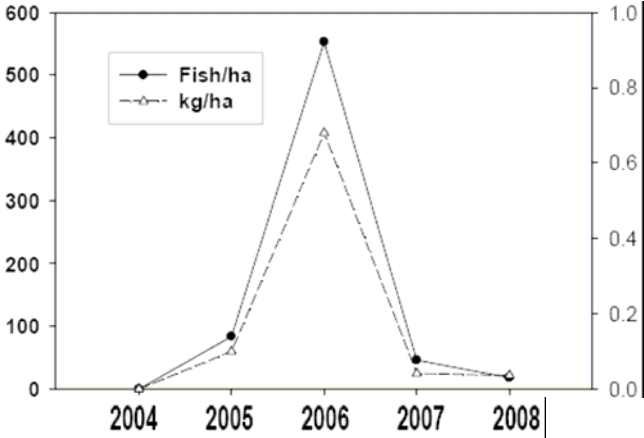


Fig 6 - Acoustic estimates of emerald shiner density and biomass in Lake Huron, 2004-2008

**Main Basin Fish Community**

Main Basin pelagic fish density more than doubled between '07 & '08 and we observed changes in species composition (Fig 7). Total density increased because bloater density increased, but also because of increased densities of non-native alewife and threespine stickleback, and some native ninespine stickleback. Those three species were rare or absent during 2007 but comprised about 20% of pelagic fish density during 2008. Total fish density in 2006 and 2008 was significantly higher than in 2004 or 2007.

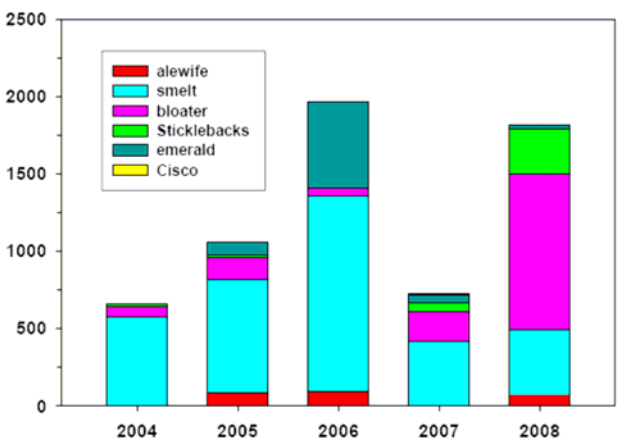


Fig 7 - Acoustic estimates of total pelagic fish density in Lake Huron's Main Basin, 2004-2008

Main Basin pelagic fish biomass increased to just over 12 kg/ha and is now dominated by native species (Fig 8). Rainbow smelt biomass was similar to 2007, but bloater biomass increased. Cisco biomass declined primarily because no large adults were captured during 2008. Pelagic fish biomass during 2008 was significantly greater than that observed in 2004, 2005, or 2006, but did not differ significantly from the 2007 estimate.

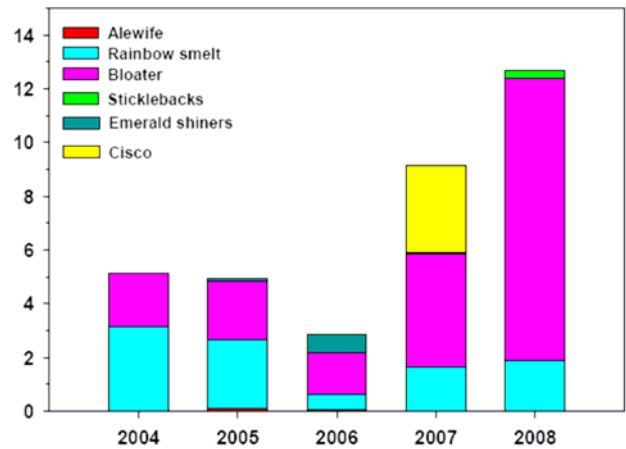


Fig 8 - Acoustic estimates of total pelagic fish biomass in Lake Huron's Main Basin, 2004-2008

**Among-Basin Comparisons**

Between 2004-2007 we observed consistent differences in total fish density and biomass among Lake Huron's three basins, with the North Channel having higher biomass than the Main Basin or Georgian Bay. This pattern was not evident in 2008; there were no significant density or biomass differences among basins during 2008 (Figs 9, 10).

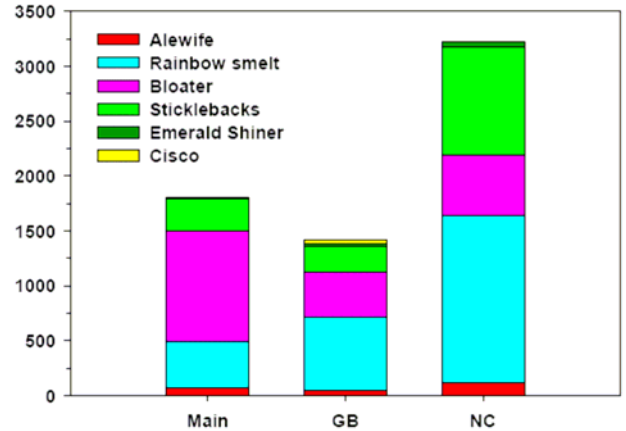


Fig 9 - Acoustic estimates of total pelagic fish densities in Lake Huron's Main Basin (Main), Georgian Bay (GB) and North Channel (NC), 2008

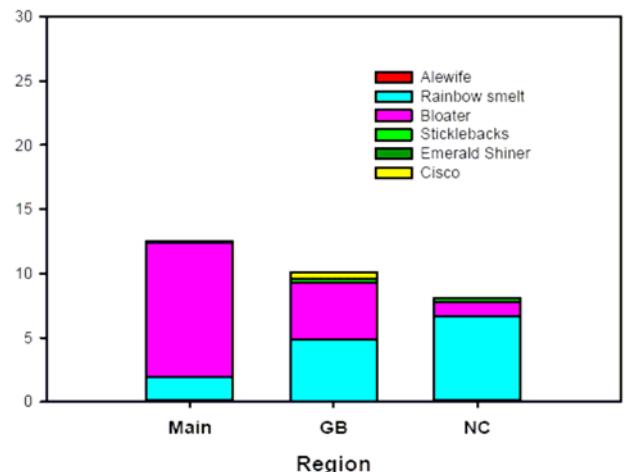


Fig 10 - Acoustic estimates of total pelagic fish biomass in Lake Huron's Main Basin (Main), Georgian Bay (GB) and North Channel (NC), 2008

## Review

Lake Huron's Main Basin pelagic fish density and biomass increased during 2007 and 2008 compared to 2004-2006. Most of the change was due to increased Cisco (2007) and bloater (2007, 2008) abundance. Both age-0 and yearling and older bloater increased during 2008; age-0 densities suggest that the 2008 year class was strong, and density increases of older fish likely can be attributed to strong year-classes in 2005 and 2007. However, even with increases during the past two years, pelagic fish biomass is substantially lower than in the past. In 2008, mean fish biomass in the main basin was about 15 kg/ha. In 1997, Warner et al. determined lakewide biomass to be 72.3 kg/ha, nearly six times higher than our 2008 Main Basin estimate. The 1997 survey occurred at a time when large bloaters were abundant. Alewife was relatively rare in 1997 as well, comprising less than 5% of the pelagic biomass. Hence, the relatively low fish biomass that we have observed since 2004 is not solely due to loss of alewives, but also to a reduction in bloater and rainbow smelt biomass.

Although alewife were more abundant during 2008 than 2007, that increase is not indicative of a return to their former abundance. We observed similar densities in 2005 and 2006, but alewife have never exceeded 2.5 % of total fish density since 2004, and will likely remain scarce during 2009. Furthermore, most all alewife captured since 2004 have been age-0; although some reproduction is occurring, this has not translated into increased adult densities.

During 2008, threespine sticklebacks were abundant in all three basins and some ninespine sticklebacks were collected as well. Sticklebacks comprised a substantial fraction of Main Basin density. They appear to reside in the offshore epilimnion, and have been collected rarely in bottom trawl

surveys and prior to 2008 they comprised only a small fraction of total density in acoustic surveys. The reason for their apparent increase is unknown. Although densities increased during 2008, their effect on biomass was minimal due to their small size relative to adult rainbow smelt and bloaters.

The low abundance of emerald shiners during 2007 and 2008 remains perplexing. Because alewives are scarce, conditions for emerald shiner recruitment should be better. One possible explanation is that emerald shiners may be the only prey species inhabiting the upper levels of the water column and the focus of predation by salmonids and walleyes. High spatial overlap with predators combined with the absence of alternative prey (especially alewife) may be a reason for their current low numbers.

The 2008 fish community contrasted with other years in one key way. During 2004-2007, density and biomass in the North Channel were higher than that in either Georgian Bay or the Main Basin, but in 2008 there were no significant differences among basins.

During 2009, forage availability for piscivores will likely depend on the level of predation on bloater. In Lake Michigan, age-1 Chinook salmon were shown to feed selectively on bloaters at times of high bloater density even in the presence of other prey, however alewife were likely never scarce enough to imply bloater dependence. The present situation in Lake Huron where bloater is relatively abundant but alewife and other prey are scarce may result in dependence on bloater as the primary prey. For 2009, we suggest monitoring Chinook salmon diet and growth to evaluate their response to a novel prey base in Lake Huron. ✧

## Status/Trends of the Lake Huron Deepwater Demersal Fish Community, 2008

### Abstract

The U.S. Geological Survey Great Lakes Science Center has conducted trawl surveys to assess annual changes in the deepwater 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 2008 fall bottom trawl survey was carried out between October 24 and November 20, 2008 and sampled only the three northern U.S. ports at DeTour, Hammond Bay, and Alpena due to mechanical problems with the research vessel and prolonged periods of bad weather. Therefore, all data presented for 2008 are based on samples collected from these ports. Compared to previous years, alewife populations in Lake Huron remain at low levels after collapsing in 2004. Age-0 alewife density and biomass appears to have increased slightly but overall levels remain near the nadir observed in 2004. Density and biomass of adult and juvenile rainbow smelt showed a decrease from 2007 despite record-high abundance of juveniles observed in 2005, suggesting recruitment was low. Numbers of adult and juvenile bloater were low despite recent high year-classes. Abundances for most other prey species were similar to the low levels observed in 2005 - 2007. We

captured one wild juvenile lake trout in 2008 representing the fifth consecutive year that wild lake trout were captured in the survey. Based on pairwise graphical comparisons and nonparametric correlation analyses, dynamics of prey abundance at the three northern ports followed lakewide trends since 1992. Density of benthic macroinvertebrates was at an all-time low in 2008 since sampling began in 2001. The decline in abundance was due to decreases in all taxonomic groups and a large reduction in recruitment of quagga mussels. Density of *Diporeia* at northern ports in 2008 was the lowest observed. *Diporeia* were found only at 73-m sites of three ports sampled in northern Lake Huron. While no lakewide estimate of prey biomass was calculated due to the limited spatial scope of the 2008 survey, existing data suggest prey biomass remains depressed. Prey available to salmonids during 2009 will likely be small alewives, small rainbow smelt and small bloaters. Predators in Lake Huron will continue to face potential prey shortages.

### The 2008 Survey

The 2008 survey was carried out during October 24 - November 20. Twenty-five of the forty-eight planned trawl

tows were completed at DeTour, Hammond Bay, and Alpena, the northern-most ports. These ports include the deepest depths (91 and 110 m) in the survey. Trawling could not be carried out at the 46 m transect at Detour due to an obstruction on the lake bottom that damaged gear. Survey logistics and bad weather prevented sampling the southern ports at Au Sable Point, Harbor Beach, and Goderich, ON. The lake remained stratified during the 2008 survey with a deep (30-40 m) thermocline present.

Because only the northern three ports (DeTour, Hammond Bay, and Alpena) were sampled in 2008, we were concerned that estimates of prey fish abundance at these ports may not be representative of lakewide trends. To assess the relationships between numeric abundance of prey fish collected at the three northern ports with lakewide abundance estimates, we used graphical biplots and nonparametric correlation analyses. These techniques allowed us to assess the strength of relationships between prey dynamics at northern ports with lakewide trends.

Common name	Scientific name	Density (No./ha)
Alewife	<i>Alosa pseudoharengus</i>	304.13
Rainbow smelt	<i>Osmerus mordax</i>	224.99
Bloater chub	<i>Coregonus hoyi</i>	104.36
Ninespine stickleback	<i>Pungitius pungitius</i>	15.86
Deepwater sculpin	<i>Myoxocephalus thompsonii</i>	0.78
Lake whitefish	<i>Coregonus clupeaformis</i>	0.60
Lake trout	<i>Salvelinus namaycush</i>	0.19
Threespine stickleback	<i>Gasterosteus aculeatus</i>	0.10
Round goby	<i>Apollonia melanostoma</i>	0.05
Sea lamprey	<i>Petromyzon marinus</i>	0.05

Appendix I - List of species and densities collected during the 2008 fall bottom trawl survey at three ports in northern Lake Huron

10 fish species was collected in the survey (Appendix I). Common and scientific names of fishes are listed in Appendix I.

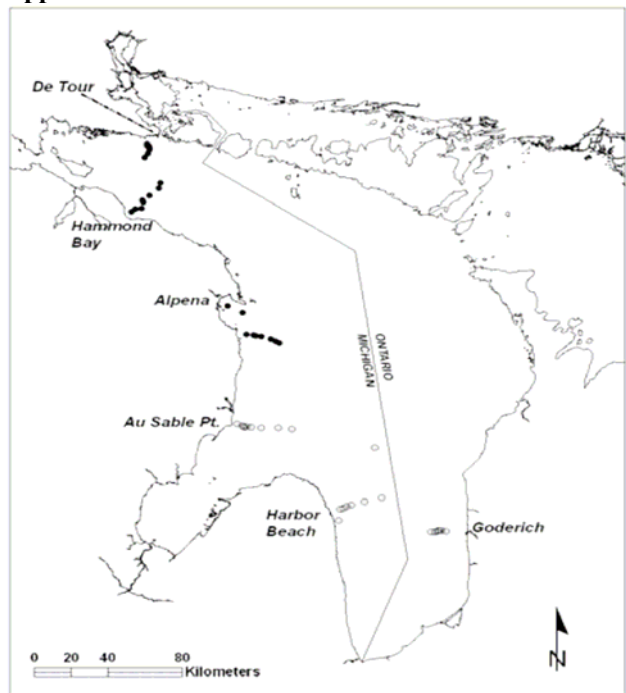


Fig 1 - Sampling locations in Lake Huron, 2008. Circles indicate trawling sites; filled circles represent locations where trawling was conducted in 2008.

### Abundance, size, and age structure Alewife

Alewives were at low abundance in Lake Huron from 2003 – 2007 and did not increase at northern ports in 2008. Adult alewife density and biomass remained near the all-time low observed in 2004 (Fig 2). Age-0 alewife abundance showed a slight increase at northern ports in 2008, but densities remain suppressed and near the all-time low for the time series (Fig 3).

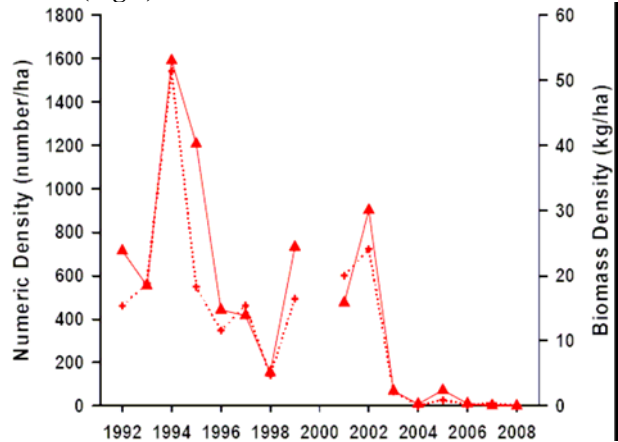


Fig 2 - Density of adult alewives as number (solid line) and weight (dotted line) of fish per hectare, 1992-2008

The alewife population collapse occurred during 2002-2004. During 2002, alewives of all sizes and ages were abundant due to a series of strong year classes that occurred in 1998, 1999, 2001, and 2002. However, high mortality of all sizes during 2002-2004 caused almost complete mortality of the 2002 year class, and substantial reduction in the abundance of older fish. During 2003, the few remaining adults produced the largest year class in the time series (Fig 3), but age-0 alewives experienced almost complete mortality resulting in record-low densities during 2004.

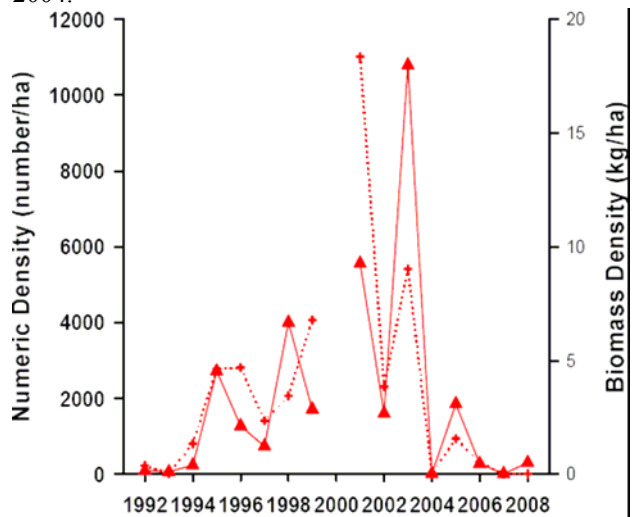


Fig 3 - Density of age-0 alewives as number (solid line) and weight (dotted line) of fish per hectare, 1992-2008

Recent alewife size and age structure reflected these conditions. Since 2003, alewife size distribution has been dominated by fish less than 100 mm TL (i.e. age-0 fish; Fig 4), whereas age-1 through age-5 fish were rare. Recent year-classes either failed to survive (2003) or were present

at low densities (2004-2008). Trends observed in the lake-wide fisheries acoustic survey follow those observed by the bottom trawl survey. In both surveys, alewives have been scarce and at unprecedented low population levels since 2004. Currently, only low numbers of small alewives are available to predators.

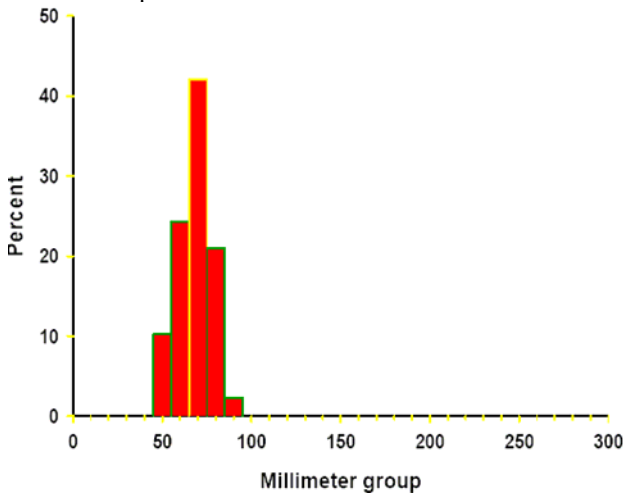


Fig 4 - Size structure of northern Lake Huron alewives, 2008

Pair-wise comparisons and correlation analyses showed statistically significant relationships for adult and YOY alewife abundance dynamics at northern ports compared with lakewide estimates.

**Rainbow smelt**

Adult rainbow smelt density continued to decline in 2008 despite record high levels of age-0 rainbow smelt in 2005 (Figs 5 and 6). In 2005, age-0 biomass was the highest on record since 1992 representing a doubling in density over 2004 estimates, but age-0 biomass declined by 85% in 2006 and increased only slightly in 2007 (Fig 6) and these 2005 fish did not recruit to the adult stock. Values for 2008 based on samples collected in northern Lake Huron suggest development of a small rainbow smelt year-class and a lack of recruitment.

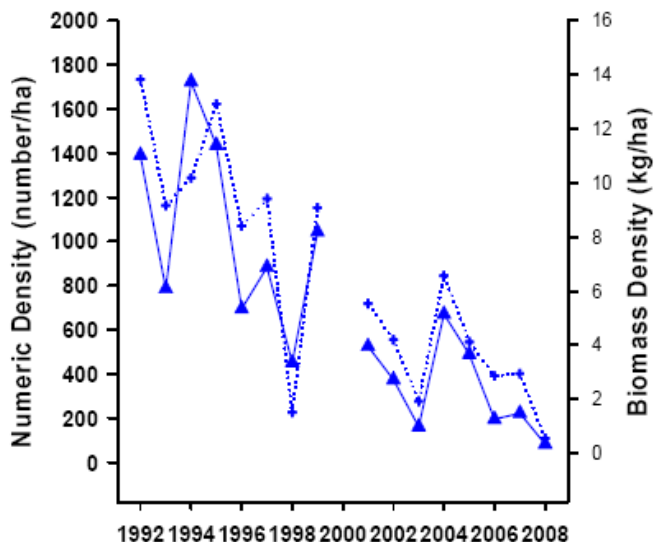


Fig 5 - Density of adult rainbow smelt as number (solid line) and weight (dotted line) of fish per hectare, 1992-2008

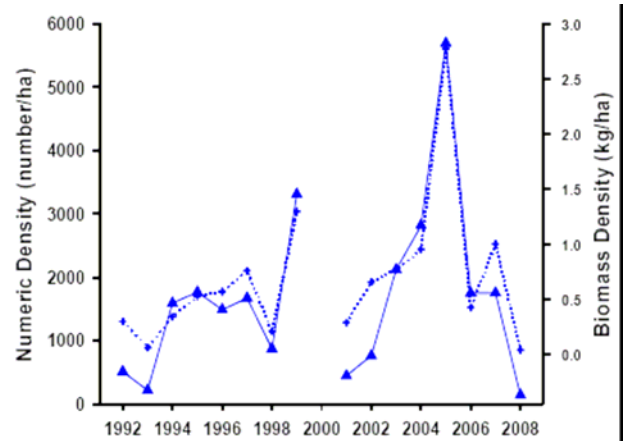


Fig 6 - Density of juvenile rainbow smelt as number (solid line) and weight (dotted line) of fish per hectare, 1992-2008

Similar to the previous three years, the rainbow smelt population was dominated by age-0 fish in 2008 with less than 40% of the population larger than 100 mm (Fig 7). The low abundance of adult fish suggests that the large numbers of small rainbow smelt observed during 2005 - 2007 did not translate into recruitment of larger rainbow smelt. In fact, the combined biomass for all age classes of rainbow smelt decreased by about 50% from 2005 to 2006-2008 despite the record-high density of age-0 fish observed in 2005.

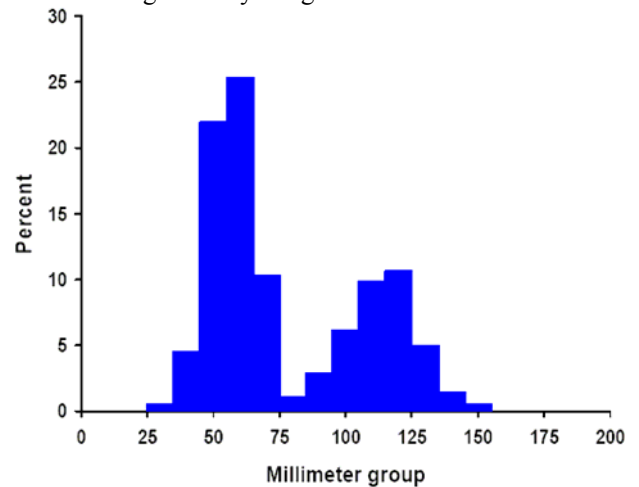


Fig 7 - Length-frequency distribution of rainbow smelt collected in bottom trawls from three northern Lake Huron sites sampled during fall, 2008

Both the bottom trawl and acoustic surveys were in agreement that there have been no substantive changes in adult rainbow smelt density or biomass in recent years, and that overall adult density and biomass remain low compared to previous levels in the 1980's and 1990's. Both surveys were also in agreement that the 2008 year class was exceptionally poor. The poor year-class strength observed in 2008 was also observed during the larval stage. Larval rainbow smelt collections in St. Martin Bay (northern Lake Huron) during spring 2008 were extremely low.

**Bloater**

Adult and juvenile bloater densities in northern Lake Huron were low compared to lakewide values from previous years (Figs 8 and 9). About 85% of bloaters captured during 2008 were less than 120 mm TL representing year-classes

formed in 2007 and 2008. Abundance of larger bloater was low compared to previous years. Juvenile bloomers are pelagic and generally not susceptible to bottom trawls, so true year class strength may not be apparent until they become fully recruited to the trawl at age-3 or older.

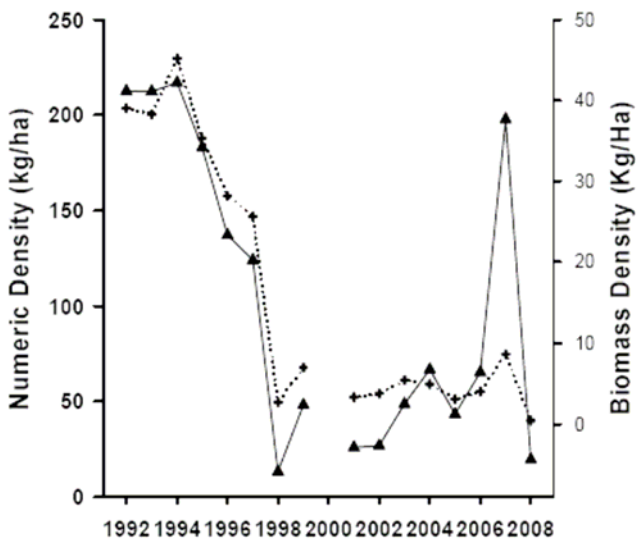


Fig 8 - Density of adult bloomers as number (solid line) and weight (dotted line) of fish per hectare, 1992-2008

High densities of juveniles observed during 2003-2007 may represent a conservative estimate of the strength of these year classes. Nonetheless, juvenile bloater densities rarely exceeded 5 fish ha during 1992-2002, but densities increased to approximately 60 fish ha in 2003, 28 fish ha in 2004, 320 fish ha in 2005, and 105 fish ha in 2006, and a record high of over 800 fish ha in 2007 (Fig 9). In 2008, densities of adult and juvenile bloater were lower than observed since the alewife collapse in 2004.

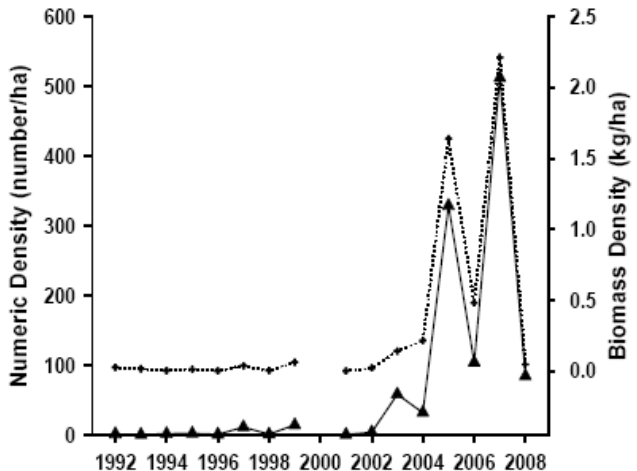


Fig 9 - Density of juvenile bloomers as number (solid line) and weight (dotted line) of fish per hectare, 1992-2008

The bottom trawl and acoustic surveys show poor agreement with respect to age-specific bloater densities. In 2005 and 2007 the bottom trawl survey caught large numbers of age-0 bloater, and this occurred at the southern ports that were not sampled in 2008. The acoustic survey found far fewer numbers of age-0 bloomers in those years. This year (2008), the southern ports were not sampled by

bottom trawling, but the acoustic survey found exceptionally high densities of both age-0 bloomers and small adults that likely originated from 2005 or 2007. Thus, the two surveys are in general agreement that bloomers are increasing and that it is a young population.

**Sculpins, sticklebacks, and troutperch**

Sculpin abundance in Lake Huron has fluctuated widely since 1992 but has been depressed since 1998 (Fig 10). Deepwater sculpins comprise most of the total sculpin catch, while slimy sculpins are only a minor component of the deepwater fish community and were not collected in 2008. Deepwater sculpin abundance in northern Lake Huron was low in 2008 compared to previous years. Based on recent offshore and northern sampling sites, deepwater sculpin distributions have become patchier during recent surveys, restricted to offshore and northern sample sites. For both sculpin species, we found statistically significant relationships between abundance dynamics at northern ports and lakewide estimates.

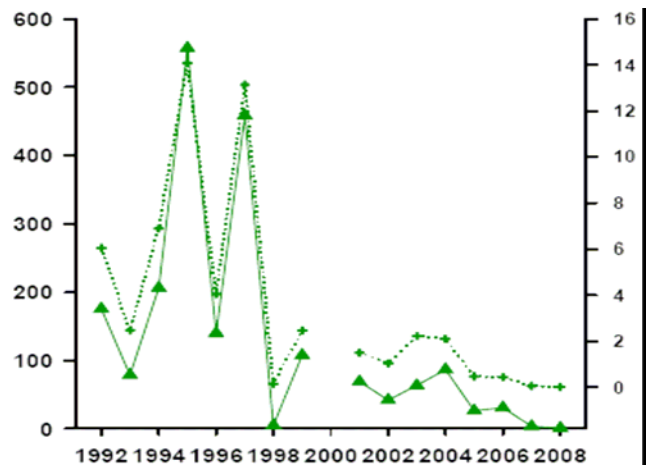


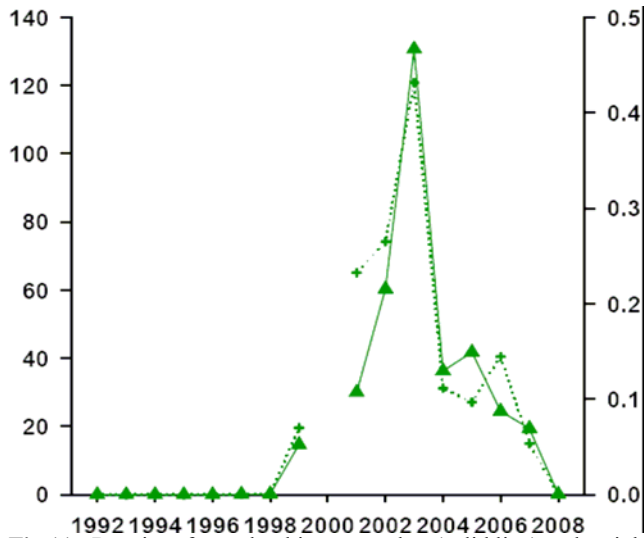
Fig 10 - Density of deepwater sculpins as number (solid line) and weight (dotted line) of fish per hectare, 1992-2008

Density and biomass of ninespine sticklebacks in northern Lake Huron were low and showed signs of continued decline as was observed in previous years. Ninespine stickleback abundance has varied considerably since 1992 and low densities have been observed previously (1992-94 and 1998-99). However, the recent trend since 2001 has been downward. Correlation analyses showed statistically significant relationships between ninespine stickleback abundance dynamics at northern ports and lakewide estimates.

Troutperch density and biomass also continue a five-year overall decline. None were collected in samples taken in northern Lake Huron during 2008.

**Round gobies**

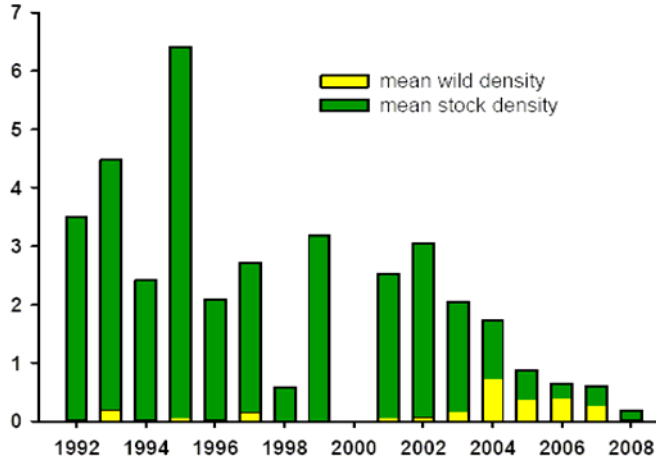
Round gobies were first collected in the trawl survey during 1997 and increased in abundance steadily until 2003 when their abundance declined in 2004 and has remained below 40 fish ha in 2005-2007 (Fig 11). Round goby abundance traditionally has been highest at the southern ports not sampled in 2008.



**Fig 11** - Density of round gobies as number (solid line) and weight (dotted line) of fish per hectare, 1992-2008

**Lake trout**

Collection of wild juvenile lake trout continued in 2008. These fish were identified as naturally-spawned because they lacked fin clips and were smaller than the smallest hatchery lake trout stocked earlier that year. Overall lake-wide mean density of wild lake trout in northern Lake Huron was low at about 0.04 fish · ha in 2008. Collections of stocked lake trout have declined in recent years (Fig 12).

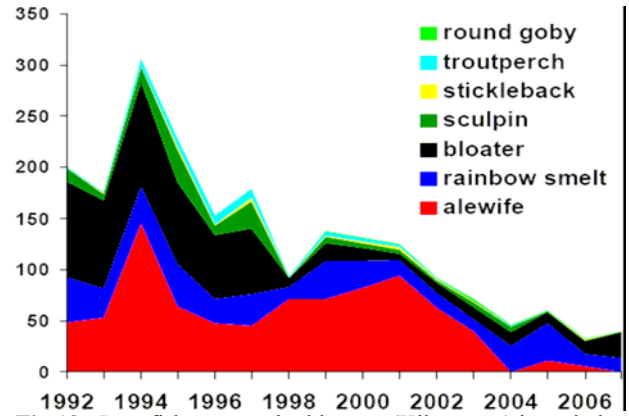


**Fig 12** - Density of wild and stocked lake trout collected in fall bottom trawls, 1992-2008

Wild age-0 lake trout have been collected in mid-lake surveys of Six-Fathom Bank and collections in recent years indicate that widespread reproduction is occurring in the main basin. A majority of these wild fish were determined to be descendants of stocked Seneca strain fish.

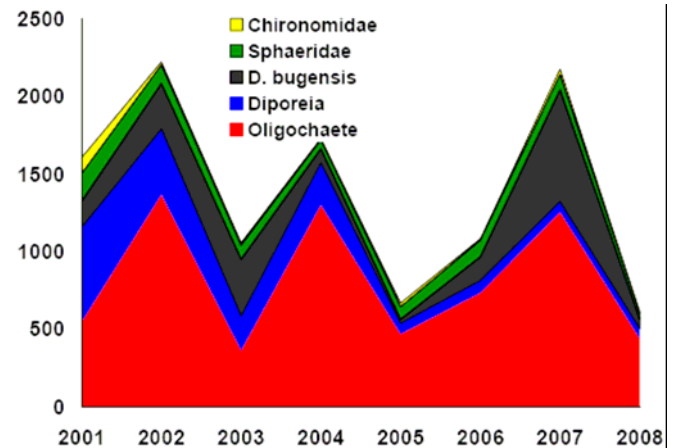
**Biomass Estimates**

Because of the limited spatial scope of the 2008 survey, no lakewide biomass estimate was calculated for this year. Total main basin prey biomass for the area increased from 32 kilotonnes in 2006 to 40 kilotonnes in 2007 (Fig 13) but remained far below levels observed when alewives dominated the forage fish community.

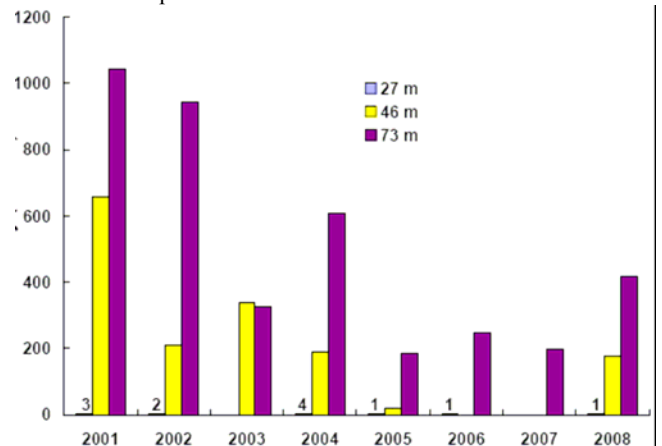


**Fig 13** - Prey fish community biomass (Kilotonnes) in main basin waters of Lake Huron, 1992-2007

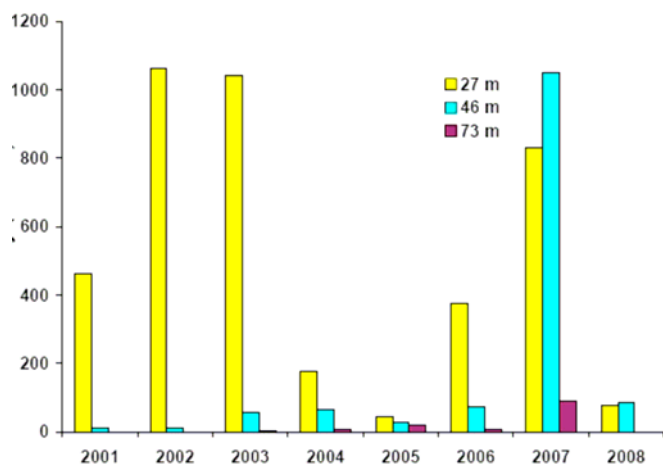
**Benthic Invertebrates-** Density of benthic invertebrates was at an all-time low in 2008 due to decreases in densities of all major macroinvertebrate taxonomic groups (Fig 14). Density of *Diporeia* shows a continuing decline in abundance since sampling began in 2001 and densities in '05 – '08 were the lowest observed (Fig 15). Overall quagga mussel density decreased in '08 and remains below the peak abundance observed in 2002 and 2003 (Fig 16).



**Fig 14** - Density of benthic macroinvertebrates collected from five U.S. ports (2001-04), five U.S. ports plus Goderich, ON ('05-07), and three U.S. ports in northern Lake Huron '08



**Fig 15** - Mean density of *Diporeia* at 27 m, 46 m, and 73 m depth strata determined from collections at five U.S. ports in western Lake Huron (2001-04) and five U.S. ports plus Goderich, ON '05-07



**Fig 16** - Mean density of quagga mussels at three depth strata from samples collected from five U.S. ports in western Lake Huron (2001-04), five U.S. ports plus Goderich, ON (2005-07), and three U.S. ports in northern Lake Huron (2008)

### Summary

The availability of prey fish in Lake Huron remains in a depressed state since the collapse of the deepwater demersal fish community in the lake in 2004. Alewife density remains near the all-time low for the time series observed in 2004 and the existing population remains dominated by small fish. Abundance of juvenile and adult rainbow smelt was also reduced despite recent record high year-class in 2005. While a reduction in the abundance of an exotic species is consistent with fish community objectives for Lake Huron, prey availability and sustainability of the Chinook salmon sport fishery remain as concerns for fisheries managers and stakeholders.

Prey availability for piscivores will likely be low during 2009 because no species has replaced alewife in either numbers or biomass. While density of bloaters nearly doubled and rainbow smelt increased by about 15% between 2006 and 2007, overall prey biomass remained low compared to previous years (1992-2001) and showed only a slight increase in 2007. Catches from northern Lake Huron during 2008 suggest small alewives may have increased slightly over the record low levels seen since 2004, but abundance of other forage species was depressed.

While this survey is designed to provide indices of forage abundance, collections are also useful in monitoring young age-classes of lake trout. Relatively high catches of wild juvenile lake trout in bottom trawls during 2004–2006 suggest that natural reproduction by lake trout had increased and occurred throughout the Michigan waters of

the main basin. Increased catches of wild juvenile lake trout in the USGS fall bottom trawl survey were coincident with a drastic decline in alewife abundance, but data were insufficient to determine what mechanism may be responsible for increased natural reproduction by lake trout. Only one wild age-0 lake trout was collected during 2008 and the overall trend in lake trout density has been downward since 2003 when the demersal forage fish community collapsed. Depressed forage fish abundance will likely be a deterrent to lake trout recovery efforts in Lake Huron.

Densities of benthic invertebrates collected during fall have been variable since collections began in 2001 but typically follow the declining trends reported in other studies. Most notable is the decline of *Diporeia*, an important forage item for demersal fishes such as rainbow smelt, deepwater sculpin, juvenile lake trout, and Lake Whitefish. This decline is coincident with declines in alewives and expansion of quagga mussel distributions toward deeper waters of the lake.

Lack of collections from the entire southern portion of the lake prevents us from making calculations of lakewide forage fish abundances and eliminates the possibility of assessing abundance of some species collected mainly in the southern part of the lake. For example, abundances of round gobies and emerald shiners are typically higher in the southern part of the lake. Despite this shortcoming, the declining trend in forage fish abundance observed in previous years appears to be continuing. Further, we found strong statistically significant relationships between numeric prey abundance estimates at northern ports and lakewide estimates. This suggests that lakewide trends in forage fish abundance are mirrored at northern ports and also stresses the importance of northern ports for species such as slimy and deepwater sculpins that are collected almost exclusively in the north.

The continued depression of forage species biomass in the northern main basin of Lake Huron suggests that predators will continue to face potential prey shortages during 2009. Rainbow smelt and juvenile bloaters will likely be the only common pelagic prey and predation on these may limit their recruitment and reduce the possibility of future strong year-classes. Rainbow smelt and bloater are utilized as prey of salmonids, but there are likely to be low numbers of large-sized prey items needed to sustain growth of large salmonids, especially adult lake trout. Managers and anglers should expect slow growth of salmonids in 2009. ✧

## Michigan Charter Fishing Data, 2008

The State of Michigan reports charter fishing data from 1997-2008 (for state of Michigan waters). Data is organized in tabular format by year and contains fish harvest and

fishing effort data. Within each year, data is reported by specific water body and also fishing location.

**Table 1 – Targeted Harvest.** Targeted harvest per hour, harvest per excursion and number fish harvested by species with total fishing effort (angler hours, anglers, and charter excursions) for charter boats fishing Michigan waters of Lake Huron and its tributaries, 2008. Targeted harvest based on total salmonine effort (salmon and trout species) or total percid + other effort (perch, walleye, plus other= smallmouth bass, musky, & unknown species).

Species	Targeted harvest per hour	Targeted harvest per excursion	Month												Season
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Coho salmon	0.008	0.157	0	0	0	8	24	13	9	30	53	2	0	0	139
Chinook salmon	0.074	1.419	0	0	0	0	47	97	420	462	219	8	0	0	1,253
Rainbow trout	0.018	0.354	0	0	7	35	6	37	93	76	59	0	0	0	313
Brown trout	0.000	0.009	0	0	0	0	7	0	1	0	0	0	0	0	8
Lake trout	0.258	4.973	0	0	0	0	239	852	1,498	1,398	404	0	0	0	4,391
Yellow perch	0.129	2.677	0	0	0	0	150	60	292	232	293	210	0	0	1,237
Walleye	0.655	13.574	0	0	0	0	409	2,229	2,452	974	200	7	0	0	6,271
Other	0.041	0.840	0	0	0	0	8	60	84	59	164	13	0	0	388
Lamprey on:															
Chinook salmon			0	0	0	0	6	15	49	36	15	0	0	0	121
Lake trout			0	0	0	0	2	8	35	38	7	0	0	0	90
Angler hours			0	0	37	221	1,826	5,987	9,139	6,894	2,258	202	0	0	26,564
Anglers			0	0	5	32	325	1,102	1,739	1,280	433	35	0	0	4,951
Charter excursions			0	0	3	16	89	289	468	342	128	10	0	0	1,345

**Table 2 – Total Harvest** Total harvest per hour, harvest per excursion, number of fish harvested, and fishing effort (angler hours, anglers, and charter excursions) for charter boats fishing Michigan waters of Lake Huron, 2008

Species	Total harvest per hour	Total harvest per excursion	Month												Season
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Coho salmon	0.005	0.105	0	0	0	8	24	13	11	30	53	2	0	0	141
Chinook salmon	0.048	0.943	0	0	0	0	47	97	421	467	229	8	0	0	1,269
Rainbow trout	0.012	0.236	0	0	7	35	6	38	97	76	59	0	0	0	318
Brown trout	0.000	0.007	0	0	0	0	7	2	1	0	0	0	0	0	10
Lake trout	0.166	3.286	0	0	0	0	239	852	1,522	1,403	404	0	0	0	4,420
Yellow perch	0.049	0.972	0	0	0	0	150	60	292	232	363	210	0	0	1,307
Walleye	0.240	4.745	0	0	0	0	413	2,232	2,521	1,006	203	7	0	0	6,382
Other	0.026	0.513	0	0	0	0	37	146	215	103	176	13	0	0	690
Lamprey on:															
Chinook salmon			0	0	0	0	6	15	49	36	15	0	0	0	121
Lake trout			0	0	0	0	2	8	35	38	7	0	0	0	90
Angler hours			0	0	37	221	1,826	5,987	9,139	6,894	2,258	202	0	0	26,564
Anglers			0	0	5	32	325	1,102	1,739	1,280	433	35	0	0	4,951
Charter excursions			0	0	3	16	89	289	468	342	128	10	0	0	1,345

## Lake Trout Production and Stocking (USFWS)

### Lake Trout Restoration Update

**Lake Trout Yearlings** – During 2008, the U.S. Fish and Wildlife Service (USFWS) released 4,262,065 yearling lake trout into the upper Great Lakes at 38 locations, in accordance with Lake Committee rehabilitation plans. Of the total, 479,646 were released from shore, and 3,782,419 were released offshore using the *M/V Spencer F. Baird*, stocking fish at 31 offshore sites. All lake trout were either fin clipped or coded wire tagged following marking guidelines. Distribution included 1,329,586 fish into Lake Huron and 2,881,868 fish into Lake Michigan.

The USFWS also released a total of 653,659 yearling lake trout, including Seneca Lake Wild (SLW), Superior Traverse Island Wild (STW), and Klondike Reef Wild (SKW) strains, at five sites in the lower Great Lakes. Lake Erie received 152,751 yearlings off Dunkirk, NY; Lake Ontario received 500,908 yearlings at five sites in the lake. All fish were stocked offshore by the USFWS and the NYSDEC. All yearlings stocked received an adipose fin clip and coded wire tag. Fish for this effort were raised at Pittsford and White River National Fish Hatcheries in Vermont, while the Allegheny National Fish Hatchery is undergoing renovations.

### Lake Trout Fall Fingerlings

During 2008, the USFWS released 826,728 lake trout fingerlings from Iron River NFH, Pendills Creek NFH, and Jordan River NFH into lakes Huron and Michigan during October. Lake Michigan received 532,778 fish which were shore stocked at seven sites. Lake Huron received 293,950 fish which were stocked at one offshore site using the *M/V Spencer F. Baird*. No lake trout fall fingerlings were stocked in the lower Great Lakes.

### Spring 2009 Stocking Plans

The USFWS is preparing to stock approximately 4,000,000 ( $\pm 10\%$ ) yearling lake trout into the upper Great Lakes in 2009, including:

- 1,900,000 from Jordan River NFH,
- 1,200,000 from Iron River NFH, and
- 900,000 from Pendills Creek NFH.

The *M/V Spencer F. Baird* will continue to deliver lake trout yearlings to offshore sites in Lake Huron and Lake Michigan in 2009.

Lake trout will be produced at White River NFH until Allegheny NFH is functional again. With the assistance of New York Department of Environmental Conservation, approximately 692,400 lake trout are scheduled to be stocked into the lower Great Lakes in 2009. Lake Erie is scheduled to receive 160,000 - 200,000 yearlings and Lake Ontario will receive the remaining fish. Four wild strains, Seneca Lake Wild, Superior Traverse Island Wild, Klondike Reef Wild, and a Seneca hybrid from the Vermont hatchery system are scheduled to be released in May 2009. Once again all yearlings will receive an adipose

fin clip and coded wire tag. All stocking is currently scheduled to occur offshore.

Current capabilities allow the USFWS to rear some fall fingerlings in addition to yearling lake trout. Our hatcheries were able to produce and stock 826,728 lake trout fingerlings in 2008 and could sustain that level during the next few years. Our hatcheries could eventually produce up to 950,000 fingerlings each year; however, this would require additional operational and new construction funding which is not currently appropriated. Since our production programs concentrate on yearlings, our ability to provide fingerlings is dependent on many conditions, and we cannot guarantee their availability.

### Lake Trout Broodstock Management

**Brood Stock Production Strains** - Yearling lake trout stocked in the upper Great Lakes in 2008 came from three brood stock strains including: **Superior Apostle Island (SAW)**, **Lewis Lake (LLW)**, and **Seneca Lake (SLW)**. Lake trout eggs for spring 2009 yearlings were provided by three Service facilities: Sullivan Creek NFH, Michigan (SLW); Iron River NFH, Wisconsin (SAW); and Saratoga NFH, Wyoming (LLW). In addition to these strains, the wild **Lake Superior Klondike Reef (SKW)** strain is maintained and eggs are shipped to the lower Great Lakes facilities. In the lower Great Lakes, yearling lake trout came from three brood stock strains—**Seneca Lake (SLW)**, **Superior Traverse Island (STW)**, and **Superior Klondike Reef (SKW)**.

### Lake Trout Health

**Fish Health Screening** - The La Crosse Fish Health Center (LFHC) conducts two fish health inspections each year, at each of the six National Fish Hatcheries in the Midwest Region. No pathogens were detected in any facility water supplies. Lake trout broodstock held at Sullivan Creek NFH, Michigan and Iron River NFH, Wisconsin were specific pathogen free in 2008 (spring and fall fish health inspections were conducted).

### Hatchery Construction Projects

**Jordan River NFH** – An updated effluent treatment system is currently in the engineering and design phase. The final design should be completed by the end of FY 09. Construction will begin in 2010. There are a number of projects being proposed for the American Recovery and Reinvestment Act at Jordan River NFH, but these have not yet been approved by DOI and OMB.

**Pendills Creek NFH** – Replacement of the existing production raceways began in May 2008 and is scheduled to be completed by summer 2009. A building to cover these new raceways will be constructed in early FY 2010.

### Vessel Operations

Currently, the *M/V Baird* is scheduled to begin its 2009 lake trout stocking runs on April 13, weather permitting.

### Lake Huron Lake Trout Spawning Survey

During the fall of 2008, the Service using the *M/V Spencer F. Baird* attempted to conduct lake trout spawning surveys at two offshore Lake Huron reefs—Yankee Reef and Six Fathom Bank Refuge (SFB). Due to high winds and inclement weather, the Service was only able to assess Yankee Reef.

Relative abundance (CPE) of lake trout at Yankee Reef was 118.8 per 1000' of gill net. This marks the third highest CPE at Yankee Reef since sampling began in 1993 (2005 CPE: 136.3/1000' and 2005 CPE: 121.3/1000'). More importantly, Fall 2008 produced the highest catch of unclipped, presumably wild lake trout captured at Yankee Reef. A total of 22 unclipped lake trout (23% of the total catch) were captured. The CPE of unclipped lake trout was 27.5 fish per 1000' of gill net, which nearly doubled the previous high set in 2004. Yearling stocking at Yankee Reef ceased in 2001. Fall fingerlings were stocked in 2007 and 2008, and will be stocked in 2009. After the 2009 stocking, it is likely that no additional fall fingerlings will be stocked at Yankee Reef until their survival and contributions to recruitment can be evaluated, especially given the higher abundance of adults recently sampled on Yankee Reef.

A similar increase of unclipped lake trout was observed at SFB during the fall spawning assessment conducted in 2007. Although upward trends of wild lake trout are quite

recent, there appears to be some evidence of natural recruitment at these offshore reefs. The increases in relative abundance of unclipped lake at SFB in 2007 and Yankee Reef in 2008 provides some measure of encouragement for the Service's efforts towards lake trout rehabilitation in this region of Lake Huron. Spawning surveys at both reefs are scheduled for the fall of 2009.

### Great Lakes Mass Marking

The Service received \$1.7 million in FY 08 and an additional \$1.5 million in FY09 for the purchase of mass marking equipment. In October 2008, we received one AutoFish trailer which is housed at the Iron River NFH, and have ordered one manual trailer that we expect this summer. We have residual funds from the FY 08 appropriations that will be used to make electrical improvements at our lake trout hatcheries to power the trailers. The FY09 appropriation will likely be spent on an additional autotrailer, and all residual funds will likely be used to make electrical improvements at State and Tribal hatcheries that require them.

The Service will continue to work with Northwest Marine Technologies to improve the processing rate for lake trout through the autotrailers—the shape and behavior differences of lake trout will require modifications to the processing channels, and the engineering solutions will be further developed this summer. ✧

## Management of Sea Lampreys in Lake Huron 2008

### Fish Community Objectives

Reduce sea lamprey abundance to allow the achievement of other fish community objectives. Obtain a 75% reduction in parasitic-phase sea lampreys by the year 2000 and a 90% reduction by the year 2010 from present levels, and establish a diverse salmonine community that can sustain an annual harvest of 2.4 million kg, with lake trout the dominant species and anadromous (stream-spawning) species also having a prominent place.

Sea lamprey abundance in Lake Huron was greater than the target level during 2008. The population of spawning phase sea lampreys during 2008 was estimated to be 190,346. The population estimate increased from 2007. 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. Wounding rates on lake trout have declined to a greater degree during the same period.

During 1998-2001 the first full round of approximately 850 ha of spot treatments was completed. These spot treatments have contributed to the decline in sea lamprey numbers and marking rates observed since 2001. This integrated program continued through 2008 with spot treatments of the most densely populated areas (about 80 ha per year) and with increased trap capture of migrating adults combined

with maximum release of sterilized males. Enhanced treatment strategies to improve the efficacy of lampricide treatments were added to several treatments this year. These strategies included: targeting lampricide concentrations greater than minimum lethal concentration, extending lampricide treatment blocks by one or two hours; conducting secondary applications of lampricide to treat backwaters, springs, and small feeder streams. Enhanced treatment strategies were used in 19 of 24 treatments during 2008.

### Tributary Information

Lake Huron has 1,761 tributaries (1,334 Canada, 427 U.S.). One hundred seventeen tributaries (56 Canada, 61 U.S.) have historical records of larval sea lamprey production. Of these, 72 tributaries (37 Canada, 35 U.S.) have been treated with lampricide at least once during 1999 - 2008. Forty-five tributaries (21 Canada, 24 U.S.) are treated on a regular cycle.

Lampricide treatments were completed in 24 tributaries (9 Canada, 15 U.S.), a lentic area of Lauzon Creek and the St. Marys River.

A total of 143 ha (64 Canada, 79 U.S.) of the St. Marys River was treated with granular Bayluscide. Included in this area was 27 ha at the downstream margin of Sugar Island, which assessment crews mapped and evaluated using Bayluscide surveys and RoxAnn sonar.

The lampricide treatment of Timber Bay Creek was completed following deferral of the system in 2007. Treatment of the upper Black Mallard River was deferred due to low discharge. Tributaries to the Echo River (Elm and Iron Creeks) were treated in sections due to beaver impoundments and extremely low discharge. Treatment of the Sauble River was postponed in June, and again in October, due to excessive discharge. The upper Black Mallard and Sauble Rivers were rescheduled during 2009.

The Cass River mainstream was treated for the first time above the Frankenmuth Dam. Goodings Creek and Scott Drain, both tributaries to the Cass River, were also treated for the first time.

A combined crew of the Department and Service personnel successfully treated the Rifle River. Extensive secondary treatment efforts enhanced overall effectiveness. A new strategy was employed by adding two additional boost sites using Bayluscide 20% emulsifiable concentrate (liquid niclosamide). This strategy assured that a lethal dose of lampricides was maintained to the mouth of the Rifle River.

A study was conducted by the Department-Great Lakes Lab for Fisheries and Aquatic Sciences (GLLFAS) in partnership with the Department-Sea Lamprey Control Center (SLCC) on the Mississagi River to examine lampricide toxicity to larval lake sturgeon *in situ*. The project compared the effects on caged larval sturgeon of the “lake sturgeon protocol” (TFM concentration limited to 1.2 X MLC) and the normal treatment protocol (TFM concentration limited to 1.5 X MLC). Caged sturgeon were also placed in an untreated tributary to the Spanish River. Survival was 94% under both treatment scenarios, as well as in the control.

### **Alternative Control Sterile-Male-Release Technique**

A total of 15,619 spawning-phase male sea lampreys were delivered to the sterilization facility from trapping operations on the Lake Huron tributaries Au Sable (85), Cheboygan (6,262), East Au Gres (126), Echo/Thessalon (3,261), Greene (127), Koshkawang (107), Ocqueoc (1,603), St. Marys (4,025), Tittabawassee (15), and Trout (8) Rivers.

A total of 22,072 sterilized male sea lampreys were released in the St. Marys River during May – July. The estimated resident population of spawning-phase sea lampreys in the St. Marys River was 17,513. The male population estimate was 11,272. Assessment traps removed 6,515 sea lampreys, of which 4,572 were males, an estimated reduction of males of 41% through trapping. The ratio of sterile to resident male sea lampreys remaining in the St. Marys River was estimated at 3.3:1 (22,072 sterile: 6,700 estimated resident after trapping).

In the St. Marys River, the theoretical reduction from trapping and enhanced sterile male release was estimated at 86% during 2008. The theoretical reduction from trapping and enhanced sterile male release averaged 86% during

1997-2008. Prior to enhancement (1991-1996), the theoretical reduction in reproduction averaged 58%.

The release of sterile males combined with the removal of lampreys by traps, reduced the theoretical number of effective fertile females in the St. Marys River from about 6,241 to 875 during 2008. A total of 712 grams of bisazir was used during 2008. Injections averaged 25.5 mg per sea lamprey.

### **Barriers**

Routine maintenance, spring start-up, and safety inspections were performed on 12 barriers (5 Canada, 7 U.S.). Operation of an electrical barrier was conducted at one U.S. barrier:

Ocqueoc River - The electrical component of the combination low-head/electrical barrier was operated from March 9 through August 7. The electrical field operated without incident between March 14 and June 7, activating eight times when rising water levels caused the effective barrier height to drop below 18 inches.

An intensive effort to inventory and ground truth the information contained in the National Inventory of Dams has been undertaken for barriers located on tributaries to the Great Lakes. During 2008, 137 barriers were inventoried in the Lake Huron basin.

Saugeen River - Rehabilitation of Denny’s Dam was originally planned to commence in 2009 but was delayed by administrative and permitting requirements. It is anticipated that these issues will be resolved, and repairs will begin in 2010. The project will be jointly funded by the Commission and the Ontario MNR.

Consultations with partner agencies regarding ensured blockage at barriers were conducted on 4 tributaries (0 Canada, 4 U.S.).

### **Assessment Larval**

Tributaries considered for lampricide treatment during 2009 were assessed during 2008 to estimate larval sea lamprey density. Assessments were conducted with backpack electrofishers in waters <0.8 m deep. Waters  $\geq 0.8$  m in depth were surveyed with deepwater electrofishers or granular Bayluscide. Survey plots were randomly selected in each tributary, catches of larvae were adjusted for gear efficiency, and lamprey lengths were standardized to the end of the growing season. The number of large lampreys in each tributary was estimated by multiplying the mean density of larvae  $\geq 100$ mm (number per  $m^2$ ) by an estimated area of suitable habitat ( $m^2$ ). Tributaries were ranked for treatment during 2009 based on an estimated cost per kill of large sea lampreys, as estimated using this index of abundance.

Larval assessment surveys were conducted on a total of 65 tributaries (38 Canada, 27 U.S.) and offshore of 9 tributaries (2 Canada, 7 U.S.). The status of larval sea

lamprey populations in historically infested Lake Huron tributaries and lentic areas are presented in Tables 3 and 4.

Surveys to estimate the abundance of larval sea lampreys were conducted in 12 tributaries (4 Canada, 8 U.S.) and offshore of 1 Canadian tributary. Surveys to detect the presence of new larval sea lamprey populations were conducted in 18 tributaries (15 Canada, 3 U.S.). No new populations were discovered.

Post-treatment assessments were conducted in 26 tributaries (10 Canada, 16 U.S.) to determine the effectiveness of lampricide treatments during 2007 and 2008.

Monitoring of larval sea lampreys in the St. Marys River continued during 2008. Approximately 950 geo-referenced sites were sampled using deepwater electrofishing gear. Surveys were conducted according to a stratified, systematic, adaptive cluster sampling design. The larval sea lamprey population in the St. Marys River is estimated to be 1.5 million. This is a 71% reduction from estimated abundance prior to the integrated control effort which began during 1999.

The downstream distribution of larval sea lampreys in the St. Marys River was investigated during 2008 using granular Bayluscide. Seventy-one 500 m<sup>2</sup> plots were surveyed using granular Bayluscide outside the limits of annual deepwater electrofishing assessment locations. A small larval sea lamprey population was documented in Munuscong Bay and a larger population was documented on the southwest tip of Sugar Island, which was subsequently treated with granular Bayluscide by application crews.

In addition to the work on the St. Marys River (48 ha), RoxAnn was used to evaluate a total of 109 ha of lentic substrate off of the mouths of Lauzon River, Manitou River, and Blue Jay Creek.

### **Spawning-phase**

33,123 sea lampreys were trapped at 22 sites in 20 tributaries during 2008. The estimated population of spawning-phase sea lampreys in Lake Huron for 2008 was

190,346, which was greater than the Fish Community Objective target and has varied widely since 1980.

Of the 33,123 spawning-phase sea lamprey captured in Lake Huron tributaries, 7,526 were captured in traps operated in the St. Marys River at the Great Lakes Power facility in Canada and the U.S. Army Corps of Engineers and Edison Sault Electric facilities in the U.S. The estimated population in the river was 17,513 and trap efficiency was 43%.

Spawning runs were monitored in the Carp River, and Albany, Trout, and Nunns Creeks through a cooperative agreement with the Chippewa/Ottawa Resource Authority.

### **Parasitic-phase**

While trout wounding rate is greater than the target of 5 wounds per 100 fish, it has remained steady at an average of 8.2 wounds per 100 lake trout since 2002, compared with 24.6 from 1990 through 2001. Lake trout wounding rate declined after completion of the St. Marys River granular Bayluscide spot treatments during 1999 (2001 spawning year). During the early 1990s, wounding rate and mortality on lake trout were so large that restoration efforts were suspended until the St. Marys River treatments commenced.

The Michigan Department of Natural Resources provided data on the frequency of parasitic-phase sea lampreys attached to fishes caught by sport charter fishers during 2008. 211 parasitic-phase sea lampreys were collected from 4 of 6 management districts; 90 were attached to lake trout and 121 were attached to Chinook salmon. Parasitic-phase sea lampreys were attached at a rate of 2.0 per 100 lake trout and 9.6 per 100 Chinook salmon.

1,872 parasitic-phase sea lampreys (Main Basin – 1,660, North Channel - 212, Georgian Bay - 0) were collected from Canadian commercial fishermen during 2008. A lake-wide mark-recapture study using metamorphosing-phase juveniles was initiated during the fall of 1997. No coded-wire tagged metamorphosing sea lampreys were released into Lake Huron during 2003, 2004, 2006 or 2008. A total of 667 metamorphosing sea lamprey were released in 2007 and will be available for recapture in 2009. ✧

## **Lake Superior**

### **Status and Trends of Prey Fish Populations in Lake Superior, 2008**

#### **Abstract**

The Great Lakes Science Center conducted daytime bottom trawl surveys of the Lake Superior nearshore between May 5 and June 14, 2008. 58 stations were sampled around the perimeter of the lake with 12-m wide bottom trawls. Trawls were deployed cross-contour at median start and end depths of 17 and 55 m, respectively.

The lakewide mean relative biomass estimate for the entire fish community was 4.61 kg/ha which was similar to that measured in 2007, 4.81 kg/ha. Dominant species in the

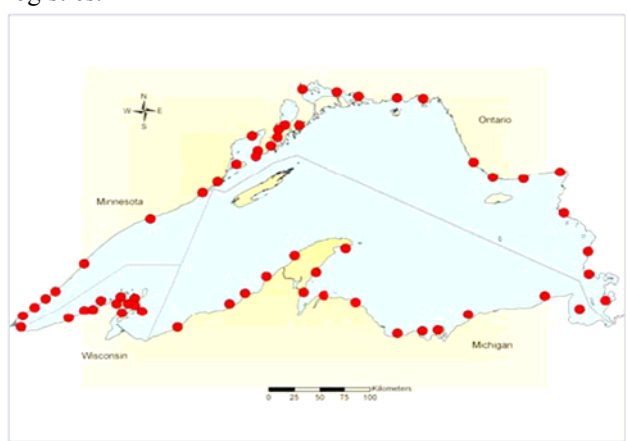
catch were Lake Whitefish, rainbow smelt, longnose sucker and Cisco, which represented 49, 18, 11, and 7 % of the total community biomass, respectively. Compared to 2007 levels, Lake Whitefish and Cisco biomass increased 35% and 55%, respectively, while bloater and rainbow smelt biomass declined 69% and 41%, respectively. Increased biomass of Lake Whitefish and decreased biomass in bloater represent trends observed since 2007; however, reversed trends in biomass were observed for Cisco and rainbow smelt. Year-class strength for the 2007 Cisco cohort (0.20 fish/ha) was below the long-term (1977-2007)

average (73.31 fish/ha), as was year-class strength for the 2007 bloater cohort (0.33 fish/ha) compared to the long-term average (11.11 fish/ha). Smelt year class strength (226.26 fish/ha) continues a trend of increasing strength from a 31-year low of 56.75 fish/ha in 2001 and was above the long-term average of 193.81 fish/ha. The 2008 Cisco age structure was dominated by age 5 and older fish, which accounted for 82% of the mean relative density. Wisconsin waters continue to be the most productive (mean total community biomass of 17.09 kg/ha), followed by western Ontario (5.40 kg/ha), eastern Ontario (3.08 kg/ha), Michigan (2.82 kg/ha), and Minnesota (0.89 kg/ha).

Densities of small (< 226 mm), intermediate (226-400 mm) and large (>400 mm) hatchery lake trout continued a pattern of decline observed since 1993-1996 to 0.04, 0.03 and 0.01 fish/ha in 2008, respectively. Densities of small and large wild (lean) lake trout continued a decreasing trend observed since 1996-1998. From 2007 to 2008, density of small lean lake trout declined from 0.29 to 0.15 fish/ha, the lowest value since 1978. Density of large lean lake trout has been relatively stable since 1986 but more recently density declined from 0.43 fish/ha in 2006 to 0.10 fish/ha in 2008. Density of intermediate size lean lake trout showed a small increase from 0.31 in 2007 to 0.41 fish/ha in 2008. Siscowet lake trout have shown a pattern of variable but increasing density since 1980. Since 2006, densities of small and intermediate size siscowet lake trout have increased from 0.10 to 0.12 and 0.08 to 0.15 fish/ha, respectively. Densities of large siscowet lake trout have fluctuated between 0.10 and 0.07 fish/ha since 2000. In 2008 the proportions of total lake trout density that were hatchery, lean and siscowet were 8, 60, and 32%, respectively.

### Spring Survey

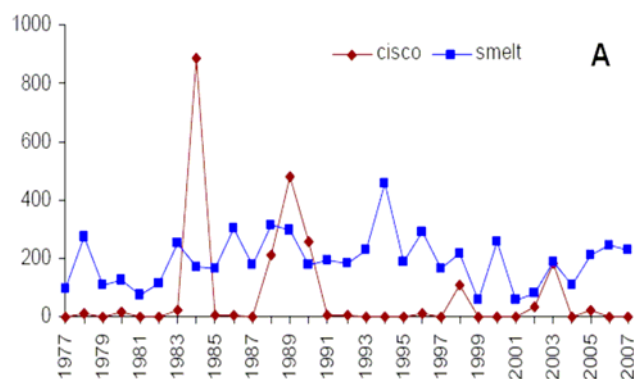
A total of 58 stations distributed around the perimeter of Lake Superior were sampled with bottom trawls during daylight hours between May 5 and June 14, 2008 (Fig. 1). We were able to sample fish at 54 of the 58 stations that were identified in 2005 as adequate for estimating relative biomass of principal prey species in Lake Superior (Stockwell et al. 2006a). These 58 stations represented a subset of 85 stations sampled annually during 1978-2004. Four stations were added in 2008 because of favorable logistics.



**Fig 1** - Locations of 58 stations sampled during the 2008 Annual spring bottom trawl survey in Lake Superior

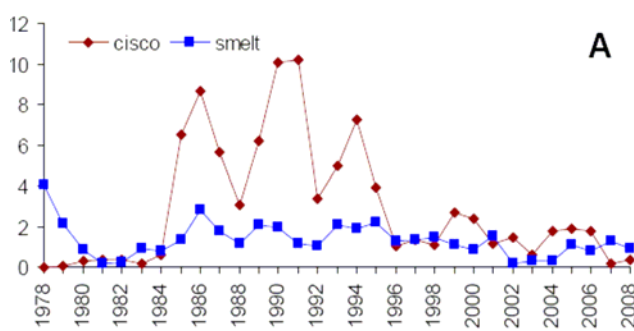
### Cisco

Year-class strength for the 2007 Cisco cohort was estimated at 0.20 fish/ha (Fig. 2). This value was the sixth weakest recorded year-class strength observed over the 31-year survey and one of six year classes of  $\leq 1$  fish/ha observed since 1999. Year-class strength for the 2007 cohort in U.S. waters was 0.32 fish/ha and no yearling Cisco were captured in Canadian waters.



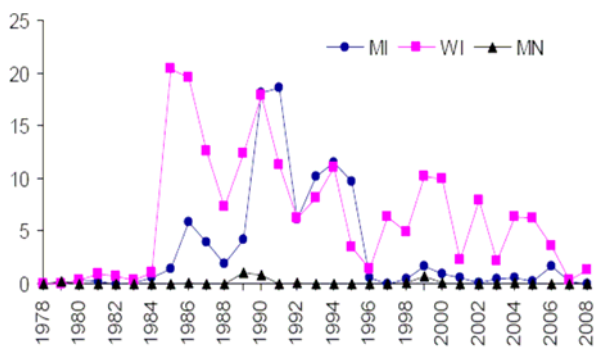
**Fig 2** - Year-class strength (number of age-1 fish/ha) for Cisco and rainbow smelt for all nearshore sampling stations for cohorts produced from 1977 to 2007

Mean relative biomass of age-1 and older Cisco (0.31 kg/ha) in 2008 was higher than in 2007 (0.20 kg/ha) (Fig. 3). This small increase in biomass did not change the downward trend in biomass observed since 2004-2006 when biomass averaged  $\geq 1.80$  kg/ha and is well below the long term 1978-2006 average of 2.90 kg/ha.

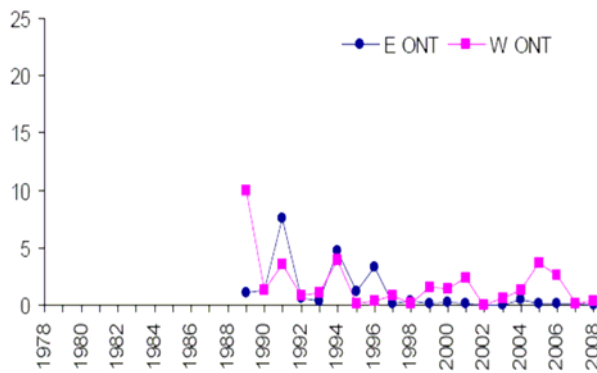


**Fig 3** - Biomass (kg/ha) of age-1 and older Cisco and rainbow smelt for all nearshore sampling stations, 1978-2008

Trends in relative Cisco biomass by jurisdiction from 2007 to 2008 were mixed: declines were observed in Michigan (0.25 to 0.02 kg/ha) and E. Ontario (0.12 to 0.01 kg/ha) while increases were recorded in Wisconsin (0.37 to 1.68 kg/ha), Minnesota (0.00 to 0.02 kg/ha) and W. Ontario (0.14 to 0.31 kg/ha; Figs. 4 and 5). Relative biomass estimates as a percent of long-term means were low in Wisconsin (26%), Minnesota (17%) and W. Ontario (17%) and very low in Michigan (0.6%) and E. Ontario (0.4%). The mean relative density of all Cisco showed a declining trend from 44.86 fish/ha in 2006 to 3.15 fish/ha in 2007 to 2.38 fish/ha in 2008. Age structure of Cisco in 2008, expressed as the relative density of each age-class by length, is shown based on scale ages and a weighted statistical age-length



**Fig 4 -** Biomass (kg/ha) of age-1 and older Cisco in MI, WI, and MN nearshore waters, 1978-2008

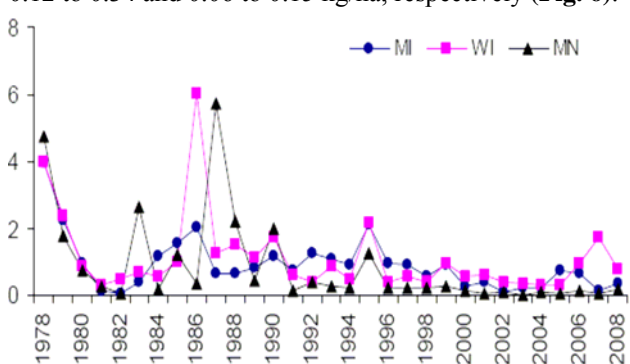


**Fig 5 -** Biomass (kg/ha) of age-1 and older Cisco in eastern and western Ontario nearshore waters, 1989-2008

**Rainbow Smelt**

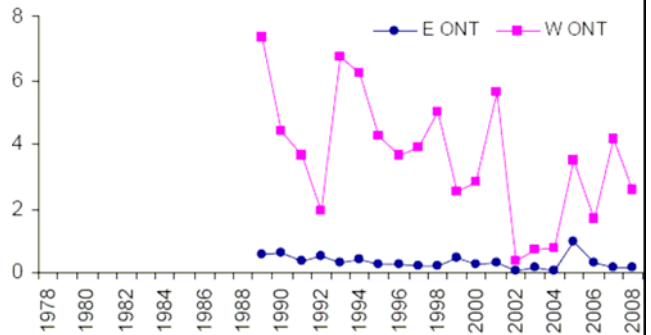
Year-class strength of rainbow smelt decreased from 246.58 fish/ha for the 2006 cohort to 226.26 fish/ha for the 2007 cohort (**Fig. 2**). Year-class strength for the 2007 cohort was greater (128%) than the average over the 31-yr survey period (193.81 fish/ha). The 2007 year-class was stronger in Canadian waters (525.96 fish/ha) than in U.S. waters (55.24 fish/ha).

Mean relative biomass for age-1 and older rainbow smelt decreased 41% from 2007 (1.29 kg/ha) to 2008 (0.76 kg/ha; **Fig. 3**) and was 57% of the 31-year mean of 1.33 kg/ha. Although biomass was lower in 2008, it is consistent with a recent trend of increasing biomass since 2005 and contrasts with a period of low biomass from 2002 to 2004. Relative biomass of rainbow smelt declined in Wisconsin waters from 1.70 kg/ha in 2007 to 0.77 kg/ha in 2008. In contrast, biomass increased in Michigan and Minnesota waters from 0.12 to 0.34 and 0.06 to 0.15 kg/ha, respectively (**Fig. 6**).



**Fig 6 -** Mean relative biomass (kg/ha) of age-1 and older rainbow smelt in Michigan, Wisconsin, and Minnesota nearshore waters, 1978-2008

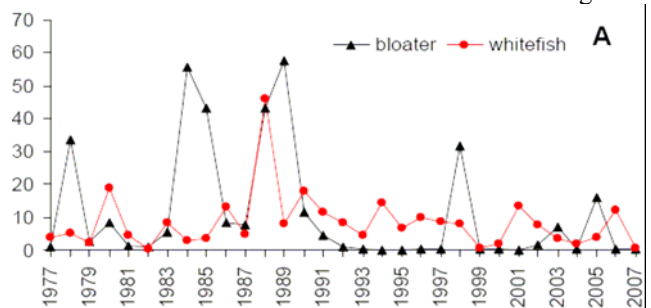
Rainbow smelt biomass in W. Ontario waters decreased from 4.14 kg/ha in 2007 to 2.59 kg/ha in 2008 (**Fig. 7**) while biomass in E. Ontario waters increased slightly from 0.13 kg/ha in 2007 to 0.17 kg/ha in 2008.



**Fig 7 -** Mean relative biomass (kg/ha) of age-1 and older rainbow smelt in eastern and western Ontario nearshore waters, 1989-2008

**Bloater**

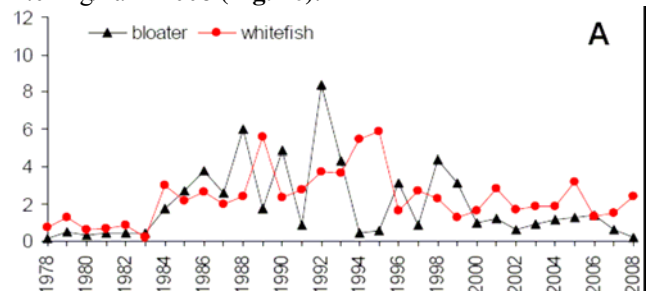
As in 2007, bloater year-class strength remained low and contrasts sharply with the 2005 cohort (**Fig. 9**) and is well below the 31-year average. Year-class strength was greater in U.S. waters (0.49 fish/ha) compared to Canadian waters (0.09 fish/ha). Mean relative lake-wide biomass of age-1 and older bloater declined from 0.61 kg/ha in 2007 to 0.19 kg/ha in 2008 and contrasts with a recent peak of 1.36 kg/ha in 2006 (**Fig. 10**). The 2008 relative biomass estimate is the lowest value observed since 1978 when it was 0.13 kg/ha.



**Fig 9 -** Year-class strength (number of age-1 fish/ha) for bloater and lake whitefish for all nearshore sampling stations for cohorts produced from 1977 to 2007

**Lake Whitefish**

Lake whitefish year-class strength decreased from 12.27 fish/ha in 2007 to 0.54 fish/ha for the 2008 cohort (**Fig. 9**). The 2007 year-class was stronger in U.S. (0.61 fish/ha) than in Canadian waters (0.44 fish/ha). Average year-class strength for lake whitefish over the 31-year survey period is 8.27 fish/ha. Mean relative biomass for age-1 and older lake whitefish in all waters increased from 1.51kg/ha in 2007 to 2.04 kg/ha in 2008 (**Fig. 10**).



**Fig 10 -** Biomass (kg/ha) of age-1 and older bloater and lake whitefish for all nearshore sampling stations, 1978-2008

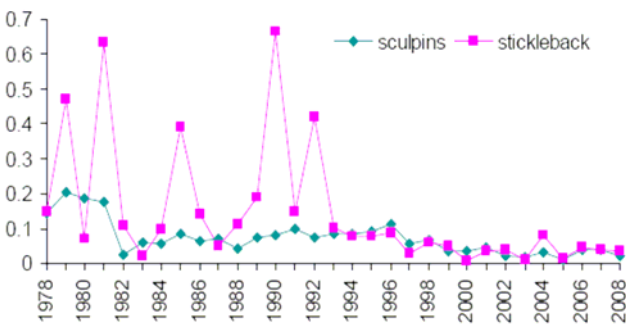
## Other Species

### Ninespine stickleback

Estimates of biomass of ninespine stickleback showed a small decrease between 2007 (0.04 kg/ha) and 2008 (0.03 kg/ha; Fig. 11). Mean relative biomass for all waters since 1997 was 0.04 kg/ha whereas mean biomass between 1978 and 1996 was 0.21 kg/ha.

### Sculpins

Mean relative biomass for all three sculpin species combined and deepwater followed a declining trend similar to that observed for ninespine sticklebacks since 1993 (Fig. 11). In the recent 2006–2008 interval, annual estimates of sculpin relative biomass have remained low (0.04 kg/ha). Deepwater sculpins were 51% of total sculpin biomass in 2008, followed by slimy (41%) and spoonhead (8%) sculpins. Although deepwater sculpins dominated the assemblage in 2006–2007, slimy sculpins were the dominant species in the group from 1978–2005, with the exception of 1984 when deepwater sculpins represented 55% of the biomass.

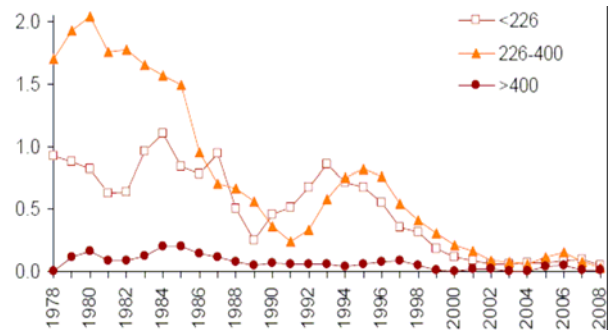


**Fig 11** -Biomass of age-1 and older ninespine stickleback and sculpins (slimy, spoonhead, and deepwater combined) for all nearshore sampling stations, 1978-2008

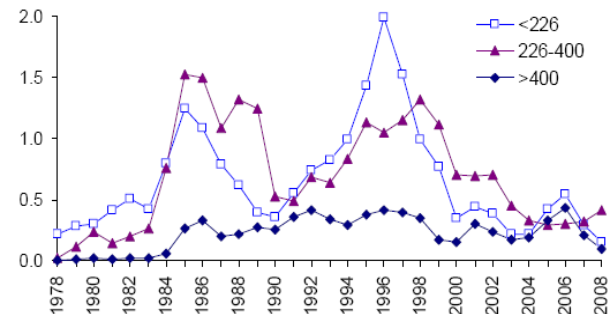
### Lake Trout

Because our bottom trawls capture a broad spectrum of lake trout sizes and life stages, biomass indices are sensitive to variable capture of large adult fish. Therefore, as introduced in the previous report, we summarized our lake trout data as density by size bins: small, < 226 mm ( $\leq$  ca., age-3), intermediate, 226-400 mm (ca., age 4-8), and large, > 400 mm ( $>$ ca., age-8). To dampen inter-annual variation in our density estimates, we expressed annual density using 2-year moving averages for hatchery and wild (lean) lake trout, and 3-year moving averages for siscowet lake trout. Densities of small, intermediate and large hatchery lake trout continued a pattern of decline observed since 1993-1996 to 0.04, 0.03 and 0.01 fish/ha in 2008, respectively (Fig. 12).

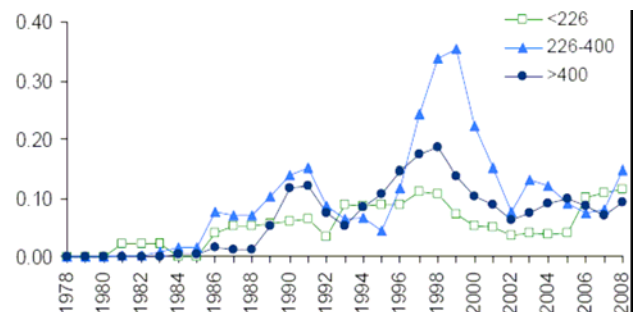
Densities of small and large wild lake trout continued a decreasing trend since 1996-1998 (Fig. 13). From 2007 to 2008, density of small lean lake trout declined from 0.29 to 0.15 fish/ha, the lowest value since 1978. Density of large lean lake trout has been relatively stable since 1986 but more recently density declined from 0.43 fish/ha in 2006 to 0.10 fish/ha in 2008. Density of intermediate size lean trout showed a small increase from 0.31 in 2007 to 0.41 fish/ha in 2008.



**Fig 12** - Density (fish/ha) of age-1 and older hatchery lake trout for all nearshore sampling stations, 1978-2008



**Fig 13** - Density (fish/ha) of age-1 and older wild (lean) lake trout for all nearshore sampling stations, 1978-2008



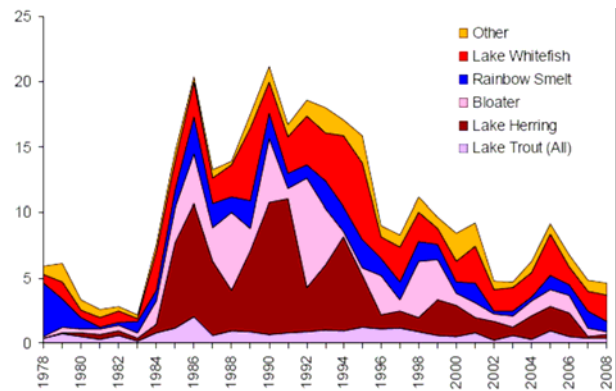
**Fig 14** - Density (fish/ha) of age-1 and older siscowet lake trout for all nearshore sampling stations, 1978-2008

Siscowet lake trout have shown a pattern of variable but generally increasing density since 1980 (Fig. 14). Since 2006, densities of small and intermediate size siscowet lake trout have increased from 0.10 to 0.12 and 0.08 to 0.15 fish/ha, respectively. Densities of large siscowet lake trout have fluctuated between 0.10 and 0.07 fish/ha since 2000. In 2008 the proportions of total lake trout density that were hatchery, lean and siscowet were 8, 60, and 32%, respectively.

### Lake Superior Fish Community

In 2008, Cisco, rainbow smelt, bloater, and lake whitefish represented 71% of the total relative biomass for all nearshore waters. Since 2005, mean biomass of all fish species caught during the spring bottom trawl survey have declined 50%; from 9.13 kg/ha in 2005 to 6.80 kg/ha in 2006 to 4.81 kg/ha in 2007 and to 4.61 kg/ha in 2008 (Fig. 15). This decline followed two consecutive years of increased biomass (34% increase from 2003 to 2004 and

45% increase from 2004 to 2005). Similarly, community biomass increased in 2000-2001 and then declined sharply in 2002-2003. Decreased biomass in 2006 -2007 was a result of declines in estimated biomass of Cisco, bloater, lake whitefish and lake trout. In 2008, biomass of bloater and rainbow smelt declined while biomass of lake whitefish and Cisco increased. In 2008, principal species contributing to community biomass were lake whitefish (49%), rainbow smelt (18%), longnose sucker (11%), Cisco (7%), burbot (6%), bloater (4%), and lean lake trout (4%). This structure contrasts with 2006 when Cisco represented the highest percentage of biomass for any species (26%), followed by bloater (20%), lake whitefish (20%), and rainbow smelt (12%).



**Fig 15-** Cumulative area plot of mean relative biomass (kg/ha) of the fish community caught in bottom trawls at all nearshore sampling stations, 1978-2008 ◇0

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## Management of Sea Lampreys in Lake Superior 2008

### Fish Community Objective

Suppress sea lampreys to population levels that cause only insignificant mortality on adult lake trout.

Sea lamprey abundance in Lake Superior was within target levels during 2008. The population of spawning phase sea lampreys during 2008 was estimated to be 27,760. Lake-wide estimates of spawning lamprey numbers increased above the target range beginning in 1999 and have remained above targets until this year. The lake trout wounding rate is greater than the target of 5 wounds per 100 fish and has trended upward since 1994. The lake trout wounding rate is currently highest in the northwest and southwest portions of the lake, but the wounding rate declined this year in Minnesota waters.

### Tributary Information

Lake Superior has 1,566 tributaries (833 Canada, 733 U.S.). One hundred forty-nine tributaries (55 Canada, 94 U.S.) have historical records of larval sea lamprey production. Of these, 91 tributaries (35 Canada, 56 U.S.) have been treated with lampricides at least once during 1999 - 2008. Forty-nine tributaries (18 Canada, 31 U.S.) are treated on a regular cycle.

### Lampricide Control

Lampricide treatments were completed in 32 tributaries (12 Canada, 20 U.S.) and lentic areas of the Kaministiquia, MacKenzie, Falls and Ravine Rivers. Lentic applications on the latter three streams were conducted in conjunction with the TFM treatment of the streams.

Lampricide treatments of the Cloud and Jackfish Rivers were completed following deferral of these systems in 2007. The Bad River system was successfully treated in 2008, after being only partially completed during 2007. During 2008 over 400 acre-feet of water were unexpectedly released into the upper end of the Marengo River, a major tributary of the Bad River, when a beaver dam was breached. This large volume of water overran and diluted the TFM block, changed treatment strategy for the lower Marengo River, and resulted in retreatment of some of the upper Marengo River.

Treatment of the Brule River was compromised by heavy rainfall. Residual larvae were found after the treatment and the stream is rescheduled during 2009. Treatment of the East Branch of the Two Hearted River was also compromised by heavy rain showers, but treatment has not yet been rescheduled.

Treatments of the Potato, Cranberry, and East Sleeping Rivers were hampered by low discharge, all requiring a strategy of several blocks of lampricide and additional application sites in order to be effective. The Traverse River was treated with very low discharge, requiring numerous applications of lampricide and walking the stream to apply lampricide to beaver dams and backwaters by hand. Low stream discharge prevented a complete treatment of the Agawa River which had already been deferred from the 2007 field season. The decision was made to treat the lower reach of the river which harbored the majority of the larval sea lamprey population. Larval assessment personnel will re-evaluate upper distribution and treatment effectiveness in 2009.

### Alternative Control

#### Sterile-Male-Release Technique

Research on the use of a sterile-male-release technique (SMRT) in sea lamprey control began during 1971. The SMRT was experimentally implemented in Lake Superior tributaries and the St. Marys River during 1991-1996, and efforts were refocused for exclusive use in the St. Marys River after 1996.

Male sea lampreys have been captured during their spawning migrations in over 25 tributaries to lakes Superior, Michigan, Huron, and Ontario for use in the SMRT. Captured males are transported to the sterilization facility at the U.S. Geological Survey Hammond Bay Biological Station. Sea lampreys are sterilized with the chemosterilant bisazir and released into the St. Marys River. Laboratory and field studies have shown that treated male sea lampreys are sterile and sexually competitive (produce mating pheromones and exhibit typical spawning behaviors). Furthermore, studies showed that in areas

where sterile males were released the number of eggs hatching in nests had been reduced.

A total of 618 spawning-phase male sea lampreys were delivered to the sterilization facility from trapping operations on Lake Superior tributaries; the Bad and Brule Rivers.

### **Barriers**

Routine maintenance, spring start-up, and safety inspections were performed on 12 barriers (6 Canada, 6 U.S.). Repairs or improvements were conducted on 5 barriers (3 Canada, 2 U.S.)

### **Assessment**

#### **Larval**

Larval assessment surveys were conducted on a total of 86 tributaries (32 Canada, 54 U.S.) and offshore of 17 tributaries (9 Canada, 8 U.S.). The status of larval sea lamprey populations in historically infested Lake Superior tributaries and lentic areas is presented in Tables 3 and 4.

Surveys to estimate the abundance of larval sea lampreys were conducted in 18 tributaries (7 Canada, 11 U.S.) and offshore of 10 tributaries (9 Canada, 1 U.S.) Surveys to detect the presence of new larval sea lamprey populations were conducted in 14 tributaries (11 Canada, 3 U.S.). A small population of larvae was found in the Little Cypress River for the first time.

Post-treatment assessments were conducted in 44 tributaries (20 Canada, 24 U.S.) to determine the effectiveness of lampricide treatments conducted during 2007 and 2008.

RoxAnn seabed classification sonar was used to map 468 ha of substrate offshore from the mouths of the Goulais, Wolf, and Black Sturgeon Rivers. This information will be used to evaluate the potential and geographic extent of

larval habitat and further delineate lentic populations in these areas.

### **Spawning-phase**

4,586 sea lampreys were trapped in 22 tributaries during 2008. The estimated population of spawning-phase sea lampreys during 2008 was 27,760, which was significantly lower than the 2007 abundance estimate. The abundance estimate is within the Fish Community Objective target range 36,000 +/- 18,000 for the first time since the mid-1990s.

Sea lamprey spawning runs were monitored in the Amnicon, Poplar, Middle, Bad, Firesteel, Misery, and Silver Rivers through cooperative agreements with the Great Lakes Indian Fish and Wildlife Commission, in Red Cliff Creek with the Red Cliff Band of Lake Superior Chippewas, in the Brule River with the Wisconsin DNR, and in the Miners River with the National Park Service, Pictured Rocks National Lakeshore.

### **Parasitic-phase**

Lake trout wounding rate is greater than the target of 5 wounds per 100 fish and has trended upward since 1994. The wounding rate is currently highest in the northwest and southwest portions of the lake, but the wounding rate declined this year in Minnesota waters. Surveys in Michigan waters suggest mortality due to sea lampreys exceeds mortality caused by the fishery. Fishing mortality, however, is low in Michigan waters.

The Michigan Department of Natural Resources provided data on the frequency of parasitic-phase sea lampreys attached to fish caught by charter boats during 2008. 26 parasitic-phase sea lampreys attached to lake trout were collected from 3 management districts. Parasitic-phase sea lampreys were attached at a rate of 1.13 per 100 lake trout.  
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### **Eels edging toward extinction in Lake Ontario**

CAPE VINCENT, N.Y. - The American eel has for millennia carried out a remarkable survival saga, swimming thousands of miles of ocean to reach Lake Ontario, where ...

### **Sinking ship-maker** - Ranger Boats

Genmar Holding's Chapter 11 bankruptcy filing last week stunned not only the boating industry, but also the professional bass fishing industry.

### **Asian carp facing starvation, reproductive problems**

COLUMBIA - Nature has found a way to limit the destructive and voluminous Asian carp population in the Missouri River.

### **AOC - White Lake fish contamination declines**

A new study shows the levels of contaminants in White Lake fish are decreasing, raising hopes that the lake can eventually be removed from a federal list of toxic hot spots

### **Fishing for solutions in Lake Huron**

Lake Huron's present condition is like an unfinished mural, with the background sketched in but the center portion blank, waiting to be filled.

**Lake level concerns depend on location**

Where you stand on Lake Michigan and Huron water levels depends on where you stand. West and Southwest Michigan property owners and tourism interests are most concerned about recently rising levels, and their contribution to beach erosion and danger to lakefront homes.

**IJC hosts Superior hearing on lake water levels**

For two years, 100 scientists and engineers from the U.S. and Canada have worked together to answer questions about the St. Clair River system and its impact on the upper Great Lakes.

**There's nothing fishy about big, numerous steelhead**

Most years, the St. Marys steelhead run would have petered out by June. This year, due to cooler water temperatures, the big fish are still thick in the rapids on the Canadian side of the river, and they should be there at least another two weeks.

**Ancient caribou-hunting camp may lie at bottom of Lake Huron**

Scientists probing an underwater ridge 35 metres deep in Lake Huron — and running 160 kilometres across the U.S.-Canadian border — have found what they believe to be 9,000-year-old traces of an ancient caribou-hunting camp used by some of the earliest inhabitants of North America.

**DNR investigates fish kill in Lake St. Clair**

Michigan wildlife experts want to know why thousands of dead fish are floating on Lake St. Clair near St. Clair Shores. Rotting fish, including smallmouth bass, muskie, walleye, perch and bass, are littering boat wells and shorelines across several miles.

