Lake Michigan Management Reports - 2010

Lake Michigan Fisheries Team
Wisconsin Department of Natural Resources

Chris Giese with whitefish captured through the ice on Green Bay. See whitefish report, starting on page 61.

CONTENTS

INTRODUCTION

Bill Horns

These reports summarize some of the major studies and stock assessment activities conducted by the Lake Michigan Fisheries Team during 2009. They provide specific information about sport and commercial fisheries, and describe trends in some of the major fish populations. For further information regarding any individual report, contact the author at the address, phone number, or e-mail address shown at the end of this document.

The Lake Michigan Fisheries Team is charged with implementing the Lake Michigan Integrated Fisheries Management Plan[1] and coordinating the Lake Michigan Fisheries Program for the Department of Natural Resources. Our management of Lake Michigan fisheries is conducted in partnership with other state, federal, and tribal agencies, and in consultation with the public, particularly sport and commercial fishers. Major issues of shared inter-jurisdictional concern are resolved by the Lake Michigan Committee[2], which includes representatives of Michigan, Indiana, Illinois, Wisconsin, and the Chippewa Ottawa Resource Authority.

Below I have summarized some highlights from these reports and added some notes on other topics related to Lake Michigan fisheries. For additional information visit the Department's Lake Michigan web page at http://dnr.wi.gov/org/water/fhp/fish/lakemich/index.htm.

Sport fishing

By any reasonable standard the Lake Michigan salmon and trout fishery remained outstanding in 2009, although the combined harvest of salmon and trout dropped from 360,340 in 2008 to 334,605 in 2009 (see report by Eggold and Zinuticz). Interest in the fishery remained high, as measured by sales of Great Lakes Trout and Salmon Stamps (133,000 sold) and Two Day Sport Fishing Licenses (49,000 sold)[3]. One concern is the decline in brown trout fishing in Green Bay, so we are trying to learn how changes in size and/or age at the time of stocking or in the date or location of stocking might improve that local fishery. Brown trout fishing remains outstanding farther south, with a world record 41 pound 8 ounce brown trout being harvested by Roger Hellen north of Racine (photo at right by Paul A. Smith, Milwaukee Journal Sentinel). Our ongoing program, in cooperation with Musky Clubs Alliance of Wisconsin and others, to restore the Great Lakes strain of muskellunge in Green Bay is drawing increasing interest and participation in that fishery (see report by Rowe). Yellow perch fishing remains disappointing in Green Bay despite several years of strong natural reproduction (see report by Paoli) and in Lake Michigan where a strong year 1998 year class supported the fishery for a decade and present hopes are pinned to a moderately good 2005 year class (see report by Hirethota). At the time of this writing, the Department is not proposing increases in the daily sport bag limits for yellow perch in Green Bay or Lake Michigan. The southern Green Bay walleye harvest has increased steadily for a decade (see report

[1] Lake Michigan Fisheries Team. 2004. Lake Michigan Integrated Fisheries Management Plan, 2003-2013. Administrative Report No. 56, Wisconsin Department of Natural Resources.

[2] Inter-jurisdictional fisheries governance on the Great Lakes is guided by *A Joint Strategic Plan for Management of Great Lakes Fisheries*, to which all state, federal, and tribal fisheries agencies on the Great Lakes are signatories. A copy may be obtained through the Great Lakes Fishery Commission at www.glfc.org.

[3] A portion of those Salmon Stamp and Two Day license sales are used by anglers on Lake Superior and its tributaries.

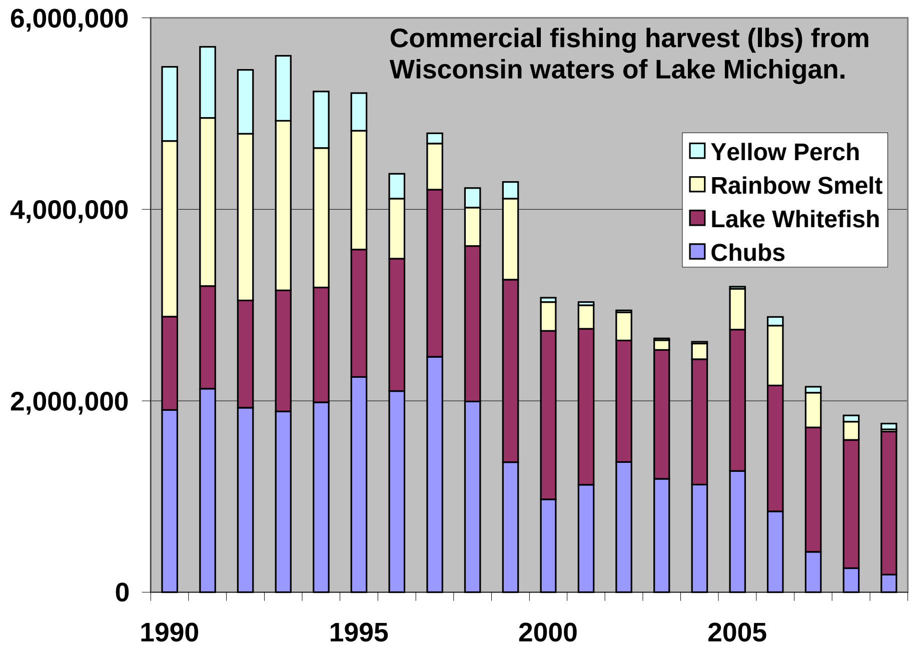
by Rowe) and the future of that fishery remains promising. The fishery is largely sustained by stocking, summarized for the last stocking year in the table below.

Fish stocked in Wisconsin waters during fall of 2009 and spring of 2010.

species	strain	fingerlings (fall 2009)	yearlings (spring 2010)
brook trout	St. Croix		40,546
brown trout	seeforellen (feral)		336,677
	St. Croix (domestic)	73,516	64,620
	Wild Rose (domestic)	332,470	157,001
chinook salmon			1,233,922
coho salmon			333,770
lake sturgeon		4,423	
rainbow trout	Chambers Creek (steelhead)	101,457	149,365
	Ganaraska (steelhead)	130,104	118,931
	Erwin (nearshore)		176,839
walleye		126,705	

Commercial fishing

Whitefish remains the mainstay of the commercial fishery on Lake Michigan (see report by Hansen). Because of the strength of that population, we were able to increase the annual total allowable commercial harvest by 16%. The actual reported harvest during calendar year 2009 was just short of 1.5 million pounds. Harvests of other species remained low (see chart and reports by Paoli, Hirethota on yellow perch, by Kroeff and Schindelholz on bloater chubs, and by Hogler on rainbow smelt).



Forage trends and lake-wide stocking levels

Our fisheries depend on a food web that is continuously changing in response to invasive species and other forces[4]. Similar changes in Lake Huron, along with steady increase in natural reproduction by chinook salmon, led to the collapse of the alewife population there, with dramatic effects on salmon and trout fisheries[5] and some evidence for an increase in natural reproduction by lake trout. Agencies on Lake Michigan reduced chinook salmon stocking by 25% starting in 2006, with the goal of stabilizing the forage base by reducing predation on forage species. We expected the effect of those reductions to be delayed, but to be significant by 2009 when fish stocked in 2006 reached age-3 and almost all chinooks stocked in earlier years were out of the system. Data from lake wide forage surveys[6] and our own data on size at age of chinooks (see report by Peterson, Hogler, and Hansen) suggest that the alewife population may have stabilized at a level sufficient to support healthy growth rates in chinook salmon. Our new Lake Michigan research vessel, *R/V Coregonus*, shown here under construction at Burger Boat Company in Manitowoc, will support our ability to conduct offshore fisheries assessments.

[4] Fahnenstiel, G., T. Nalepa, S. Potoven, H. Carrick, and D. Scavia. 2010. Lake Michigan lower food web: Long-term observations and *Dreissena* impact. J. Great Lakes Res. 36, 1-4.
[5] Michigan DNR and Ontario MNR. 2010. Recreational Harvest Summary, Lake Huron. Presented to Lake Michigan Committee, March 2010
[6] Madenjian, C.P., D.B. Bunnell, J.D. Holuszko, T.J. Desourcie, and J.V. Adams. 2010. Status and Trends of Prey Fish Populations in Lake Michigan, 2009. USGS report presented to Lake Michigan Committee, March 2010.

SPORTFISHING EFFORT AND HARVEST

Brad Eggold and Jeff Zinuticz

Wisconsin's Lake Michigan open water fishing effort was 2,857,378 hours during 2009, 2.18% above the five-year average of 2,796,378 (Table 1). Effort was above the five-year average for all fishery types except for the charter boat industry, which was below its five-year average by 8.76%.

Wisconsin Lake Michigan trout and salmon anglers had a slightly worse season in 2009 than in 2008. Overall harvest was down, with 334,605 salmonids harvested; and the harvest rate dropped to 0.1171 fish per hour (Tables 2 and 3). Chinook dominated the catch, but the harvest of 214,621 was the lowest Chinook harvest since 2001. Coho salmon harvest rebounded in 2009 with 42,690 fish taken, a 65% increase over 2008. Cold water near-shore made for good fishing conditions the majority of the season, and both shore and boat anglers took advantage for a good portion of the early season. However, later in the season little, if any, thermocline had set-up in deeper waters, making it more difficult for trollers to target schools of trout and salmon.

The open-water Yellow Perch harvest was 254,953 fish (Table 2), a slight increase from 2008 but still 23% below the five-year average of 331,187. Although the perch harvest was low in 2009, there was some encouraging news because most of the fish caught were from the 2005, 2003, and 2002 year-classes. As in past years, the majority of the perch harvest was caught by Green Bay anglers.

Walleye harvest was estimated at 87,228, a major increase from 2008. The Northern Pike catch was slightly higher in 2009 with 2,693 fish caught. Smallmouth Bass harvest was 8,059 fish, a slight decrease from 2008.

For more summaries, check out Wisconsin's Lake Michigan website at:
http://dnr.wi.gov/fish/lakemich/managementreports.htm

Table 1. Fishing effort (angler hours) by various angler groups in Wisconsin waters of Lake Michigan and Green Bay during 2009 and percent change from the 5-year average (2004-2008).

YEAR	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	TOTAL
2009	1,577,376	406,318	267,696	184,526	169,044	252,418	**2,857,378**
% change	3.29%	5.60%	-8.76%	3.51%	1.42%	2.58%	**2.18%**

Table 2. Sport harvest by fishery type and species for Wisconsin waters of Lake Michigan and Green Bay during 2009.

SPECIES	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	**TOTAL**
Coho salmon	15,042	13,160	12,187	606	1,101	594	**42,690**
Chinook salmon	72,426	60,048	60,625	4,678	3,071	13,773	**214,621**
Rainbow trout	15,311	12,885	11,804	1,227	861	4,441	**46,529**
Brown trout	5,379	1,242	1,807	1,340	3,486	2,538	**15,792**
Brook trout	0	0	27	0	0	0	**27**
Lake trout	5,288	4,651	4,883	124	0	0	**14,946**
Northern pike	1,761	0	0	0	23	909	**2,693**
Smallmouth bass	2,511	4,715	0	437	396	0	**8,059**
Yellow perch	197,608	34,478	0	6,293	15,069	1,505	**254,953**
Walleye	78,752	1,868	0	943	106	5.559	**87,228**
TOTAL	**394,078**	**133,047**	**91,333**	**15,648**	**24,113**	**29,319**	**687,538**

Table 3. Total number of fish harvested by year by species across all angler groups in Wisconsin waters of Lake Michigan, 1994-2009.

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Brook Trout	7,481	1,914	419	299	159	574	199	263	144	126	1	18	17	62	13	27	38,996
Brown Trout	52,397	49,654	38,093	43,224	27,371	37,187	40,966	26,421	35,220	23,654	20,918	27,489	17,769	37,947	23,763	15,792	1,003,857
Rainbow Trout	114,776	117,508	77,099	94,470	110,888	84,248	71,829	72,854	74,031	48,548	25,529	48,490	48,420	62,249	41,552	46,529	1,674,287
Chinook Salmon	99,755	162,888	183,254	130,152	136,653	157,934	136,379	191,378	275,454	317,619	360,991	418,918	398,905	431,143	256,796	214,621	5,433,117
Coho Salmon	110,001	65,647	104,715	138,423	59,203	56,297	87,927	47,474	102,313	50,625	76,944	59,244	56,136	94,677	25,453	42,690	1,912,951
Lake Trout	53,989	69,332	36,849	57,954	82,247	39,819	31,151	40,408	39,865	23,881	14,209	14,139	10,638	19,281	12,763	14,946	1,231,094
TOTAL	**438,399**	**466,943**	**440,429**	**464,522**	**416,521**	**376,059**	**368,451**	**378,798**	**527,027**	**464,453**	**498,592**	**568,298**	**531,885**	**645,359**	**360,340**	**334,605**	**11,294,302**
Harvest per hour	0.1256	0.1426	0.1481	0.1619	0.1451	0.1331	0.1614	0.1382	0.1789	0.1719	0.1904	0.2036	0.1916	0.2108	0.1443	0.1171	0.1439

Table 4. Total number of salmonids harvested by year by angler group in Wisconsin waters of Lake Michigan, 1994-2009.

Fisheries Type	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	TOTAL
Ramp	167,388	193,752	176,085	190,976	155,953	141,903	170,081	156,470	236,241	196,235	195,953	241,535	197,833	254,231	115,698	113,446	4,347,255
Moored	134,315	128,743	125,017	129,332	141,538	100,078	68,872	85,435	110,094	111,148	130,418	149,845	128,666	164,286	92,635	91,986	3,010,311
Charter	81,909	84,898	86,346	94,556	84,867	73,622	91,665	76,868	106,631	100,037	123,995	137,922	152,749	173,250	110,481	91,333	2,532,356
Pier	15,130	14,621	6,218	5,002	4,200	4,614	4,402	7,327	10,629	8,464	11,329	9,284	8,835	15,440	6,487	7,975	301,613
Shore	16,370	17,676	19,676	16,726	8,997	12,685	13,971	18,308	20,111	14,995	11,175	8,557	13,472	16,394	10,191	8,519	383,641
Stream	23,287	27,253	27,087	27,930	20,966	43,157	19,460	34,390	43,321	33,574	25,722	21,155	30,330	21,758	24,848	21,346	719,126
TOTAL	**438,399**	**466,943**	**440,429**	**464,522**	**416,521**	**376,059**	**368,451**	**378,798**	**527,027**	**464,453**	**498,592**	**568,298**	**531,885**	**645,359**	**360,340**	**334,605**	**11,294,302**

* Totals represent total number of salmonids harvested from 1986 - 2009.

WEIR HARVEST

Cheryl Peterson, Steve Hogler, Scott Hansen

The Wisconsin Department of Natural Resources (WDNR) operates three salmonid egg collection stations on Lake Michigan tributaries. The Strawberry Creek Weir (SCW), which has been in operation since the early 1970's, is located on Strawberry Creek in Door County near Sturgeon Bay and is the primary facility for chinook salmon *Oncorhynchus tshawytscha*. The Buzz Besadny Anadromous Fisheries Facility (BAFF) has been in operation since 1990 and is located on the Kewaunee River in Kewaunee County near Kewaunee. BAFF is a co-primary egg collection station for three strains of steelhead *O. mykiss*, and coho salmon *O. kisutch.* BAFF also serves as a backup for Chinook salmon egg collection. The Root River Steelhead facility (RRSF) has been in operation since 1994 and is located on the Root River in Racine County in Racine. RRSF is a co-primary egg collection station for the three strains of steelhead, and coho and serves as a backup for Chinook salmon egg collection.

Total numbers of fish returning as reported here cannot necessarily be interpreted strictly as the absolute number of fish returning to Wisconsin weirs. Returns can vary depending upon several variables including the timeframe the weir was operated, whether fish were passed upstream, and the number of smolts previously released at these sites. The salmonid egg harvest quota varies from one year to the next for each species or strain based on the projected needs of WDNR hatcheries and egg requests from other agencies. In 2009, all Lake Michigan salmon and trout egg quotas for Wisconsin waters were met.

Strawberry Creek Weir

Rebounding Lake Michigan water levels were noticeable in 2009 though we continued to utilize our 3,500 foot pipeline and pump to deliver approximately 1,500 – 2,000 gallons of water per minute to Strawberry Creek. This greatly increases the flow thereby helping attract Chinook salmon to the weir. During the fall 2009 run, 2,171 Chinook salmon were handled at SCW (Table 1). The number of fish handled at the weir is dependent upon the period of time that fisheries staff allow the pipeline to run and can attend to the returning fish. In 2009 the weir was allowed to run eight fewer days than in 2008. The pump was shut off October, 16 upon completion of Wisconsin’s egg take quota. However, Chinook continued to run Strawberry Creek even without the added flow provided by the pump. Nevertheless, the total rate of return to SCW appears to be down compared to past levels. These reduced returns are not unexpected in part due to stocking reductions. Despite the reduced number of returning Chinook salmon, Wisconsin’s entire Chinook salmon egg quota was once again collected at SCW in 2009 where approximately 2.04 million eggs were harvested.

Chinook average size at age continues to improve from levels that were at or near record lows in 2007 (Figures 1 and 2). However, for the past nine years, mean length and weight at age for Chinook salmon returning to Strawberry Creek has generally followed a decreasing trend since it last peaked in 2001. For example, since 2001 length and weight at age for age 2+ Chinooks has on average decreased by 71 mm and 1.8 kg, respectively. However, in 2009, average length and weight at age for age 3+ males increased considerably from 2008 and approximated 2001 levels.

Besadny Anadromous Fisheries Facility

Spring Operations

Spring operations in 2009 began on March 30 when the ponds were sorted to look for steelhead with Chambers Creek and Ganaraska fin clips and continued through April 13. During this period 815 steelhead were handled at BAFF. The run consisted of 272 Chambers Creek strain steelhead, 219 Ganaraska, 32 Skamania and 292 unclipped, misclipped or strays from other streams or states (Table 2). The 2009 spring run total although above the five year average of 738, was only 51.5% of the 2008 spring run total.

Gamete collections for the two spring strains of steelhead were good from BAFF in 2009 and should result in near normal numbers of Chambers Creek and Ganaraska being stocked in 2010.

Fall Operations

The fall 2009 trout and salmon run on the Kewaunee River was below average with stressful conditions due to low water levels through mid to late October. Lake Michigan water levels were somewhat higher this year and fish had an easier time in the lower river reaches. However, drought conditions made it difficult for the migrating fish once they reached the upper sections closer to the weir. These conditions caused a good number of the fish to die before they even arrived at BAFF and fish that did survive the journey were stressed. High levels of the parasite *Ichthyophthirius Multifiliis* were noted in 2009. BAFF ponds were sorted eight times during October and November to process migrating fish. Once again in 2009, as a measure taken to prevent the spread of Viral Hemorrhagic Septicemia (VHS), fish were not allowed to bypass the BAFF facility.

The summer/fall steelhead collection began on October 7 when the BAFF fish ladder began to operate. BAFF ponds were sorted six times during October and November to process migrating fish. One-hundred-seven steelhead were captured at BAFF during the summer/fall run of 2009 (Table 2). This was the highest total since 1999 when 145 steelhead were captured. Sixty-six of the 107 steelhead had an identifiable Skamania clip which was similar to the 2008 total catch of Skamania. All steelhead captured on October 9 and October 13 were harvested while those captured during the remaining operational days were trucked to the harbor and released.

The number of Chinook salmon captured at BAFF during the fall operations in 2009 was down by 800 fish from 2008 (Table 1). Once again, stocking cuts may have played a role in the reduced return. No eggs were harvested from Chinook at BAFF.

Adult Skamania to be used as brood fish were not collected from either steelhead facility in 2009 due to VHS concerns which will result in no Skamania stocking in 2011 by Wisconsin unless gametes or fingerlings are obtained from another source.

In 2009 the coho run fell precipitously from 2008 by over 2,800 fish (Table 3). The return was the fourth lowest since 1990. Approximately 309,000 coho salmon eggs were collected at BAFF in the fall of 2009 for Wisconsin stocking.

Root River Steelhead Facility

Spring Operations

The Root River Steelhead Facility (RRSF) was in operation for 4 processing dates during the spring 2009 migration. We were able to capture and process 1,024 steelhead between March 23 and April 15 (Table 2). This was the strongest steelhead return to RRSF since 2004. In conjunction with the Besadny Anadromous Fisheries Facility in Kewaunee, we met our egg collection quotas for Chambers Creek and Ganaraska strains of steelhead. Our biological sampling goals were fulfilled, and fish health sampling was conducted.

Because of the constraints placed on the hatchery systems by Viral Hemorrhagic Septicemia (VHS), the Skamania contribution to the Lake Michigan steelhead program has been halted. There will be no stocking of this strain beyond 2008 unless we can find another source of Skamania eggs. The overall lakewide steelhead quotas will be made up of additional Chambers Creek and Ganaraska strains.

Fall Operations

The Root River Steelhead Facility was in operation for 9 processing dates during the fall 2009 fish migration. A total of 1,716 Chinooks and 1,338 coho salmon were captured and processed between October 13 and November 12 (Tables 1 and 3). Stream flows were relatively high for most of the operating season, and some fish were likely able to bypass the facility. Furthermore, due to the absence of a Skamania egg collection program and the resulting later fall processing season, Chinooks and steelhead are able to migrate upriver past the facility before we start capturing fish, resulting in lower numbers handled at the facility. Therefore, we only need to run the facility when coho start to show up in significant numbers, usually in mid-October. Approximately 1,033,000 coho salmon eggs were collected at RRSF in the fall of 2009 for Wisconsin stocking. Biological sampling goals were met, and fish health sampling was conducted.

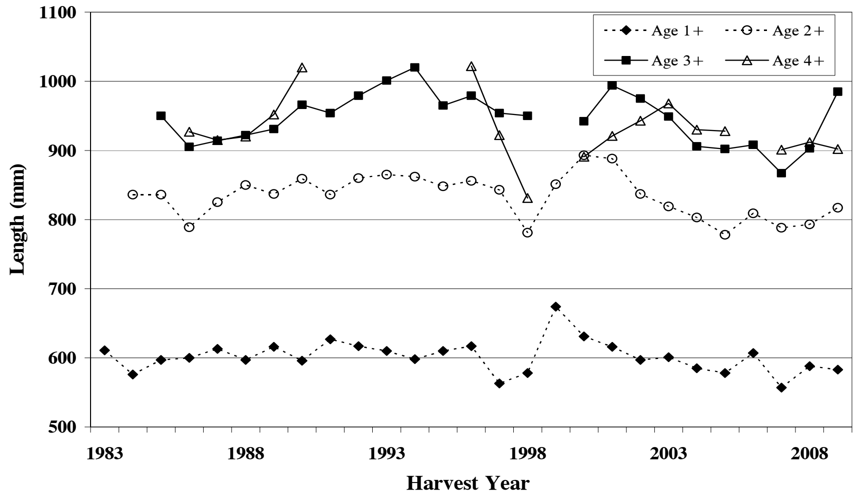


Figure 1. Length at age of male chinook salmon returning to the Strawberry Creek weir between 1983 and 2009.

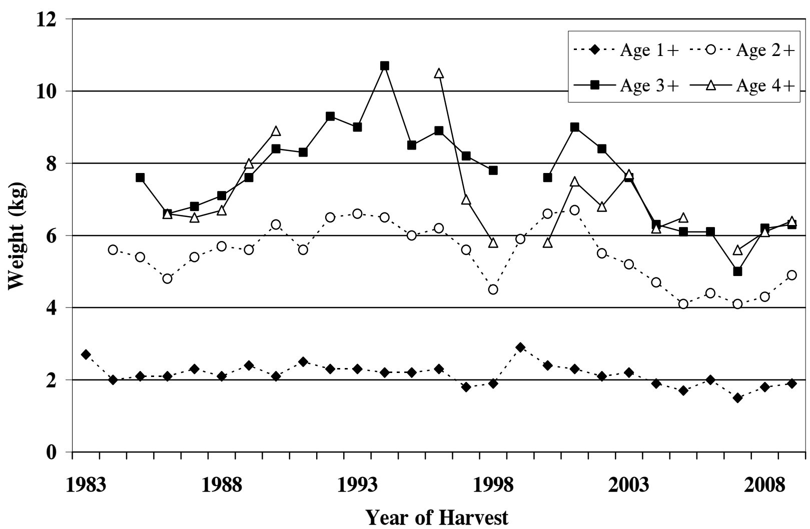


Figure 2. Weight at age of male chinook salmon returning to Strawberry Creek weir between 1983 and 2009.

Table 1. The total number of chinook salmon handled during fall migrations at Strawberry Creek (1981-2009), Besadny (1990-2009) and Root River (1994-2009) weirs.

Harvest Year	SCW	BAFF	RRSF
1981	4,314		
1982	3,963		
1983	3,852		
1984	5,208		
1985	5,601		
1986	4,392		
1987	7,624		
1988	3,477		
1989	1,845		
1990	3,016	3,104	
1991	3,009	3,356	
1992	4,099	3,874	
1993	4,377	3,260	
1994	4,051	1,722	1,858
1995	2,381	2,621	2,979
1996	6,653	3,193	5,589
1997	4,850	1,518	4,102
1998	5,035	4,005	3,977
1999	1,934	5,798	6,022
2000[1]	6,649	2,774	7,382
2001	8,125	5,092	10,214
2002	11,027	6,224	10,439
2003	6,086	1,197[2]	149
2004	10,917	2,821[2]	392
2005	5,500	3,268[2]	3,623
2006	4,510	4,671[2]	10,318
2007	3,101	3,351	3,547
2008	3,706	2,451	1,504
2009	2,171	1,672	1,716

1 Beginning in 2000 through the present, low stream flow and low lake levels have persisted. A pipeline was installed in 2000 which delivers approximately 1,500 – 2,000 gallons of water per minute, and facilitates weir operation.
2 All fish were allowed to bypass BAFF until October 1.

Table 2. The total number of steelhead examined during spring and fall runs at BAFF (1992-2008) and RRSF (1994-2008).

Year	BAFF	RRSF
1994 – Spring	2,804	
1994 – Fall	321	848
1995 – Spring	1,696	2,720
1995 – Fall	457	538
1996 – Spring	1,964	3,169
1996 – Fall	24	353
1997 – Spring	1,955	3,045
1997 – Fall	85	638
1998 – Spring	746	382
1998 – Fall	41	151
1999 – Spring	608	2,263
1999 – Fall	145	70
2000 – Spring	220	2,171
2000 – Fall	2	219
2001 – Spring	324	859
2001 – Fall	6	490
2002 – Spring	307	1,303
2002 – Fall	3	301
2003 – Spring	307	1,060
2003 – Fall	0	236
2004 – Spring	720	1,028
2004 – Fall	16	398
2005 – Spring	407	887
2005 – Fall	6	116
2006 – Spring	552	845
2006 – Fall	15	536
2007 – Spring	431	428
2007 – Fall	50	98
2008 – Spring	1,582	241
2008 – Fall	79	10
2009 – Spring	815	1,024
2009 – Fall	107	99

Table 3. The total number of coho salmon examined at BAFF (1990-2008) and the RRSF (1994-2008).

Year	BAFF	RRSF
1990	3,887	
1991	1,140	
1992	958	
1993	1,671	
1994	746	813
1995	3,767	3,321
1996	3,328	4,406
1997	1,162	7,645
1998	2,432	4,000
1999	1,638	1,150
2000	1,629	3,408
2001	175	1,327
2002	241	2,548
2003	266	198
2004	2,081	1,271
2005	937	841
2006	856	1,400
2007	2,482	1,169
2008	3,296	2,581
2009	487	1,338

GREEN BAY YELLOW PERCH

Tammie Paoli

This report summarizes assessments and monitoring of the yellow perch population in southern Green Bay completed in 2009. Yellow perch abundance in Green Bay increased steadily through the 1980's. The estimated total biomass of yearling and older yellow perch rose from under 1 million pounds in 1978 to nearly 9 million pounds in 1987 (Figure 1). The population growth was fueled by the production of strong year classes in 1982, 1985, 1986, and 1988 (Figure 2). Following the late 1980's, yellow perch abundance began to decline and the biomass estimate dropped to between 500 and 600 thousand pounds by 2002 (Figure 1). The decline in the population during the 1990's and early 2000's can be attributed to poor recruitment. From 1988 to 2002, only two reasonably strong year classes (1991 and 1998) appeared during summer trawling surveys (Figure 2). More recent summer trawling surveys, however, show a trend towards improved recruitment. Surveys from 2002 to 2009 indicate reasonably strong year classes. The 2003 survey indicates a record year class was produced that year (Figure 2). This report is a summary of the status of yellow perch in southern Green Bay based on annual assessments during 2009.

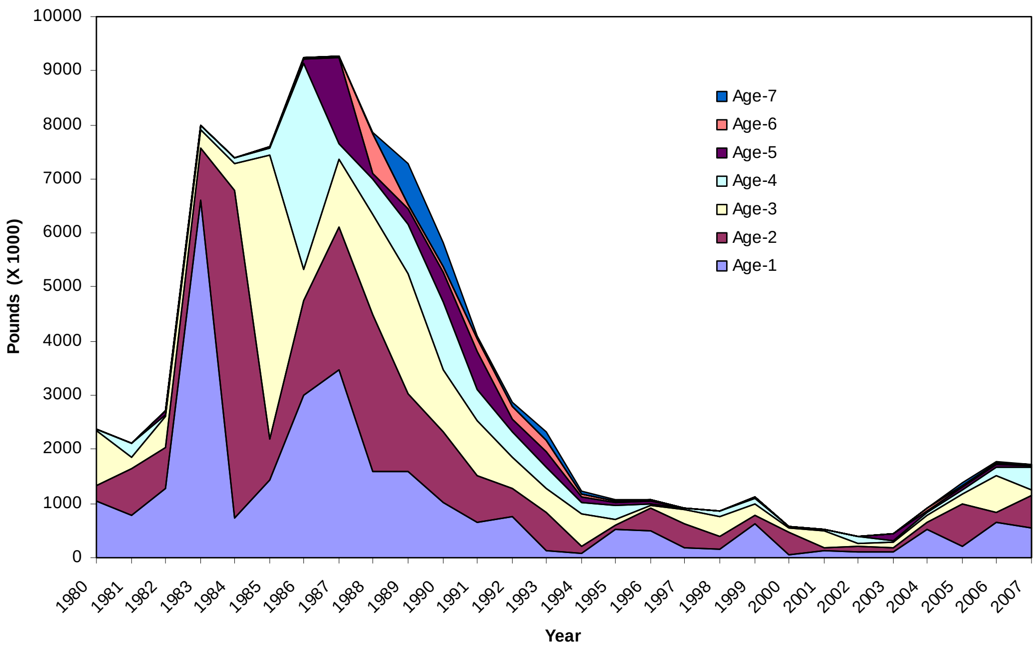


Figure 1. Estimated yellow perch population biomass in Green Bay from 1978 to 2007.

Spawning assessment

The spring spawning assessment continued for the 32nd year on Green Bay at Little Tail Point. Double-ended fyke nets were set at three locations at ice-out on April 16, 2009. Water temperature reached 50 F on April 28. On April 30, 77% of mature females sampled were ripe or spent which triggered the removal of the nets for a total effort of 42 net nights.

Aging structures from immature females, mature females, and males were collected from 20 fish per 10 mm group when possible. All fish species were counted and lengths were taken from 500 yellow perch per sex and maturity category and incorporated into the age expansion. Age-2 (2007 year class) males comprised 92% of the total males sampled (n=683) with a mean length of 148 mm, or 5.8 inches. A majority (75%) of the mature females sampled were age-2 with a mean length of 168 mm, or 6.6 inches. Younger females (ages 2 and 3), continue to contribute significantly to the spawning population in southern Green Bay (Table

1). In contrast, older fish (1998 and 2002 year classes) have dominated the spawning population in southern Lake Michigan in recent years (Hirethota 2008, 2009).

Besides yellow perch, trout perch dominated the catch, followed by spottail shiners, walleye, and white sucker. Most notably, the catch rate of trout perch increased from 4 fish per net night in 2008 to 147 in 2009.

Table 1. Percent mature females by age sampled during April fyke netting surveys, 2004 - 2009.

Year	Age-2	Age-3	Age-4	Age-5	Age-6+	Total (*n*)
2009	75%	11%	11%	1%	2%	350
2008	56%	35%	2%	5%	2%	271
2007	72%	6%	16%	3%	3%	511
2006	56%	34%	5%	3%	2%	447
2005	42%	26%	15%	3%	14%	302
2004	56%	28%	7%	1%	8%	191

Water temperature

A StowAway TidbiT® templogger (Onset Computer Corporation) was deployed on April 17, 2009 near Little Tail Point to record water temperature every 30 min until August. May 2009 water temperatures averaged 56.8 F. The 7-year May average for this location is 56.9 F.

Larval sampling

In 2009, larval sampling continued for the 12th year, with support from University of Wisconsin Sea Grant for equipment. Larval yellow perch were collected using a high-speed Miller sampler at two locations off of Little Tail Point and one standard location north of Oconto River. Sampling occurred at Little Tail every two to ten days from May 11 through June 18, as dictated by wind conditions. Larval yellow perch began appearing in samples on May 26, with peak abundance noted on June 10. Few larval yellow perch and abundant spiny waterfleas (*Bythotrephes*) were noted in samples taken near the Oconto area. All samples were delivered to University of Wisconsin-Milwaukee's Great Lakes Water Institute for identification and analysis.

Beach seining

Due to budget reductions, index station seining was limited in 2009. Seven index sites along the west shore of Green Bay were sampled once in early July using a beach seine (25ft x 6ft, ¼-in delta mesh with 6x6x6ft bag). At each site, one or two 50ft hauls were pulled in perpendicular to shore. The number of YOY retained and escaped from the seine bag when it was placed in a tub was recorded. Catch per effort (CPE) was calculated as the mean number of YOY perch per 100ft seine haul. The mean CPE for all seven sites was 139. It is difficult to compare CPEs to previous years, since 8 sites were deleted from the sampling scheme in 2009. The site with the highest abundance in 2009 was at Suamico which had a CPE of 798 and a high escapement rate (56%).

Mean length of YOY during early July was 37 mm. As expected, escapement rates decreased with larger fish and all YOY ≥ 42 mm were retained in the seine bag. Because many YOY had not yet reached a size where they were effectively captured, our CPE values are probably underestimated. However, a seine with a smaller mesh would be difficult to pull in areas with abundant cladophora. In these locations, retention of small YOY increased because algae clogged the mesh. Spottail shiners dominated the catches followed by YOY yellow perch, banded killifish, and round gobies. A total of sixteen fish species were identified during the survey.

Trawling survey

Annual late summer trawl surveys continued for the 32nd year to monitor trends in yellow perch abundance. Trawling was conducted at 77 out of 78 index sites at 12 locations: 45 shallow sites (established in 1978-1980) and at 32 deep water sites (added in 1988) using a 16-ft semi-balloon trawl with 1½-in stretch mesh on the body, 1¼-in stretch mesh on the cod end, and a cod end liner with ½-in stretch mesh. The net was towed for 5 minutes at a speed of 2.8 knots. Hauls were made during daylight hours. At each of the 12 locations, 100 YOY were preserved when possible and later measured. One index site (LRS4) was deleted beginning in 2009 after the net was hung up on a large boulder in the area.

The average number of yellow perch collected per trawl hour was adjusted based on the amount of habitat that standard and deep sites represent, creating a weighted area average value. The trawling surveys indicated that 2009 produced a strong year class with the relative abundance of YOY yellow perch (1211) ranking as the 4th highest since the deep water sites were added in 1988 (Figure 2).

While the trawling surveys are designed to assess YOY distribution and abundance, yearling and older yellow perch are also measured, weighed, sexed, and aged. Abundance of age-1 and older fish decreased at index sites from 105 in 2008 to 66 in 2009. A majority (79%) of the age-1 and older fish captured were yearlings (2008 year class) with males and females represented near equally. Other common species in order of abundance captured at shallow sites were gizzard shad, white perch YOY, freshwater drum, and trout perch. Deep water trawls were dominated by lake whitefish YOY, adult alewife, trout perch, and round goby.

At each of the 12 locations, a temperature and dissolved oxygen profile is taken along with a secchi disk reading. In 2009, water clarity was at all-time highs in 8 out of 12 locations. Of particular interest was a secchi reading near Green Island off of Marinette (LRD). Secchi readings at this location have ranged from 2.4 to 4.3 m in recent years but in 2009 were 8 m.

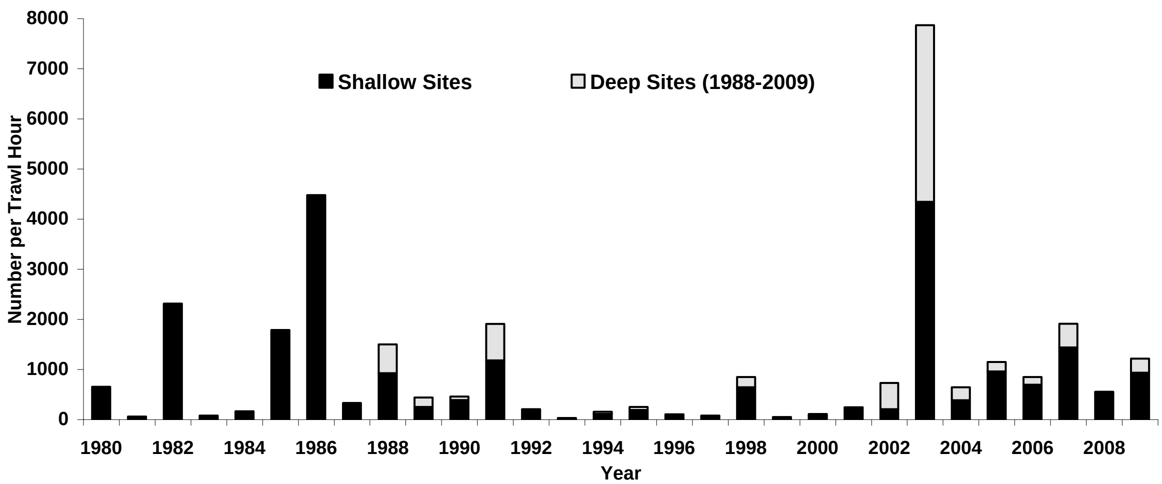


Figure 2. Relative abundance (weighted area average) of young-of-year yellow perch collected during late summer index trawling surveys in Green Bay from 1980 to 2009.

Sport harvest

Sport fishing harvest is estimated from an annual creel survey. Fish obtained through that survey were used to describe the age and size composition of the catch. Open water harvest of yellow perch in 2009 was 204,209 fish (52,630 lbs) compared to196,852 fish (55,922 lbs) in 2008 (Figure 3). The harvest rate (0.17/hr) and catch rate (0.25/hr) of yellow perch in 2009 decreased from 0.22/hour and 0.33/hour, respectively, in 2008. A majority (74%) of the open water harvest was from the 2007 year class, while the 2006 year class comprised approximately 15%. The mean length of open water harvested yellow perch was 7.9 inches (n = 148; SE = 0.1).

Winter harvest is influenced largely by ice conditions, daily bag limits, angler effort, and abundance of adult perch. Since the creel survey began in 1986, angler harvest of yellow perch during winter months has ranged from a high of 2 million fish in 1990 to a low of 6,930 in 2002 (Figure 3). Winter harvest of yellow perch in 2009 (42,782) was lower than the previous three years and slightly below the 12-year harvest average (46,095). Harvest rate for anglers targeting yellow perch fell from 0.64/hr in 2007 to 0.43/hr in 2008 to 0.21/hr in 2009. The 2005, 2006, and 2007 year classes were nearly equally represented, comprising 88% of fish harvested under the ice with a mean length of 8.2 inches (n = 51; SE = 0.2).

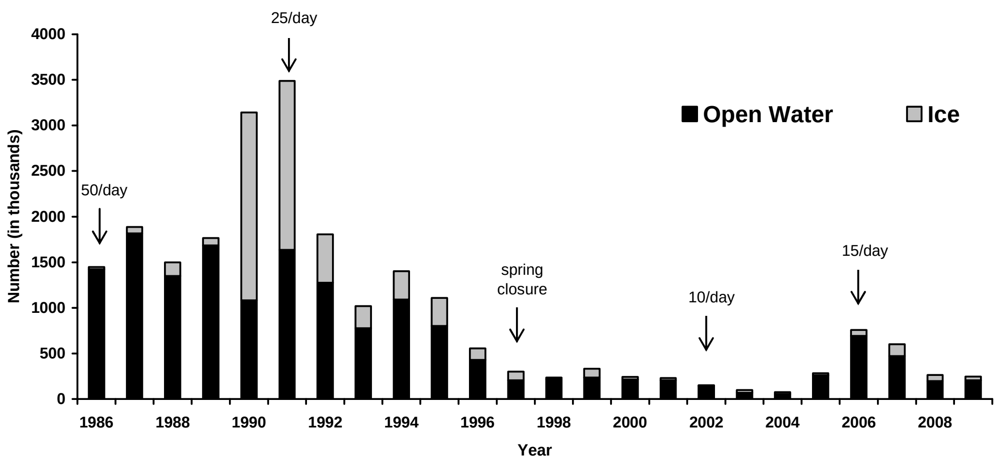


Figure 3. Estimated sport harvest of yellow perch in Green Bay from 1986 to 2009. Regulation changes indicated by arrows.

Commercial harvest

The annual commercial harvest was reported by commercial fishermen who are required to weigh their harvest daily. Fish sampled by WDNR at commercial landings were used to describe the age and size composition of the catch. Since the 1983-1984 commercial fishing license year, the yellow perch commercial harvest in Green Bay has been managed under a quota system. The zone 1 (Green Bay) quota has ranged over the past decade from 20,000 pounds to a high of 475,000 pounds.

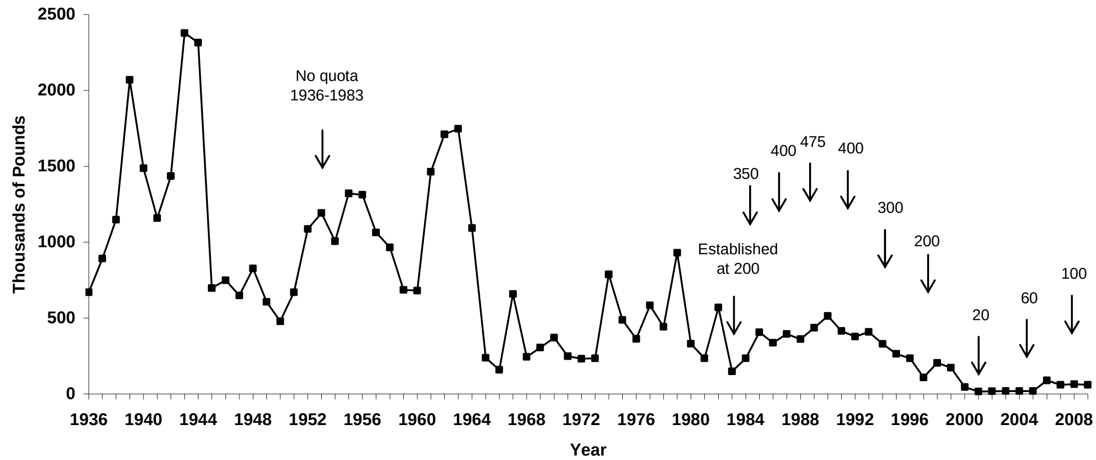


Figure 4. Commercial harvest of yellow perch in Green Bay from 1936 to 2009. Total allowable commercial harvest changes (thousands of pounds) indicated by arrows.

In calendar year 2009, commercial fishers harvested a total of 61,509 pounds using gill and drop nets, compared to 65,401 pounds in 2008 (Figure 4). The total allowable commercial harvest has remained at 100,000 pounds since 2008. The harvest rate (CPE) for gill nets increased slightly from 29 pounds per 1000 ft fished in 2008 to 30 in 2009, while drop net CPE fell from 9.77 pounds per net in 2008 to 3.87 in 2009 (Figure 5). Age-2 perch (2007 year class) made up 60% of the total harvest in 2009, while age-3 and age-4 each comprised 16% and 20%, respectively.

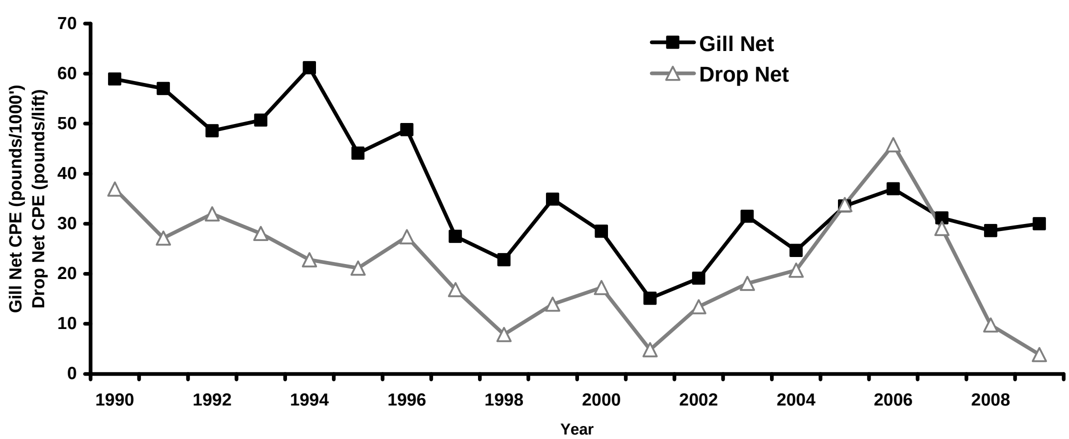


Figure 5. Gill net and drop net catch per unit effort (CPE) of all licensed yellow perch commercial fishers in Green Bay waters, 1990 – 2009. Gill net CPE is in pounds of yellow perch harvested per 1,000 feet lifted. Drop net CPE is in pounds of yellow perch harvested per pot lifted.

Management actions

Wisconsin DNR evaluates a statistical catch-at-age (SCAA) model regarding changes to yellow perch commercial and sport regulations. Presently, WDNR has a policy of allocating yellow perch harvest equally between the sport and commercial fishery over the long term (Figure 6) while protecting the resource from overfishing.

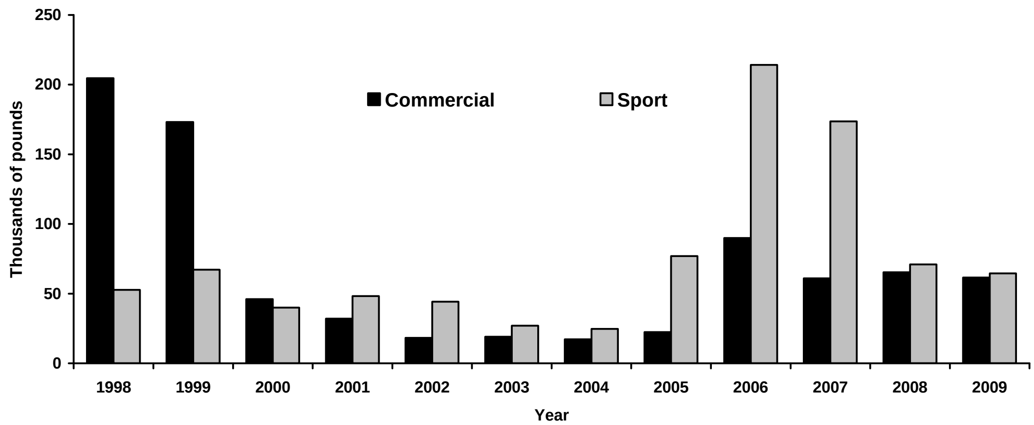


Figure 6. Commercial harvest and estimated sport harvest in Green Bay from 1998 to 2009.

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LAKE MICHIGAN YELLOW PERCH

Pradeep Hirethota

This report is a summary of the status of young and adult perch in Lake Michigan assessed through several annual surveys in Wisconsin waters during 2009-10.

Young-of-the-year Assessment

In southeastern Wisconsin, beach seining was conducted to assess young-of-the-year (YOY) yellow perch. In 2009, we sampled at 15 sites between Kenosha and Sheboygan from August 24, 2009 to September 15, 2009 using a 25' bag seine with ¼" delta mesh. The number of stations at each port city varied from 2 to 5; Kenosha -2, Racine -2, Milwaukee -5, Port Washington -3 and Sheboygan -3. Each station was visited at least twice during the sampling period. Surface water temperature remained in the higher 50s (^{0}F) during most of the sampling period, ranging from 48 to 64 ^{0}F. In the previous years of sampling we have observed water temperature in 70s during the same period. The density of filamentous alga, cladophora, did not inhibit seining at majority of the sites. However, many sites in Kenosha and Racine area had significant algal growth on the bottom that clogged up the seine. A total of 5,800 ft of seine haul at fifteen stations produced only 7 YOY yellow perch. The over all catch per effort (CPE) of YOY yellow perch in the southern Lake Michigan was much lower in 2009 (CPE= 0.12) compared to 2008 (CPE=3.05). The CPE is calculated as the mean number of YOY perch per 100ft. seine haul. This number is used as an index of year-class strength. The average total length of the YOY perch caught in 2009 was 37 mm which is much lower than the previous year (52.7 mm). Figure 1 shows the catch per effort of YOY yellow perch for the sites in the Southeast Region (SER) since 1989. In recent years, 2005 and 2007 surveys produced higher YOY yellow perch with CPEs of 39 and 34, respectively. A total of thirteen species of fish (young and adult) were documented during the survey. Alewife dominated the catch followed by spottail shiner and longnose dace.

In addition to a standard bag seine used to sample at fifteen sites, two index stations - Wind Point and Doctors Park - were selected for setting micromesh gillnet. The nets were set (from 9/15/2009 to 10/21/2009) using an inflatable boat on a calm day at depths ranging from 5 to 10 feet and fished over night. We used a 100-foot long and 5 feet deep net made of 12mm stretch mesh. Each lift at each station consisted of two gangs of 100 ft net (200ft total). Two lifts were taken at each index station. A total of eight species of fish were captured in these nets. The average total length of YOY perch caught in the gillnet was 57.7 mm in 2009, which was smaller when compared to 61.5 mm average length in 2008. The catch per 100 ft of gill net (CPE) was also lower in 2009 (1.3 YOY) when compared to 2.6 YOY yellow perch in 2008. The CPEs from 2005, 2006 and 2007 were in the order of 195, 61 and 11 YOY yellow perch per 100 ft of gillnet. It is possible that the cold upwelling water in the nearshore area may have some influence on the poor number of YOY yellow perch captured both in seining as well as gillnetting effort.

Spawning Assessment

This assessment has been conducted since 1990 on the Green Can Reef and in the Milwaukee Harbor (Table 1). The objective is to quantify the relative abundance of mature female perch in previously identified spawning areas. In spring 2009, we took four samples from May 19th to June 10th. The effort varied from 500ft (1 box) to 1000ft (2 boxes) of gillnet in each lift. Each box of 500 ft gillnet consisted of 2, 2.5, 2.75, 3.0 and 3.25 inch mesh (100 ft each panel). The nets were set at depths ranging from 30ft to 59ft, and allowed to fish overnight. The bottom water temperature ranged from 48 ^{0}F at the beginning of the sampling period to 52 ^{0}F at the end of the sampling period. The majority of females caught were still green until June 2nd. The fourth lift on June 10th had 55% of spent female and 91% of spent male perch indicating peak spawning activity. The bottom temperature had reached 52 ^{0}F at this time. A total of 629 adult yellow perch – 465 male and 164 female - were caught in four lifts totaling 3,500 ft of gillnet. When compared to the previous years, the total number of perch caught in 2008 and 2009 spawning assessment was much lower (Table 1) even though effort was nearly doubled. The main difference was the dramatic decline in the proportion of male perch in the catch. A subsample of 100 yellow perch was aged; the ages ranged from 3 to 11 years. 2002 (age 7) and 2005 (age 4) year-classes comprised the majority of perch followed by 1998 year-class (age 11) (Figure 2).

Yellow perch egg deposition survey was conducted by the WDNR dive team on June 9th, June 15th and June 23rd. The divers counted 222 egg masses resulting in 5.8 egg mass per 1000 square meters (Figure 3) which is lower compared to 10.81 egg mass per 1000 square meters found in 2007 survey, but much better than 2008. The overall number of spawning perch on the reef has dropped since 2008.

Graded Mesh Gill Net Assessment

The WDNR conducts standardized graded mesh gill net assessments annually in winter months, in grids 1901 and 1902 off Milwaukee. The mesh sizes used in these assessments run from 1 to 3.25 inches stretch on 1/4 inch increments. Yellow perch begin to recruit to this assessment gear by age 2 and are almost fully recruited by age 3 (Figure 4). Four lifts with a total effort of 16,000 ft gillnet (20 boxes of 800 ft each) were taken on12/02/2009, 12/8/2009, 12/15/2009 and 12/16/2009 at depths ranging from 50ft to 76ft.

Table 2 shows the relative abundance as catch per effort of perch, by age, for this assessment from 1995 through 2010. The data show variability in catch rates by calendar year. These data show very low CPEs of younger fish and higher CPEs of older fish until 1998 (dominated by male perch). However, data on age and size distribution of yellow perch from 1999 onward represented smaller and younger perch in significant proportions, essentially from 1998 year-class (Table 2). The 1998 year-class perch comprised the major portion of the population for a number of years, and is gradually declining in the catch.

In our 2010 winter graded mesh assessment we documented multiple year classes. The 2005 year-class yellow perch (age 5) emerged as a dominant group comprising 40% (Figure 5) followed by the 2002 year-class (14%) and the 1998 year-class (14%). The 1998 year-class is no more the dominant player. The majority of large male and female perch that belonged to 1998 and 2002 year-classes were captured in 3 inch to 3.25 inch stretch mesh. In addition to the above three year classes, 2006, 2003 and 2007 year-classes also comprised substantially with 7.8%, 7.7% and 6.4%, respectively.

Since 2000 the sex ratio of the yellow perch population was shifted toward predominantly female and lasted until 2002. This trend is reversed again since 2003 with greater number of males, except for 2007. But in 2009 and 2010 surveys, the female proportion has increased markedly with 60% and 71%, respectively. The data from 2008 and 2009 spawning assessment also indicated a decreased number male perch in the population. An absence of commercial harvest in Lake Michigan certainly has helped decrease the impact on fast growing larger female perch in the fishery, allowing them to spawn multiple years.

Harvest

In September 1996, the commercial yellow perch fishery was closed in the Wisconsin waters of Lake Michigan. Hence, the information on commercial harvest is limited up to 1995 catches. Sport harvest is monitored by a contact creel survey. The sport bag limit has been reduced to five fish per day since September 1996, which is reflected in the total harvest (Table 3). Our creel survey data on the sport caught yellow perch in 2009 indicated that the sport harvest was more than doubled compared to 2008 harvest. The overall harvest in Lake Michigan increased from 20,000 perch in 2008 to 51,000 in 2009. In general, the lakeshore counties – Milwaukee, Racine and Kenosha accounted for 97% of the harvest. The main reason for the dramatic increase is the strong 2005 year-class reaching harvestable size combined with good weather conditions. The average size of sport caught 4-year-old perch was 250 mm.

The 2005 year-class yellow perch recruited to the fishery as 3-year-old fish continued to dominate the sport catch in 2009 replacing the 1998 year-class. In 2009 sport harvest, the 4-year-old 2005 year-class yellow perch comprised 60% of the catch followed by 2003 (12%) and 2002 (10%) year-classes. The 1998 year-class, which was the dominant year-class for many years is now reduced to only 3.7% in the sport harvest. Recent data from the winter graded mesh assessment also indicated a strong 2005 year-class in the population which may continue to support a good sport fishery in the years to come.

Management Actions

All yellow perch assessments and harvest data from the Wisconsin waters of Lake Michigan show weak year classes beginning with the 1990 year class. However, in recent years, the 1998 year-class was the strongest year-class supporting the fishery. Recent data indicate that the 2002, 2003 and 2005 year-classes comprise substantial numbers in the population. 2005 year-class has emerged as a dominant year-class in recent years. These observations are consistent with data collected by other agencies throughout the lake. Effective September 1996 commercial fishing was closed in the Wisconsin waters of Lake Michigan and daily sport bag limit was reduced to 5 fish. Effective May 2002, the sport fishery for Lake Michigan yellow perch is closed from May 1 to June 15. These rule changes are implemented to benefit perch population recovery by reducing impact on spawning stocks, and allowing mature adults to spawn multiple years in their life time. Presence of multiple year-classes in the spawning population as well as in the sport harvest is a positive change. The current regulation will remain in effect until a detailed analysis is complete on the status of yellow perch population. The Yellow Perch Task Group is working with a research team on developing a Statistical Catch at Age model to help guide management actions.

Table 1. Yellow perch spawning assessment in Milwaukee waters (Green Can Reef) of Lake Michigan.

Year	Total	Males	Females	Sex-unknown	% Females	Total effort[1]
1995	1,272	1,233	39	0	3	17,000[2]
1996	4,674	4,584	90	0	2	14,400
1997	14,474	14,417	46	11	0.32	5,000[3]
1998	4,514	4,283	231	0	5.1	24,600[4]
1999	5,867	5,635	232	0	4	9,200
2000	855	722	133	0	15.5	3,700
2001	1,431	993	438	0	31	5,400
2002	1,812	1,645	167	0	9.2	2,500
2003	1,609	1,583	26	0	1.6	1,700
2004	1,143	997	144	0	12.6	2,100
2005	1,271	1,207	64	0	5	2,000
2006	1,741	1,580	161	0	9	2,500
2007	2,132	2,076	56	0	3	2,000
2008	326	209	117	0	35.9	4,000
2009	629	465	164	0	26	3,500

[1] effort = length of gill net in feet
[2] includes 7,000 feet of standard 2 1/2" mesh commercial gill net
[3] in addition to this 5,000' of commercial gill net, double-ended fyke nets were used
[4] in addition, 11 lifts of contracted commercial trap net and 4 lifts of fyke nets were used

Table 2. Catch per Effort (fish/1000ft./night), and the percent of each sex, of yellow perch caught in standardized assessment graded mesh gill net sets conducted in January each year, WDNR, Lake Michigan Work Unit.

Age	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	42	323	1	0	2	3	0	3	40	3	2	6
3	4	2	57	65	243	4	0	1	61	29	24	159	50	43
4	14	6	215	9	20	118	0	0	12	249	60	7	282	56
5	11	29	93	27	2	4	33	1	0	37	204	46	6	287
6	18	35	57	2	2	3	0	27	11	0	31	120	59	33
7	77	20	45	0	1	1	0	1	226	23	4	16	139	52
8	251	43	63	8	2	0	0	0	6	417	20	7	18	94
9	109	110	44	9	1	0	0	0	0	7	113	7	12	8
10	15	60	33	11	1	0	0	0	0	0	0	69	5	26
11	0	15	9	1	1	1	0	0	0	0	0	1	78	0
12	0	4	7	0	0	1	1	1	2	0	0	0	2	6
%M	89	80	58	36	36	38	52	60	64	53	48	51	40	29
%F	11	20	42	64	64	62	48	40	36	47	52	49	60	71

Note: Aging of yellow perch changed from scales to spines starting in 2000 to be consistent with Green Bay methodology.

Table 3. Reported commercial Lake Michigan yellow perch harvest (excluding Green Bay), in thousands of pounds, and sport harvest, estimated in thousands of fish, by calendar year.

Year	Commercial harvest (lb. x 1000)	Sport harvest (number x 1000)
1995	128	214
1996	15[a]	41[b]
1997	Closed	27[b]
1998	Closed	36[b]
1999	Closed	23[b]
2000	Closed	16[b]
2001	Closed	121[b]
2002	Closed	88[b]
2003	Closed	66[b]
2004	Closed	42[b]
2005	Closed	33[b]
2006	Closed	68[b]
2007	Closed	66[b]
2008	Closed	20[b]
2009	Closed	51[b]

[a] commercial yellow perch fishery was closed effective September 1996
[b] sport bag limit was reduced to 5/day effective September 1996
(Note: Sport harvest data includes Moored boat catch since 1989)

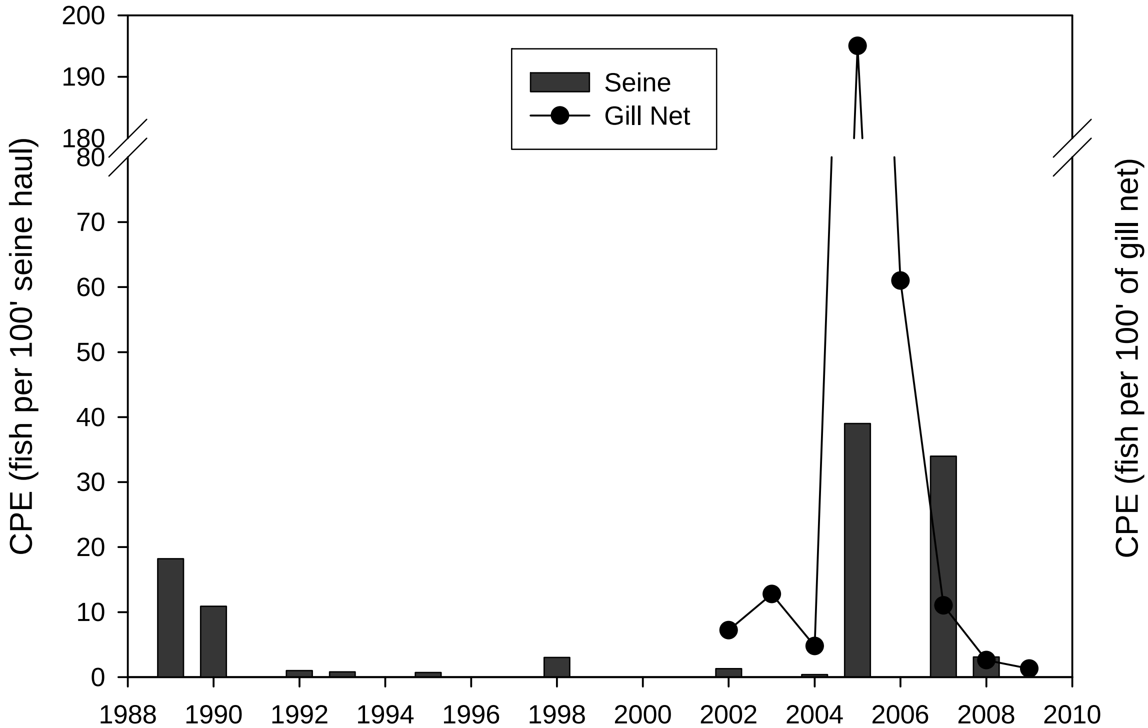


Figure 1. CPE (fish/100’) of YOY yellow perch in summer beach seining and graded mesh gillnetting.

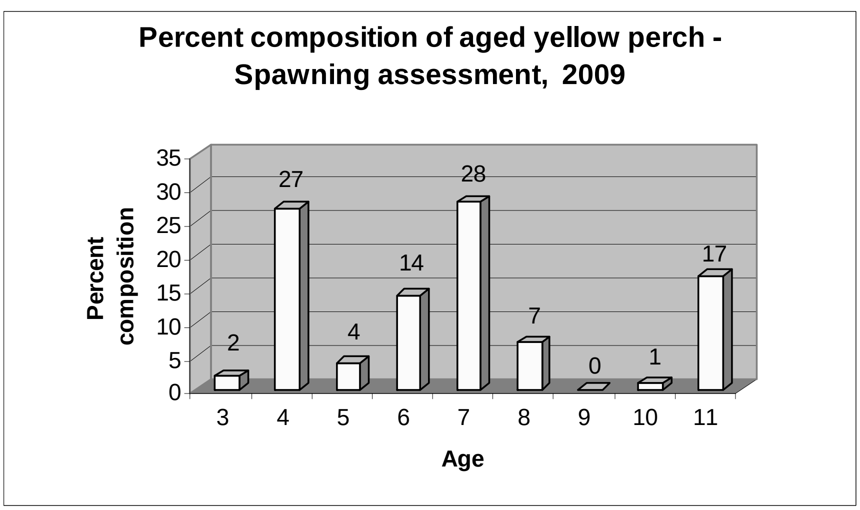


Figure 2. Composition of different age groups in the yellow perch spawning assessment on the Green Can Reef off Milwaukee in Lake Michigan, 2009.

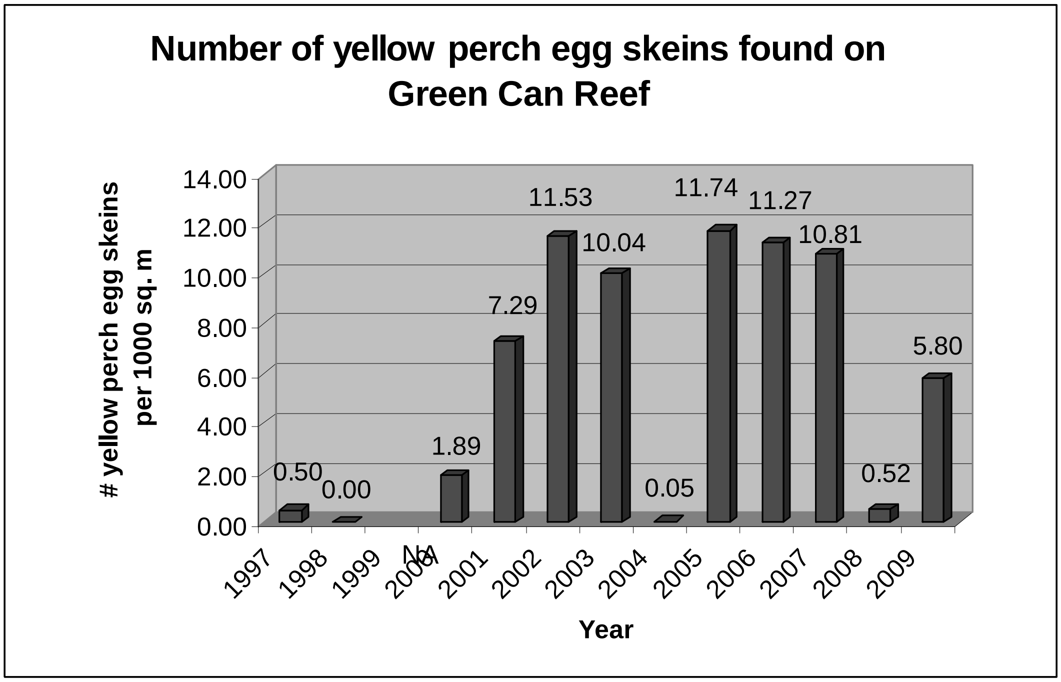


Figure 3. Yellow perch egg deposition survey in Lake Michigan, WDNR.

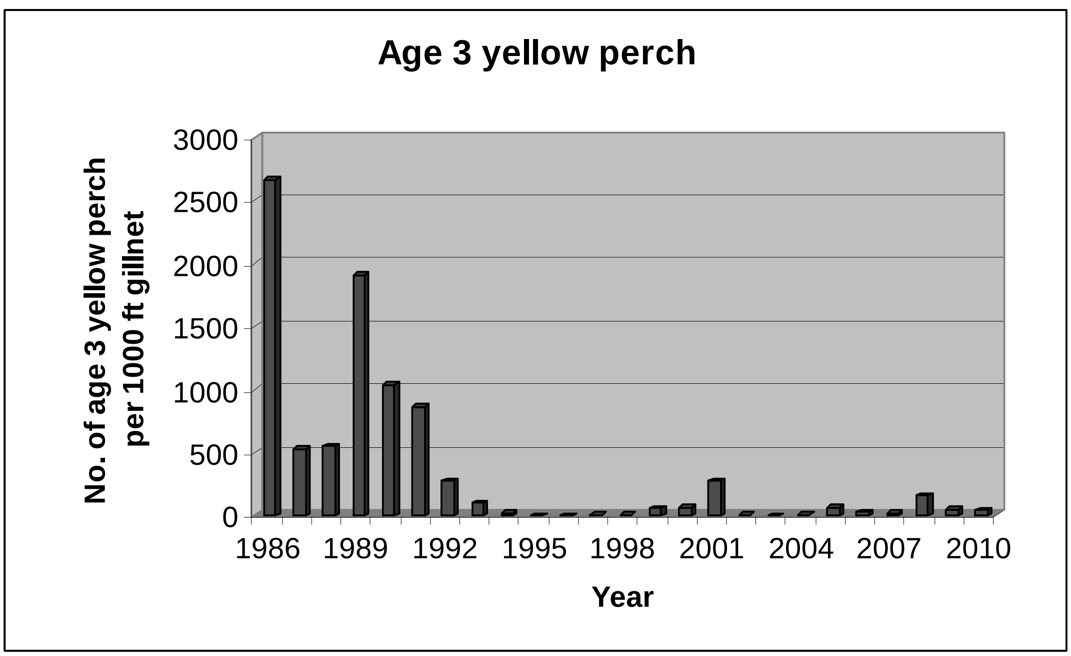


Figure 4. Age 3 yellow perch year-class strength (computed to 1000 ft of gillnet) in the winter graded mesh gillnetting assessment in Lake Michigan.

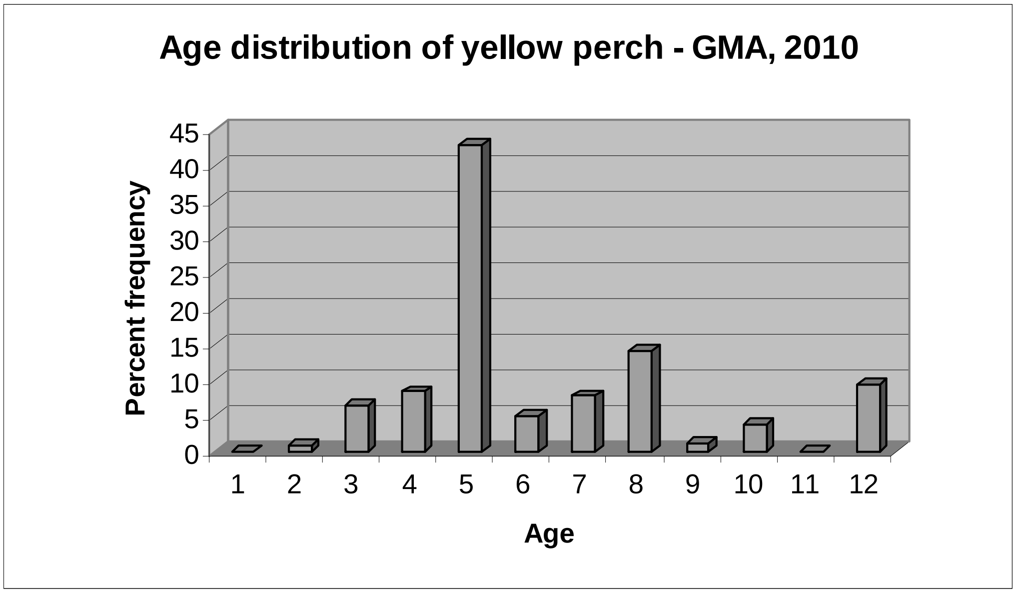


Figure 5. Age distribution of yellow perch in the winter graded mesh gillnetting assessment (GMA) in Lake Michigan, 2010.

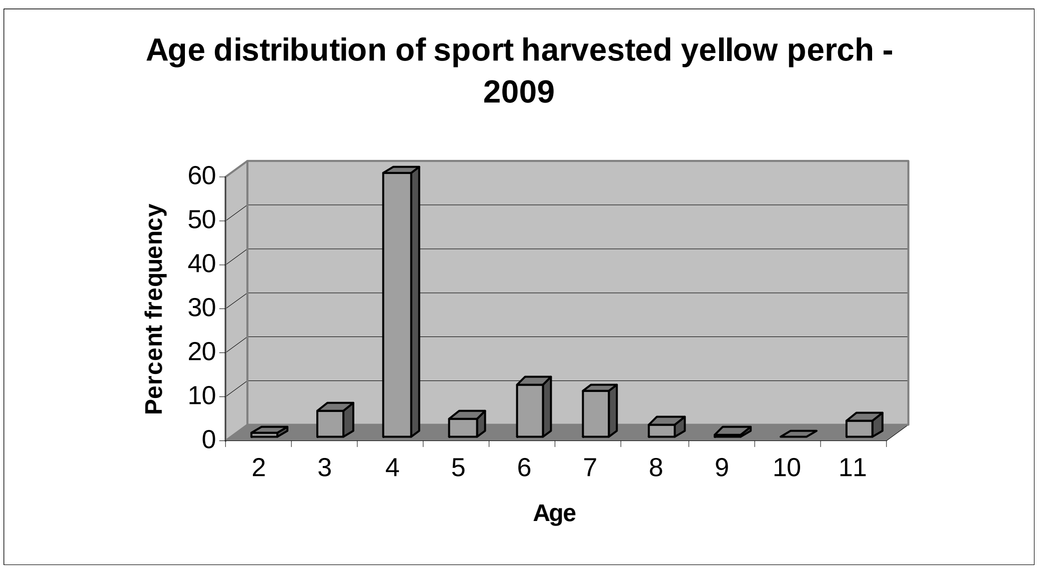


Figure 6. Age distribution of sport harvested yellow perch in Lake Michigan.

WALLEYE IN SOUTHERN GREEN BAY

David Rowe and Rodney Lange

Background

Walleye stocks in southern Green Bay were decimated during the early to mid 1900s by habitat destruction, pollution, interactions with invasive species, and over-exploitation. At one point, only the Menominee River supported a spawning stock (Schneider et al. 1991). The water quality and fish community of southern Green Bay began to improve by the mid 1970s after the passage and enforcement of the Clean Water Act (1972). Rehabilitation of walleye stocks by the Wisconsin Department of Natural Resources began during 1973 with the stocking of fry and fingerlings into the Sturgeon Bay area. Stocking began in the lower Fox River (downstream from the De Pere Dam) during 1977. Stocking (fingerlings and fry) was so successful in southern Green Bay and the lower Fox River that it was discontinued in 1984 to allow for surveys of natural reproduction and recruitment.

Spring fyke net surveys that targeted spawning walleyes were conducted in the Sturgeon Bay area of Green Bay during 1982-1996 and in the lower Fox River below the De Pere Dam during 1981-1984 and 1987-2004 (Kapuscinski et. al 2010). The lower Fox River spring fyke net survey was discontinued after 2004 because the walleye stock was considered to be self-sustaining for about two decades and resources were required for other surveys. Electrofishing index surveys were conducted on southern Green Bay (during August or early September 1990-2009) and the lower Fox River (during late October or early November 1991-2009). These surveys were designed to target young-of-year (YOY) walleye and other gamefish. We plan to continue these index electrofishing surveys in the future.

The results of previous studies suggest that Green Bay walleye stocks are in small areas and are quite discrete (Schneider et al. 1991). The walleye stock in southern Green Bay and the lower Fox River is likely distinct from other stocks in Green Bay, but genetic analysis is needed to verify this assumption. Walleye spawner abundance and YOY production have been variable since monitoring began, but the stock has not been augmented through stocking since 1984 and is considered self-sustaining. The purpose of this report is to summarize data collected during the 2009 field season on the southern Green Bay / lower Fox River walleye stock, and to describe long-term trends in YOY production and angler catch and harvest.

Fall electrofishing index surveys

Recruitment of YOY walleye

Results of our 2009 electrofishing index surveys show that relative abundance of young of the year (YOY) walleye at the fall fingerling stage was above average for the Fox River (Figure 1) and indicates a strong year class for 2009. The 2009 age 0 catch per unit effort (CPUE) from the Fox River was 28.8 YOY/hour of electrofishing which is well above the 15 year average of 11.6 YOY/hour. The Lower Green Bay catch was 3.4 YOY/hour, which is below the 15 year average of 8.2 YOY/hour. The difference between the bay catch rate and the river catch rate may be attributed to warmer than normal temps at time of sampling the bay. Stable water temperatures and the extended warming period during the 2009 spawning and hatching periods likely provided good conditions resulting in a very strong year class (Hansen et al. 1998). The abundant YOY gizzard shad population provided ample forage and likely resulted in better than normal growth for the YOY walleyes and the mean length of YOY walleye was 224 mm as compared to 175mm in 2008. Year-class failures have not been observed in more than two consecutive years during 2001-2009 (Figure 1).

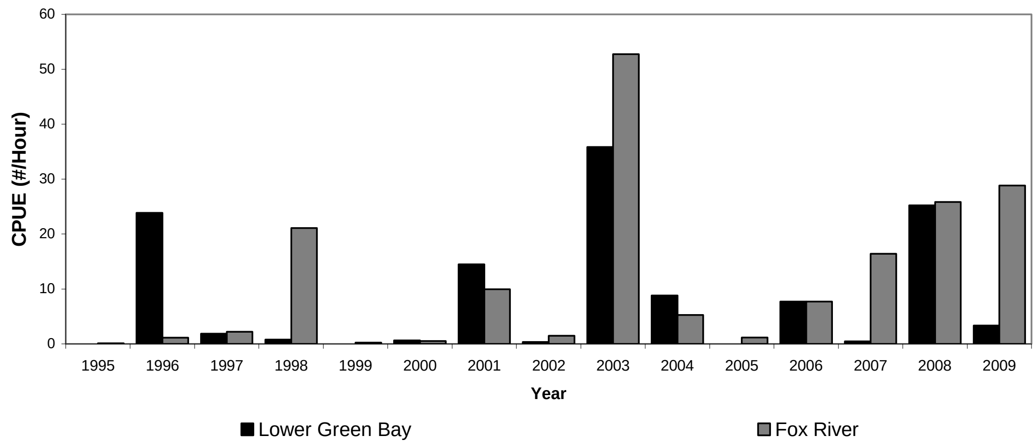


Figure 1. Relative abundance of young-of-year walleye in the lower Fox River (DePere Dam to mouth), lower Green Bay (south of a line drawn from Longtail Point to Point Sable), as measured by catch per unit effort (CPUE; number per hour) from data collected in electrofishing index surveys during 1995-2009.

Walleye stock size and age structure

In 2009, 950 walleye were captured during our electrofishing index surveys that averaged 354 mm in total length (range 143-705mm). The length-frequency distribution of captured walleye indicates that the stock's size structure was not negatively affected by year-class failures, low recruitment, slow growth, or excessive mortality (Figure 2). Spines were collected from a stratified subsample (n=167) and ages were estimated by cross sectioning and counting annuli. An age-length key was used to assign ages to un-aged individual fish by proportion of known aged fish at length from the sub-sample (Iserman and Knight 2005). Both the YOY fish from 2009 and the strong year class of 2008 are evident as modes at 220mm and 330mm respectively. The very strong 2003 year class was still well represented, but the 2005 year class was poorly represented (Figure 3).

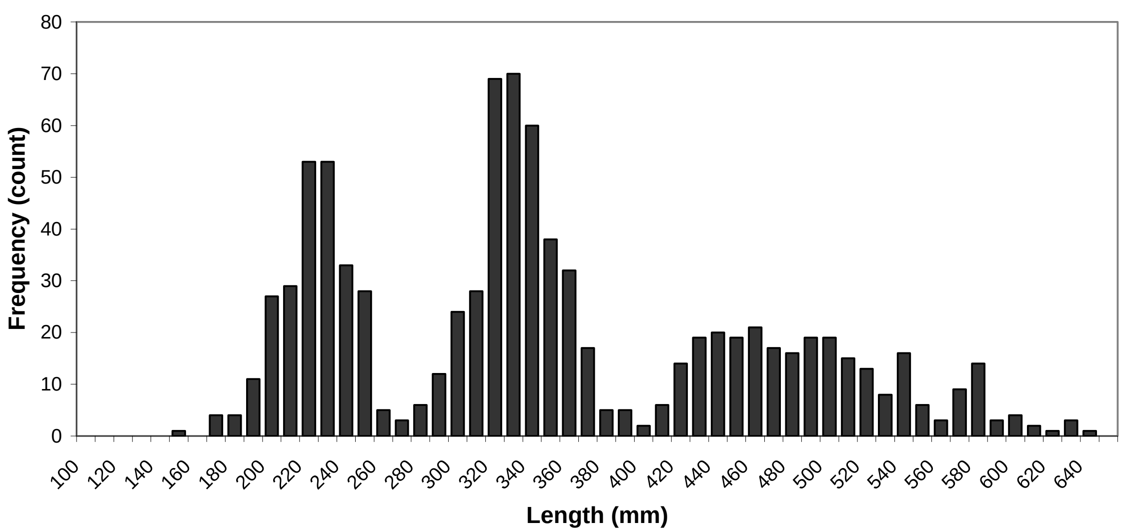


Figure 2. Length-frequency distribution of walleye sampled while electrofishing Green Bay and the lower Fox River during 2009.

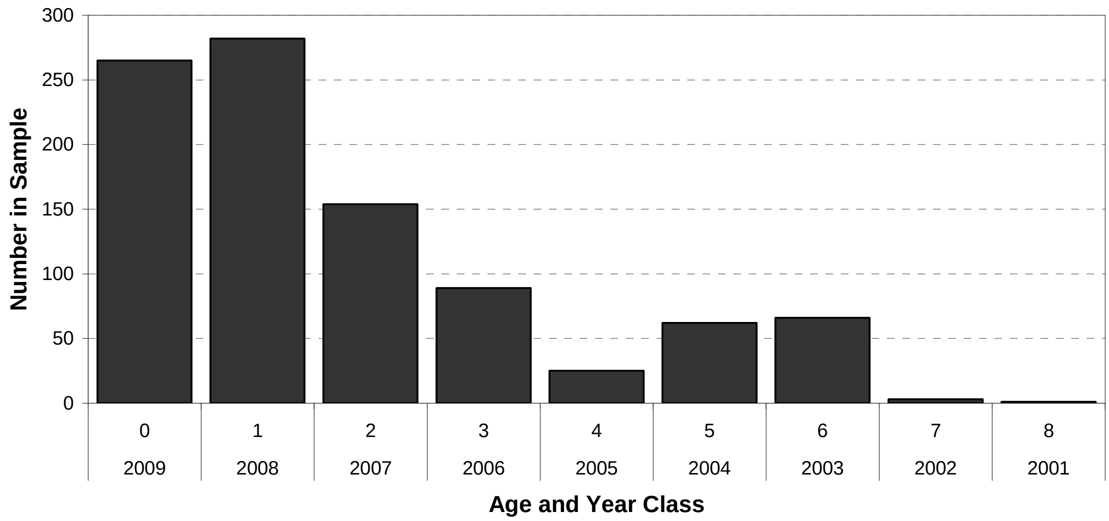


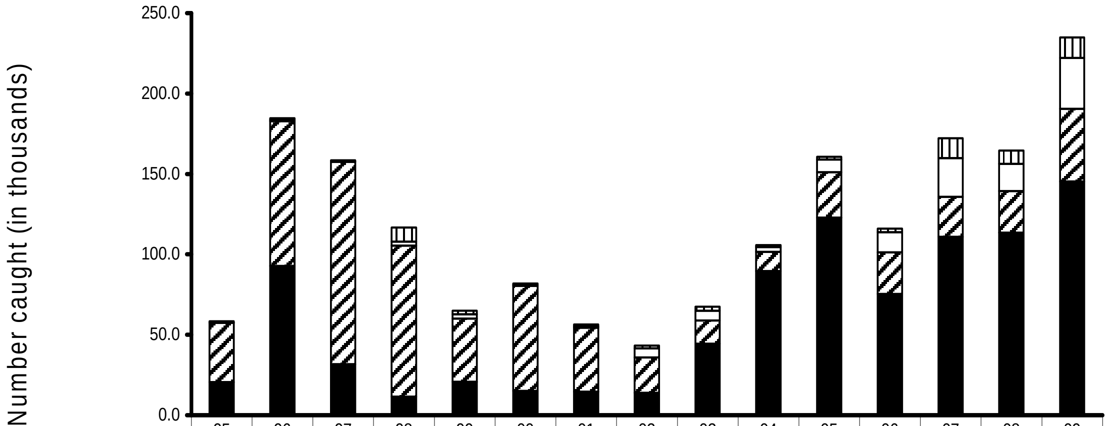
Figure 3. Estimated age-frequency distribution of walleye sampled while electrofishing Green Bay and the lower Fox River during 2009.

Catch and Harvest

Total catch of walleye from Wisconsin waters of Green Bay was estimated at 234,872 during the 2009 open water season (March –October 31), this was a 42% increase from the estimated 164,601 caught during 2008 (Figure 4). This was two times greater than the average estimated walleye catch for the last 15 years of 117,396 and the largest estimated catch since the Lake Michigan Creel survey began in 1986. The total catch of walleye increased in all counties surrounding Green Bay.

Total open water season harvest of walleye from Wisconsin waters of Green Bay increased from 47,820 during 2008 to 83,425 during 2009 (Figure 5). Harvest increased in all counties during 2009 compared to 2008, except for a slight decrease in Door and Kewaunee counties. Brown County and the lower Fox River had a large increase in harvest of 67%. The average size walleye harvested was 21.2 and the most common size in the creel was 23 inches, likely from the dominant 6 year old 2003 year class (Figure 6).

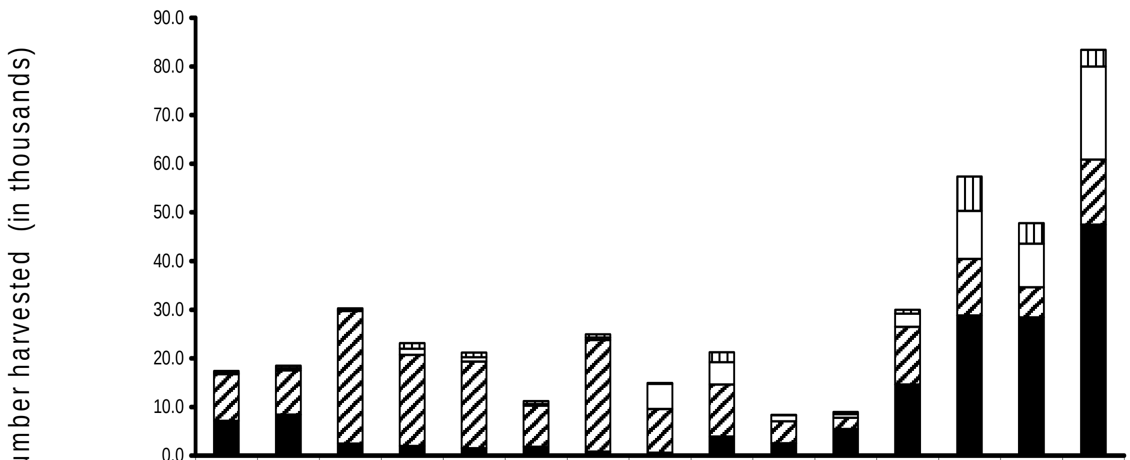
The walleye catch has been relatively high for the last five seasons, with the greatest contribution to the catch from the lower Fox River and Brown County waters of Green Bay. This is likely attributable to the very strong and abundant year class of 2003 (Figures 1 and 3). Angler attitudes appear to be changing, and anglers are harvesting higher numbers of walleyes from Brown County waters. This may be in response to the decrease in PCB contaminant levels and the increased size of fish available for consumption based on consumption guidelines (WDNR 2009). However, the relationship between catch and harvest of walleye from Green Bay is likely complicated by anglers: 1) targeting trophy walleye, 2) catching walleye during the spring season with a one fish daily bag limit, 3) practicing catch and release, or 4) some combination of these three scenarios.



	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Door/Kewanee	0.6	1.0	0.5	8.8	2.2	0.8	1.2	1.5	2.6	1.1	1.7	2.2	12.5	8.3	12.8
Oconto	0.4	0.9	0.4	2.5	2.7	0.7	0.8	5.9	6.1	3.1	7.9	12.5	24.1	16.9	31.6
Marinette	36.8	89.9	125.9	93.9	39.2	65.3	39.9	21.9	14.3	11.8	28.1	25.8	24.9	25.8	45.1
Brown	20.6	92.9	31.7	11.5	20.8	15.1	14.6	13.9	44.6	89.7	122.9	75.4	110.9	113.5	145.4

Year

Figure 4. Estimated total open water season (March-October) walleye catch from Wisconsin waters of Green Bay and the lower Fox River by county during 1995-2009.



	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09
Door/Kewanee	0.4	0.5	0.3	1.2	1.0	0.6	0.6	0.2	2.1	0.0	0.4	0.7	7.1	4.2	3.4
Oconto	0.2	0.4	0.2	1.2	0.9	0.3	0.5	5.1	4.6	1.3	0.8	2.7	9.9	9.0	19.2
Marinette	9.5	9.1	27.3	18.8	17.8	8.5	23.0	9.0	10.7	4.5	2.3	11.9	11.6	6.2	13.4
Brown	7.2	8.5	2.5	2.0	1.5	1.8	0.8	0.6	3.9	2.6	5.5	14.6	28.9	28.4	47.5

Year

Figure 5. Estimated total open water season (March-October) walleye harvest from Wisconsin waters of Green Bay and the lower Fox River by county during 1995-2009.

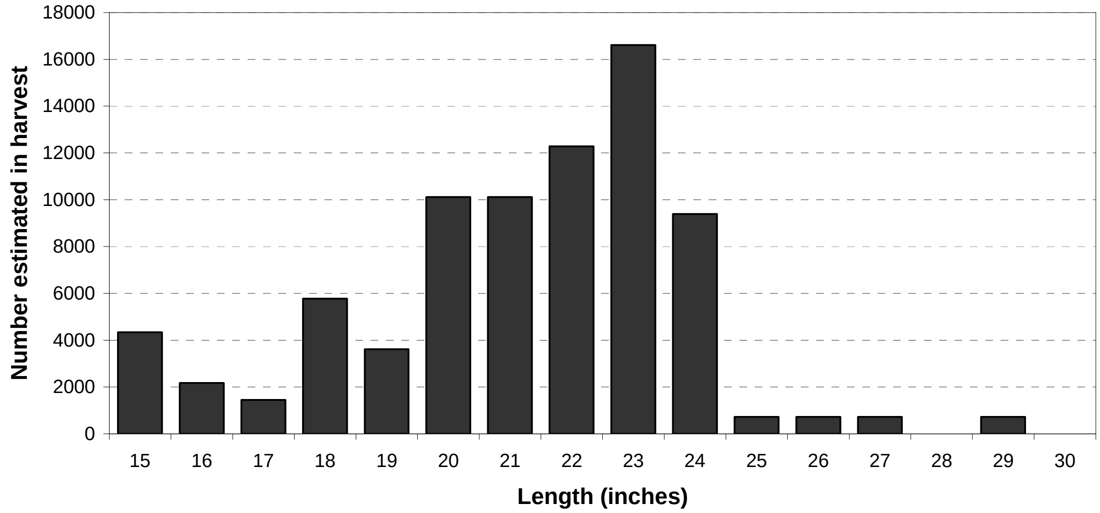


Figure 6. Estimated size distribution of 2009 open water season (March-October) walleye harvest from Wisconsin waters of Green Bay and the lower Fox River.

The Future of the Sport Fishery

The future of the southern Green Bay/lower Fox River walleye stock and sport fishery appears to be very promising. The size structure of the population indicates that a good proportion of the stock is at or above quality size, and mortality is not excessive at any size. Furthermore, year-class failures have not been observed in more than two consecutive years during 1994-2009. The back to back 2008 and 2009 year classes will recruit to the fishery in the next couple of years and maintain the abundance of fish. However, there will be a noticeable shift downward in the population size structure as the 2003 year class is continued to be reduced through harvest and the younger and smaller ‘08 and ‘09 year classes take their place. Harvest will be continued to be monitored in relation to PCB contamination levels. As contaminant levels continue to decrease, harvest will likely continue to increase.

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GREAT LAKES MUSKELLUNGE

David Rowe

Background

The Wisconsin Department of Natural Resources (WDNR) in cooperation with several local musky clubs and the Musky Clubs Alliance of Wisconsin initiated a Great Lakes strain muskellunge reintroduction program in 1989 in the Green Bay waters of Lake Michigan. Muskellunge in southern Green Bay were decimated during the early to mid 1900s by habitat destruction, pollution, and over-exploitation (Kapuscinski 2007). The need to re-establish a native inshore predator fish species has been identified in several planning efforts including the Lake Michigan Integrated Fisheries Management Plan and the Lower Green Bay Remedial Action Plan (Lake Michigan Fisheries Team 2004, WDNR 1986).

A three-phase plan was drafted by WDNR biologists to re-establish a self-sustaining population of muskellunge in Green Bay: (1) identify and appropriate egg source, obtain eggs, and successfully hatch, rear and stock fish, (2) establish an inland lake broodstock population, and (3) develop a self sustaining population in Green Bay. Phase 1 included the collection of gametes from the Indian Spread Chain in the lower peninsula of Michigan, a tributary system to Lake Huron. In cooperation with the Michigan DNR, gametes were collected and brought to the Wild Rose Fish Hatchery from 1989-1993. In 1997, additional spawn was collected from Lake St. Clair to increase the genetic diversity of the population.

Phase 2 was initiated with the stocking of muskellunge fingerlings into Long Lake in Waushara County, Wisconsin from 1989-1992. From 1995-2001, Long Lake was the main brood source for the reintroduction effort. In 2002 the WDNR discontinued the use of Long Lake as a broodstock lake. In April of 2009, three new inland lakes were stocked with muskellunge from Georgian Bay, Lake Huron, in order to establish brood populations.

To date there has been no significant amount recruitment from natural reproduction of muskellunge documented in Green Bay or the Lower Fox River. However in 2008, two young of the year muskellunge were collected from the Lower Menominee River, and in 2009 young of the year muskellunge were captured in both the Lower Menominee River and in Sturgeon Bay. Tissue samples have confirmed these individuals are the progeny of Great Lakes spotted muskellunge, the first evidences of natural reproduction.

Current Status

Current assessment of the Green Bay muskellunge population includes spring fyke netting and fall electrofishing. Spring netting was conducted in 2009 from April 24th through May 14th. A total of 94 net nights were fished and 197 muskellunge were captured ranging in size from 914mm (36in) to 1289mm (50.75in, Figures 1 and 2). The average daily catch rate was 2.5 fish per net night. The mean size of fish has continued to increase as this re-established population continues to mature (Figure 1). The average fish length was 1105mm (43.5in); in 2008 the average was 1085mm (42.7in). Twelve fish were larger than 1270mm (50in) and 30 fish were larger than 1219mm (48in). Male fish appear to recruit to the population sooner, but female fish grow faster and attain larger ultimate size (Figure 2).

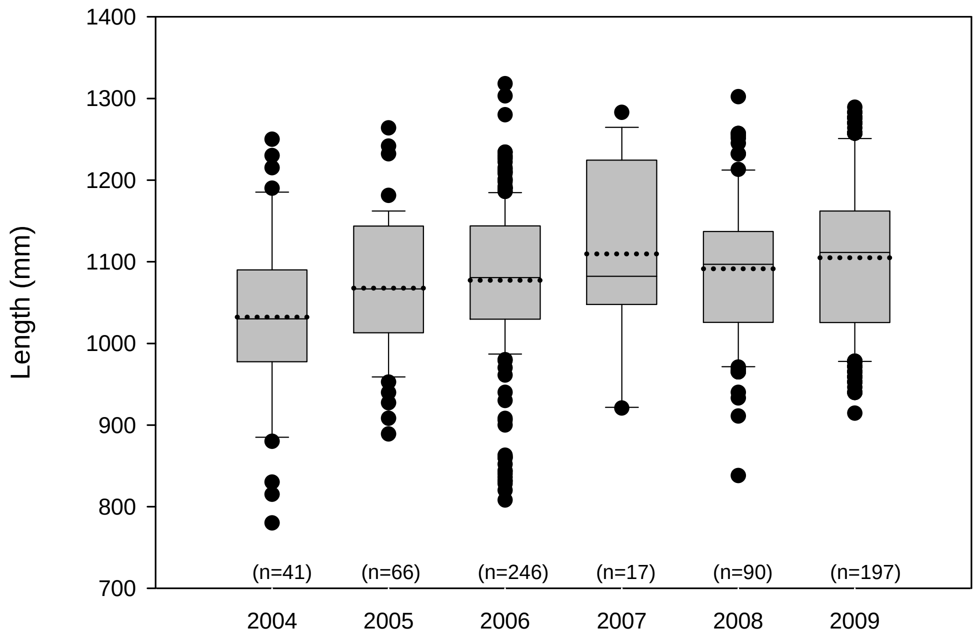

Figure 1. Length distributions of muskellunge captured during spring netting surveys of the lower Fox River from 2004-2009. The shaded box is defined as the upper and lower quartiles with the median described by the solid line in the box and the mean by the dotted line. The whiskers represent the 10th and 90th percentiles of the distribution.

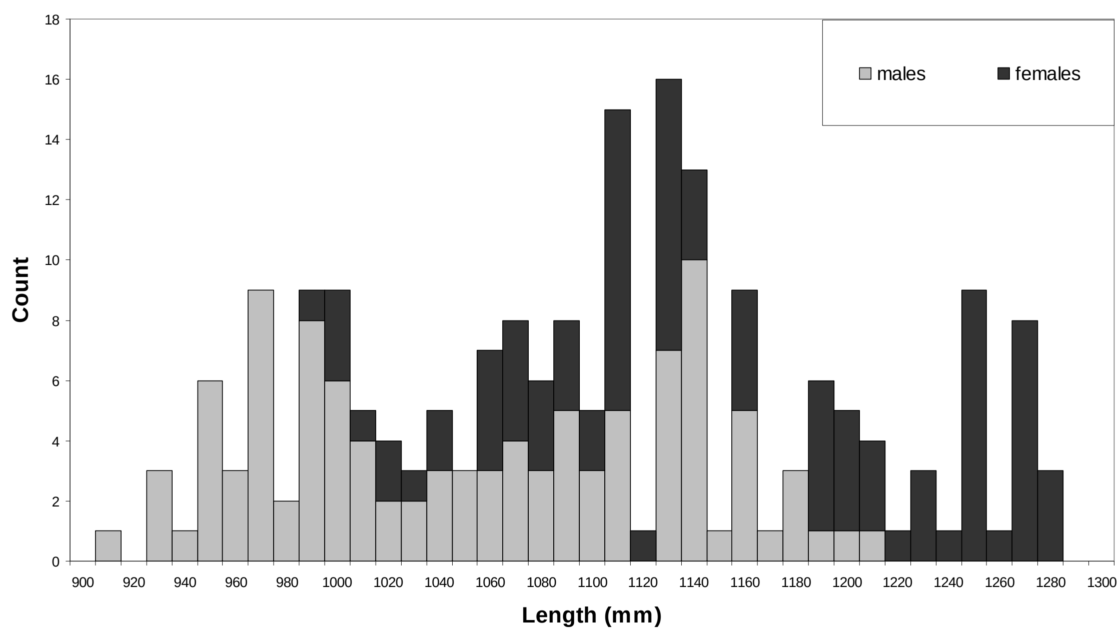

Figure 2. Length frequency distribution of Great Lakes Spotted muskellunge, by sex, from spring 2009 netting of the Lower Fox River and Green Bay.

Nighttime electrofishing surveys have been conducted along the length of the Fox River from the mouth to the DePere dam during the last week of October to index walleye and muskellunge populations. In

2009, 20 muskies were captured ranging in size from 813mm (32in) to 1200mm (47.2in), during 7.7 hours of effort over three evenings. The average length of an adult fish was 1035mm (40.7 in). Adult muskellunge catch per unit of effort (CPUE) was 2.6 fish per hour (Figure 4). The CPUE in the fall index sampling has steadily increased over the past eight years, suggesting a growing population, likely as a result of the increases in stocking.

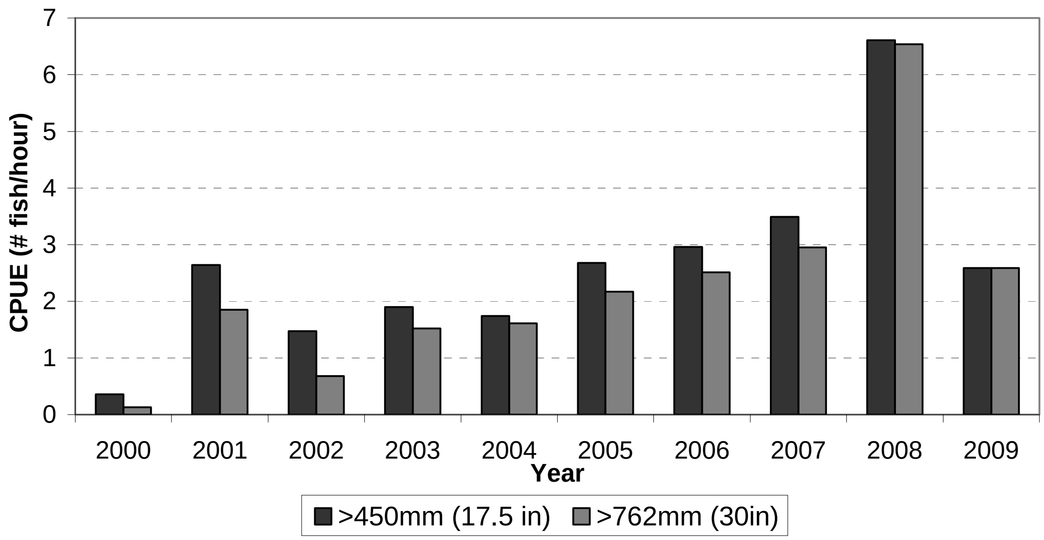

Figure 3. Catch per Unit Effort (CPUE) from night time electrofishing of Lower Fox River for muskellunge greater than 450mm (17.5in) and greater than 762mm (30in) from 2000- 2009.

Propagation and Stocking

The first six years of the program (1989-94), hatchery production averaged 2,200 fingerling and yearling muskies and was based upon spawn collected directly from the Indian Spread Chain in the State of Michigan. From 1995 to 2001, hatchery production averaged 2,875 muskies and was primarily from spawn collection from Long Lake, with the exception of 1997 when spawn was collected from Lake St. Clair, Michigan. From 2002 to 2006, spawn was collected from the Fox River and Long Lake and the annual hatchery production increased to an average of 20,324 muskellunge. Stocking has increased as hatchery production increased (Table 1). In 2005, the lower Fox River became the sole location for spawn collection for the reintroduction program. During 2007, discovery of other species of fish infected with Viral Hemorrhagic Septicemia virus in Lake Michigan, Green Bay and the Fox River prevented any collection of gametes from those waters and no spawn was collected. Additional stocking has been indefinitely postponed until egg disinfection protocols are approved or a disease free source of gametes becomes available. Since 2005, stockings have been distributed to a greater diversity of locations around Green Bay (Figure 4). There is evidence that muskellunge may exhibit spawning site fidelity (Crossman 1990) and more areas with appropriate habitat have been stocked to foster natural reproduction.

Table 1. Stockings of great lakes strain muskellunge into the waters and

tributaries of Green Bay, Lake Michigan from 1989-2009.

Stocking	Fingerlings	Yearlings
1989	5261	0
1990	1274	9
1991	2624	0
1992	2107	152
1993	1394	215
1994	0	237
1995	1803	0
1996	3135	247
1997	1842	130
1998	4311	278
1999	3305	294
2000	2451	295
2001	1854	176
2002	9281	140
2003	33107	103
2004	20772	161
2005	18609	325
2006	18785	421
2007	0	640
2008	0	0
2009	0	0

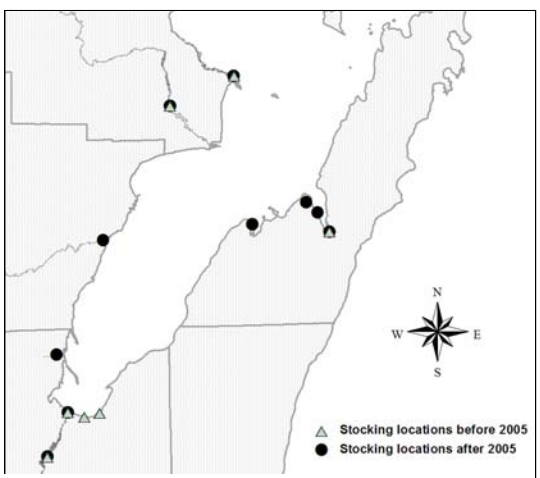

Figure 4. Stocking locations of Great Lakes spotted muskellunge in Green Bay and tributaries before and after 2005.

Efforts are continuing to increase the genetic diversity of the present Green Bay muskellunge stock by establishing new inland brood lakes with fish from Canadian waters of the Great Lakes. Three new brood lakes were established in April 2009 when 1063 yearling muskies, of Georgian Bay, Lake Huron ancestry were imported and stocked into Northeast Wisconsin lakes. In December of 2009 an additional 324 fish were imported and will be stocked into the brood lakes in May 2010. These populations should begin providing gametes to be stocked into Green Bay by the year 2015. This project is a cooperative effort between the WDNR, Ontario Ministry of Natural Resources, Sir Sanford Fleming College and supported financially by the Natural Resource Damage Assessment and Restoration settlements from the Fox River and Green Bay cleanup as well as local musky clubs, Muskies Inc., and the Musky Clubs Alliance of Wisconsin.

Fishery

The Lake Michigan creel survey estimated a total of 31,729 hours of directed effort for muskellunge on Green Bay and the lower Fox River from March 15th through October 31st, 2009 (Figure 5). However, this value underestimates effort since a substantial amount of angling goes on in November after the creel survey ends. This was down again compared to 2007 and 2008, but still over twice the effort of 2005 and 2006. The catch rate has continued to decrease since 2006 (Figure 5). An estimated 1,103 muskies were caught and released in 2009 compared to 1,300 in 2008 and 1,945 in 2007. The catch rate in 2006 was 0.094 fish /hour (10.6 hours/fish). The catch rate slowed to 0.049 fish/hour (20.4hours/fish) in 2007, 0.036 fish/hour (27.8 hours/fish) in 2008, and slowed further in 2009 to 0.032 fish/hour (31 hours/fish). In comparison, statewide directed muskellunge catch rates average 0.039 fish/hour (25.6 hours/fish) for naturally reproduced populations, and 0.020 fish/hour (50 hours/fish) for populations maintained by stocking (Simonson 2003).

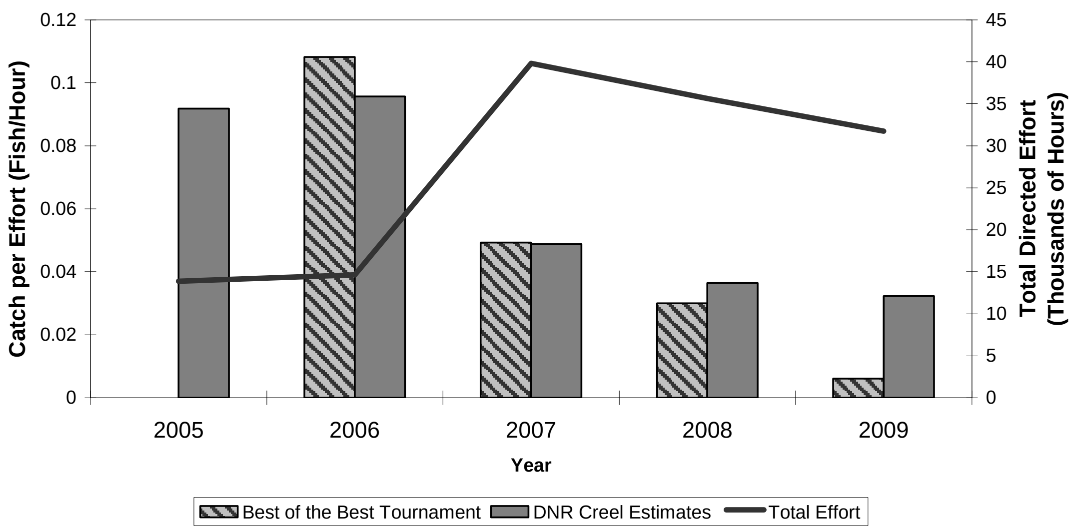

Figure 6. Total directed fishing effort for muskellunge on Green Bay waters of Lake Michigan from 2005-2009 is displayed by the solid black line and on the right axis. The left axis shows catch rate in number of muskellunge caught per hour of directed fishing, the estimated catch rate from creel surveys is displayed in gray, catch rate from the Muskies Inc. "Best of the Best Tournament" is shown with diagonal stripes.

Figure 6 also shows the catch rates from a Muskies Inc. tournament that has been held annually on the lower part of the Bay and the Fox River since 2006. This tournament is only conducted over 2 days but during the most active period of muskellunge angling. The similarity in values of the tournament census data, and the creel estimates gives good confidence in the creel survey estimates.

Future

The population of adult Great Lakes strain muskellunge in Green Bay waters is increasing as documented by the fall index CPUE steadily increasing since 2000. This is likely in response to the increases in stocking and hatchery production. This population appears to be separate from the populations in the Menominee River and Peshtigo River area, and the Sturgeon Bay area based on recaptures of tagged fish.

Hopefully the increase will push the population over a density threshold and there will begin to be significant recruitment from natural reproduction. As the population has increased the WDNR has received anecdotal reports of muskellunge spawning in Green Bay and tributary rivers. Recruitment may be limited by lack of adequate spawning and nursery habitats.

The WDNR in cooperation with the University of Michigan and supported by a Great Lakes Fish and Wildlife Restoration Act Grant has begun efforts to assess natural recruitment and spawning site selection of muskellunge on Green Bay. In the spring of 2009, 20 gravid females were implanted with miniature radio transmitters during spring netting. Transmitters were inserted into oviducts, so during spawning the transmitter would be expressed and deposited with the eggs allowing identification of spawning sites. Thirteen of 20 tags were located after deposition. Identification of spawning locations and quantifying associated habitat will allow for prediction of additional locations for habitat protection, enhancement, and selection of more effective stocking locations for re-establishing muskellunge in the waters of Green Bay.

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NEARSHORE RAINBOW TROUT

Steve Hogler and Brad Eggold

Nearshore fishing opportunities for Lake Michigan trout and salmon have declined since the late 1980's due to changes in species or strains stocked, reduction in the Lake Michigan forage base or perhaps from clearer water nearshore making trout and salmon more difficult to catch. With reduced yellow perch abundance and salmon and trout moving farther offshore, anglers have requested the Wisconsin DNR to evaluate the stocking of rainbow trout to increase nearshore fishing opportunities.

The original study outline called for stocking six ports, Kenosha, Milwaukee, Sheboygan, Manitowoc, Algoma and Sister Bay with two strains of rainbow trout to facilitate the evaluation of the effectiveness of rainbow trout stocking. Following the initial stocking of Arlee rainbow trout in 2001, a second rainbow trout strain, Kamloops, was identified to be part of this study in 2003. Both strains were stocked from 2003 through 2007. In 2008 and 2009, only Arlee strain rainbow trout were stocked (Table 1).

Arlee Rainbow Trout

In 2009, 121,156 unmarked Arlee rainbow trout were stocked into Wisconsin waters of Lake Michigan (Table 1). Stocking size was smaller than in previous years and stocking dates were the earliest of the time series.

Table 1. Stocking history of nearshore rainbow trout stocked into Wisconsin's waters of Lake Michigan since 2001.

Strain	Year Stocked	Number per Port	Number of Ports	Fin Clip	Average Length	Average Weight	Stocking Dates
Arlee	2001	12,000	6	ALP	174 mm	55 g	April 16 through May 1
	2002	7,500	2	LP	170 mm	55 g	April 9
	2003	10,150	6	ALP	182 mm	74 g	April 27 through May 9
	2004	5,000	6	LP	199 mm	108 g	April 12 through April 19
	2005	10,590	6	ALP	178 mm	72 g	March 30 through April 19
	2006	10,000	6	LP	178 mm	59 g	April 4 through April 20
	2007	10,978	6	ALP	173 mm	55 g	March 26 through April 25
	2008	6,665	9	LP	178 mm	62 g	April 8 through April 15
	2009	13,462	9	--	153 mm	43 g	March 11 through March 17
Kamloops	2003	10,300	6	ARP	148 mm	32 g	April 17 through April 19
	2004	10,066	6	RV	147 mm	36 g	April 20 through April 27
	2005	8,500	6	LV	152 mm	29 g	April 21 through April 27
	2006	9,762	6	RV	145 mm	28 g	March 23 through April 7
	2007	10,161	6	RV	178 mm	55 g	March 26 through April 25

It was estimated that anglers harvested 1,768 Arlee rainbow trout in 2009 (Table 2). The estimated harvest in 2009 was 22.7 % lower than the 2008 harvest estimate and continued the decline in harvest of Arlee rainbow noted since 2007. In 2009 most of the harvested Arlee rainbow were taken by pier and shore anglers with fewer caught in the ramp and stream fisheries.

Table 2. Estimated angler harvest of nearshore rainbow trout by strain and fishery type from 2001 through 2009.

Strain	Harvest Year	Harvest Location Boat	Pier and Shore	Stream	Total Harvest
Arlee	2001	62 (5%)	1,262 (95%)	0	1,324
	2002	1,259 (78%)	285 (18%)	61 (4%)	1,605
	2003	46 (5%)	813 (95%)	0	859
	2004	250 (26%)	585 (61%)	118 (12%)	953
	2005	600 (43%)	201 (14%)	600 (43%)	1,401
	2006	426 (20%)	1,193 (52%)	511 (24%)	2,130
	2007	911 (24%)	2,126 (56%)	760 (20%)	3,797
	2008	635 (28%)	1,015 (44%)	635 (28%)	2,285
	2009	465 (26.3%)	1,024 (57.9%)	279 (15.8%)	1,768
Kamloops	2003	0	267 (100%)	0	267
	2004	73 (11%)	513 (78%)	73 (11%)	659
	2005	875 (50%)	525 (30%)	350 (20%)	1,750
	2006	1,111 (43%)	855 (33%)	600 (24%)	2,566
	2007	740 (29%)	1,199 (47%)	613 (24%)	2,552
	2008	1,644 (57%)	1,011(35%)	254 (8%)	2,909
	2009	757 (22.9%)	1,226 (37.1%)	1,321 (40.0%)	3,304

Analysis of fish clips indicated that Arlee rainbow harvested in 2009 came from fish stocked since 2004 with those stocked in 2004 being the most common. Fin clips can also help to determine how fish are growing in the lake. For example, Arlee rainbow that were stocked in 2005 have grown to average 658 mm in length and 3.5 kg in weight after 5 summers in the lake (Table 3). 2008 stocked fish averaged 536 mm in length and 2.0 kg in weight after 2 summers in the lake. The average lengths and weights from other stocking years are listed in Table 3. It appears that the growth rate of recently stocked Arlee rainbow trout has slowed as compared to the growth rates from fish stocked early in the experiment.

Kamloops Rainbow Trout

It was estimated that anglers harvested 3,304 Kamloops rainbow trout in 2009 (Table 2). The 2009 harvest of Kamloops rainbow trout was the highest since Kamloops rainbow stocking began in 2003. Most of the harvested Kamloops rainbow were taken by stream and shore/pier anglers with fewer taken in the boat fishery (Table 2).

Analysis of fish clips indicated that Kamloops rainbow harvested in 2009 came from all stocking years. Kamloops rainbow stocked in 2004 were the most commonly harvested cohort followed by the 2005 stocking cohort. Fin clips can also help to determine how fish are growing in the lake. Kamloops rainbow that were stocked in 2005 have grown to average 650 mm in length and 3.4 kg in weight after five summers in the lake (Table 4). 2007 stocked fish averaged 437 mm in length and 1.0 kg in weight after three summers in the lake. The average lengths and weights from other stocking years are listed in Table 4. Similar to growth rates for Arlee rainbow, the growth of recently stocked Kamloops rainbow appears to also to be slowing.

Table 3. The average length and weight of Arlee rainbow trout after 1,2,3,4 or 5 summers in Lake Michigan for each stocking year. Fish that spent 1 summer in the lake were stocked that year in spring.

	Length					Weight				
Year Stocked	1 summer in lake	2 summers in lake	3 summers in lake	4 summers in lake	5 summers in lake	1 summer in lake	2 summers in lake	3 summers in lake	4 summers in lake	5 summers in lake
2001	330 mm	547 mm	658 mm	688 mm	681 mm		2.3 kg	3.1 kg	4.5 kg	3.1 kg
2002	566 mm	610 mm	655 mm	709 mm	711 mm	1.7 kg	2.4 kg	2.6 kg	3.5 kg	4.0 kg
2003	414 mm	521 mm	559 mm	612 mm	716 mm	1.1 kg	1.5 kg	2.2 kg	2.5 kg	4.0 kg
2004	323 mm	592 mm	556mm	635 mm	622 mm	0.5 kg	2.1 kg	1.8 kg	3.3 kg	3.1 kg
2005	305 mm		587 mm	572 mm	658 mm	0.4 kg		2.6 kg	3.3 kg	3.5 kg
2006	368 mm	498 mm	534 mm	584 mm		0.9 kg	1.5 kg	1.8 kg	2.0 kg	
2007	356 mm	534 mm	665 mm			0.6 kg	1.6 kg	2.0 kg		
2008	419 mm	536 mm				0.8 kg	2.0 kg			
2009	259 mm					0.9 kg				

Table 4. The average length and weight of Kamloops rainbow trout after 1,2,3,or 4 summers in Lake Michigan for each stocking year. Fish that spent 1 summer in the lake were stocked that year in spring.

	Length					Weight				
Year Stocked	1 summer in lake	2 summers in lake	3 summers in lake	4 summers in lake	5 summers in lake	1 summer in lake	2 summers in lake	3 summers in lake	4 summers in lake	5 summers in lake
2003	358 mm	424 mm	625 mm	699 mm	739 mm	0.7 kg	0.9 kg	2.6 kg	3.5 kg	4.0 kg
2004	553 mm	531 mm	663 mm	709 mm	691 mm	1.5 kg	1.4 kg	3.0 kg	3.6 kg	4.0 kg
2005	546 mm	647 mm	691 mm	660 mm	650 mm	0.8 kg	2.7 kg	2.9 kg	3.5 kg	3.4 kg
2006	376 mm	587 mm	536 mm	574 mm		0.8 kg.	2.1 kg	1.6 kg	2.3 kg	
2007	229 mm	559 mm	437 mm			0.2 kg	1.6 kg	1.0 kg		

Summary

The first nine years of creel survey data is encouraging and indicates that Arlee and Kamloops rainbow trout may be benefiting nearshore anglers although the results are not clear cut (Table 5). Since the inception of this project, it is estimated that anglers have harvested 30,129 nearshore rainbow trout. Of that total, 14,100 (46.8%) have been harvested by anglers fishing from piers or from the shore. However, the percent harvested by pier and shore anglers has varied greatly from a high of near 100% in 2003 to a low of 23% in 2005. This may indicate that the rainbow trout stocked as part of this experiment have not consistently improved nearshore fishing.

In the years that Arlee and Kamloops rainbow trout were both stocked, anglers have harvested more Arlee rainbow than Kamloops rainbow in both number and standardized return rate (# per thousand stocked) (Tables 2, 5 and 6). It appears that for both strains, fish stocked in stocked in 2003 and 2004 have returned well, while fished stocked in 2007 have returned poorly.

Table 5. Return rates (number per thousand stocked) to creel for Arlee Rainbow Trout stocked into Lake Michigan 2001 through 2009.

	Year Stocked								
Year Harvested	2001	2002	2003	2004	2005	2006	2007	2008	2009
2001	18.3	--	--	--	--	--	--		
2002	6.8	74.4	--	--	--	--	--		
2003	3.7	17.7	9.8	--	--	--	--		
2004	6.1	9.7	4.8	2.5	--	--	--		
2005	2.4	23.3	2.9	17.5	2.8	--	--		
2006	0.0	28.4	9.8	11.4	0.0	12.8	--		
2007	0.0	0.0	5.0	45.6	11.9	12.6	9.2		
2008	0.0	0.0	2.1	21.2	6.0	10.6	5.8	2.1	
2009	0.0	0.0	3.1	34.1	1.5	1.6	1.4	3.1	0.8
Total	37.3	153.5	37.5	132.3	22.2	37.6	16.4	5.2	0.8

Table 6. Return rates (number per thousand stocked) to creel for Kamloops Rainbow Trout stocked into Lake Michigan 2003 through 2007

	Year Stocked						
Year Harvested	2001	2002	2003	2004	2005	2006	2007
2001	--	--	--	--	--	--	--
2002	--	--	--	--	--	--	--
2003	--	--	4.3	--	--	--	--
2004	--	--	8.3	2.4	--	--	--
2005	--	--	19.8	5.6	3.4	--	--
2006	--	--	12.5	20.0	5.0	5.7	--
2007	--	--	4.9	9.9	11.8	15.4	2.5
2008	--	--	4.1	18.8	12.4	10.8	4.1
2009	--	--	4.6	25.0	24.0	3.2	1.6
Total	--	--	58.5	81.7	56.6	35.1	8.2

It also appears that the fish are growing well, despite recent slower growth as anglers have caught fish of each strain over 10.0 kg in weight. From comparisons of length and weight at age for each strain, it appears that Arlee rainbow are larger in size than Kamloops rainbow during their first two summers in lake, but after three summers, Kamloops are larger in size. We do not know at this time if Arlee rainbow or Kamloops rainbow will ultimately provide the greater return to anglers and be selected to continue this project.

STEELHEAD MANAGEMENT

Steve Hogler

Wisconsin began its Lake Michigan rainbow/steelhead trout fishery in 1963 when rainbow trout were stocked into a Door County stream (Daly 1968). During the years following the original stocking, many changes in Wisconsin's steelhead program have occurred, including changes in the strains and the age of fish stocked. Despite increasing stocking levels through the early 1980's (Figure 1), harvest (Figure 2) and catch rates (Figure 3) declined to near record low levels. Concerns regarding the declining steelhead fishery prompted the Wisconsin Department of Natural Resources to form a steelhead committee to evaluate the program and make recommendations to improve the fishery (WDNR 1988).

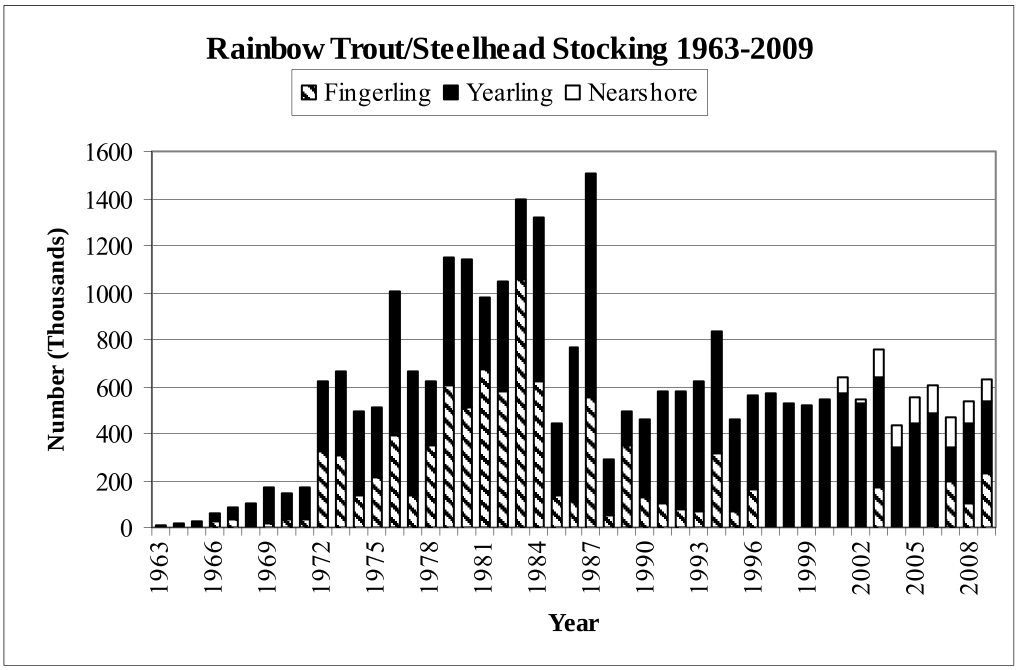

Figure 1. Annual stocking numbers (in thousands) for rainbow trout (steelhead) stocked into the Wisconsin waters of Lake Michigan from 1963 through 2009 (Burzynski 2009). Fingerling and yearling rainbow trout stocked between 1963 and 1987 are a mixture of domestic rainbow trout and steelhead while those stocked after 1987 are steelhead. The nearshore rainbow trout stocked from 2001 through 2009 are Arlee and Kamloops strain rainbow trout.

The 1988 Lake Michigan Steelhead Fishery Management Plan (1988 LMSFMP) made recommendations in three areas: developing new stocking strategies, improving rearing facilities and increasing stream access for anglers. In addition Wisconsin decided to stock three strains of steelhead, Chambers Creek, Ganaraska and Skamania to diversify the fishery and to provide greater opportunities for stream anglers to catch steelhead on a nearly year round basis.

The goal of the 1988 LMSFMP was to improve steelhead fishing. The measure of success was a harvest target of 50,000 steelhead per year. This goal was surpassed from 1988 through 1999 (Figure 2). From 1993 through 1995 the harvest of steelhead was more than twice the harvest target.

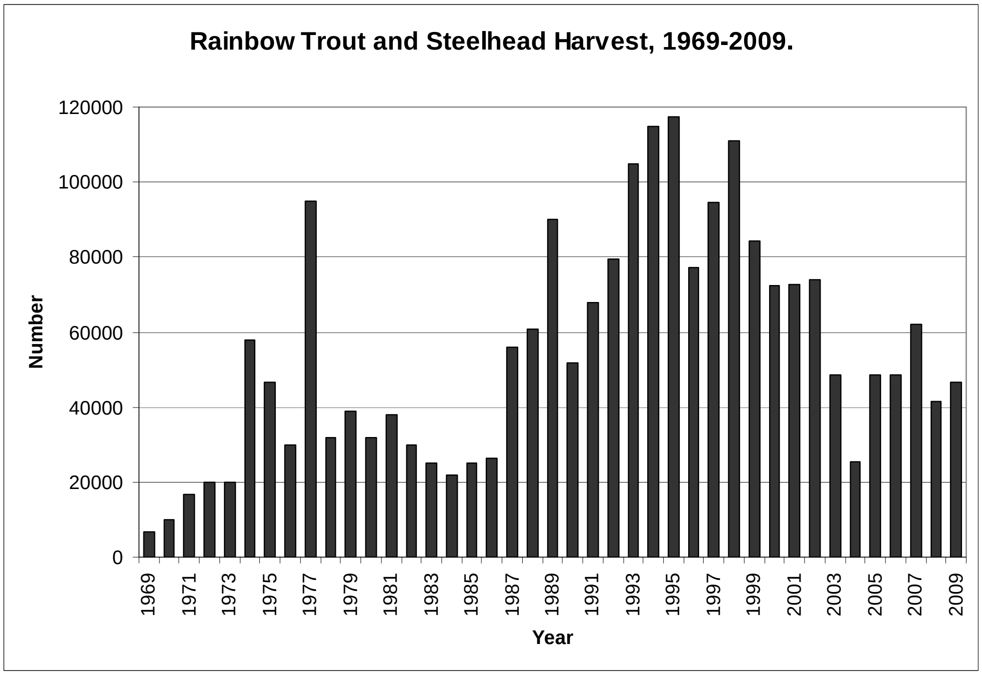

Figure 2. Annual harvest of rainbow (steelhead) trout by anglers fishing the Wisconsin waters of Lake Michigan from 1969 through 2009 (Peterson and Eggold 2009).

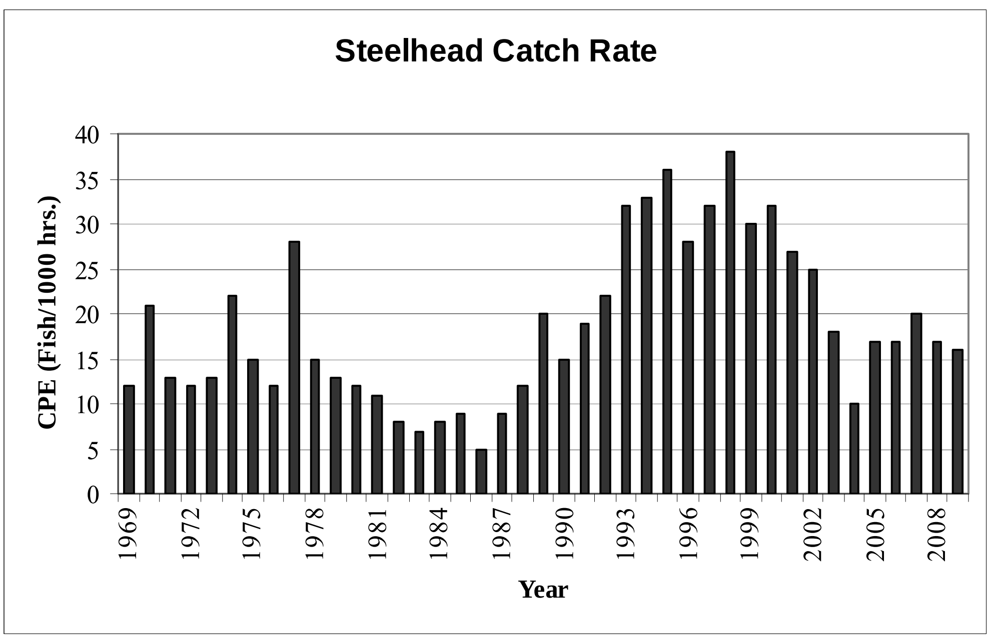

Figure 3. Annual harvest rate (fish/ 1000 hours) of rainbow (steelhead) trout by anglers fishing the Wisconsin waters of Lake Michigan from 1969 through 2009 (Peterson and Eggold 2009).

Wisconsin partially met the hatchery goals of the plan. Many projects were completed at Kettle Moraine State

Fish Hatchery to improve rearing techniques but several issues most notably problems with the water supply (volume and quality) were unresolved. We did not achieve the size at stocking goals of the 1988 LMSFMP with stocking size consistently less than the 91 gram average weight or the 191 mm in length targets (Table 1). We did however achieve the stocking date goal with stocking in most years occurring in early April.

Additionally Wisconsin has improved habitat for both adults and recently stocked smolts in several rivers including the Kewaunee and Milwaukee Rivers. Access to streams has increased with the purchase of several tracts of lands on the Kewaunee River and by removal of several dams on the Milwaukee River increasing the number of river miles anglers can utilize to steelhead fish.

Table 1. The average stocking date, length and weight for steelhead at stocking from 1988 through 1997. The 1988 Lake Michigan Steelhead Fishery Management Plan goal was 191 mm in length, and 91 g in weight at the time of stocking for steelhead.

	Chambers Creek			Ganaraska			Skamania		
Year	Average Stocking Date	Average Length (mm)	Average Weight (g)	Average Stocking Date	Average Length (mm)	Average Weight (g)	Average Stocking Date	Average Length (mm)	Average Weight (g)
1988	Apr. 20	164	36	Apr. 23	139	19	Apr. 4	172	42
1989	Mar. 23	158	34	May 4	121	25	Mar. 26	154	33
1990	Apr. 14	162	35	Mar. 16	163	36	Apr. 7	169	40
1991	Apr. 11	161	35	Apr. 6	154	36	Apr. 12	164	37
1992	Apr. 2	146	26	Apr. 12	142	24	Apr. 6	164	37
1993	Apr. 23	165	37	Apr. 26	136	21	Apr. 26	162	33
1994	Apr. 5	159	34	Apr. 6	135	20	Apr. 2	176	47
1995	Apr. 7	168	40	Apr. 23	139	22	Mar. 16	155	31
1996	Apr. 15	161	35	Mar. 17	137	20	Mar. 30	149	27
1997	Apr. 5	147	27	Apr. 4	147	26	Mar. 28	139	31
Avg.	Apr. 10	159	32	Apr. 10	142	22	Apr. 3	161	33

1999 Steelhead Management Plan

Following the review of the 1988 LMSFMP it was clear that Wisconsin's steelhead program could be improved and expanded with the addition of several new tactics. The 1999 LMSFMP retained many components of 1988 plan including strain management that included Chambers Creek, Ganaraska and Skamania strains and stocking the proper streams with healthy steelhead at the proper time (WDNR 1999). Other tactics that remained the same included: stocking number (500,000 yearlings), increasing access and improving fish habitat.

Changes that were incorporated into the 1999 LMSFMP included: increasing the harvest goal to range between 75,000 and 100,000 steelhead per year and setting stocking size goals to the average lengths and weights measured during the previous ten years which were 160 mm in length and 33 grams in weight (Table 1).

Despite the success of the 1988 LMSFMP, several problems in the steelhead program were clearly identifiable. They included: decreasing nearshore fishing opportunities, angler crowding on the Root and Kewaunee Rivers, limited fishing opportunities on small streams, decreasing weir returns on the Kewaunee River and a lack of a formal operational steelhead spawning protocol. The plan developed tactics that addressed each of these issues.

2009 Evaluation of the 1999 LMSFMP

As was the case with the 1988 LMSFMP, Wisconsin achieved several goals of the 1999 LMSFMP, failed on several goals and had mixed results on others.

The main goal of the 1999 LMSFMP was to sustain an annual harvest of 75,000 to 100,000 steelhead. We were close to meeting this goal for the first three years of the plan, but in succeeding years harvest has dropped substantially below goal and on average anglers have harvested only 45,902 steelhead each year from 2003 through 2009 (Figure 2). Along with the decline in overall harvest, catch rate (steelhead/ 1000 hours fishing) has decreased by 57% since 1998 (Table 3). It is likely that several factors have lead to the decline in harvest number. First and foremost is that Wisconsin has stocked fewer yearling steelhead than called for in the 1999 LMSFMP (Figure 1). The stocking goal of 500,000 yearling steelhead has not been met since 2002 because of water supply and water quality issues at Kettle Moraine Springs Fish Hatchery. Since 2003 Wisconsin has stocked approximately 319,000 yearling steelhead each year. To make up for some of the shortfalls, fall fingerlings were stocked in 2003 and from 2006 through 2009. However because of their small size at stocking, it is unknown to what degree the fall fingerlings contributed to the fishery. Research by Seelbach (1985) and Bartron (2003) suggest it is not likely that fall fingerlings will contribute to the fishery in any number.

Size at stocking was also below goal (Table 2). Mortality of smolts may play an important role in determining the number adult steelhead harvested. Size at stocking has been shown to be an important factor in the survival of smolts (Seelbach 1985) and their ultimate contribution to the fishery (Bartron 2003). Research by Bartron (2003) indicated that the minimum size for substantial survival was 150 mm while Seelbach (1985) recommended a much large stocking size at 200 mm. On many occasions since 2000, steelhead smolts averaged 150 mm or less in length at the time of stocking. However, the benefit of larger size at stocking is not clear cut. Although average size at stocking from 2000-2009 was smaller than those from 1988 to 1997 (Table 1), there is considerable overlap in size at stocking especially for Ganaraska (Table 2). If the harvest of fish stocked between 1988-1997 are compared to those stocked from 2000-2009, those stocked before 2000 appear to have survived better and provided higher harvests than those stocked after 2000. It is likely that environmental conditions were more favorable for smolt survival in the earlier period than those found after 2000.

The goal of stocking steelhead during the first week of April was not met on a consistent basis although it was achieved two of the past three years (Table 2). This was in stark contrast with stockings that occurred between 1998 and 1997 when the stock date goal was met nearly every year for all three strains (Table 1). Perhaps the shift toward earlier stocking dates may account for some decline in harvest (reduced smolt survival) that was noted the past ten years. It is not clear what may cause differential survival but it may be related to longer exposure to fish predators or to a lack of appropriate forage in streams at the time of stocking.

Table 2. The average stocking date, length and weight for steelhead at stocking from 2000 through 2009. The 1999 Lake Michigan Steelhead Fishery Management Plan goal was 160 mm in length, and 33 g in weight with stocking occurring during the first week of April.

	Chambers Creek			Ganaraska			Skamania		
Year	Average Stocking Date	Average Length (mm)	Average Weight (g)	Average Stocking Date	Average Length (mm)	Average Weight (g)	Average Stocking Date	Average Length (mm)	Average Weight (g)
2000	Mar. 21	147	36	Mar. 23	137	27	Mar. 25	160	41
2001	Mar. 3	150	27	Mar. 17	135	18	Apr. 1	160	36
2002	Mar. 22	142	23	Mar. 29	130	18	Apr. 1	150	27
2003	Mar. 9	117	18	Mar. 9	112	14	Mar. 8	135	18
2004	Mar. 24	135	23	Mar. 26	127	23	Mar. 24	147	32
2005	Mar. 20	135	23	Mar. 22	119	18	Mar. 21	135	18
2006	Mar. 15	160	41	Mar. 25	122	18	Mar. 12	130	18
2007	Apr. 7	145	32	Apr. 9	142	27	Mar. 20	150	36
2008	Apr. 12	145	27	Apr. 18	140	27	Apr. 10	170	36
2009	Mar. 26	160	55	Mar. 20	165	36	--	--	--
Avg.	Mar. 22	144	31	Mar. 26	133	23	Mar. 24	149	29

Since the implementation of 1999 LMSFMP Wisconsin has continued to manage the fishery by stocking three strains of steelhead until 2009 when Skamania stocking was halted. The contribution of each strain to the fishery has varied throughout the period. Early in the period based on fin clips on Wisconsin stocked steelhead, Wisconsin anglers harvested about 35% Skamania and near equal numbers of Chambers Creek and Ganaraska strain steelhead (John Kubisiak, WDNR, personal communication). By 2006 and continuing through 2008 harvest by strain had shifted to favor Ganaraska (Table 3). In 2009 the percent of each strain harvested by anglers was nearly equal for all three strains of steelhead. Much of the shift was likely due to the number of each strain being stocked which has varied from year to year. It is likely in the near future Skamania will be less abundant in the harvest because during the past several years Wisconsin has not collected Skamania strain steelhead gametes. With the finding of VHS in Lake Michigan, DNR policy has not allowed Fisheries staff to collect, transport and hold adult Skamania until spawned at Kettle Moraine Springs Hatchery. It is likely this prohibition will continue into the foreseeable future.

Table 3. The percentage of Wisconsin marked steelhead harvested by Wisconsin anglers as measured by creel survey, 2006-2009.

Year	Chambers Creek	Ganaraska	Skamania	Arlee Rainbow	Kamloops Rainbow
2006	21.8%	32.5%	12.7%	15.7%	18.1%
2007	25.7%	17.7%	17.7%	22.1%	16.8%
2008	13.9%	19.4%	9.7%	25.0%	31.9%
2009	20.1%	20.1%	17.2%	14.2%	26.1%
Average	20.4%	22.4%	14.4%	19.3%	23.2%

During this period Wisconsin continued to improve access and habitat when appropriate. For example work continued on the Milwaukee River to increase access and habitat by removing dams and a habitat project was completed on the Oconto River. On the Kewaunee River additional land purchases have increased access.

As part of the 1999 LMSFMP an new initiative was began to improve trout and salmon fishing opportunities for anglers fishing from small boats, piers or from along the shoreline by stocking domestic rainbow trout. After several years of evaluating potential strains of rainbow trout, two strains, Arlee and Kamloops were selected. Following the initial stocking of Arlee rainbow trout in 2001, a second rainbow trout strain, Kamloops, was identified to be part of this study in 2003. Both strains were stocked from 2003 through 2007.

The first nine years of creel survey data was encouraging and indicated that Arlee and Kamloops rainbow trout may be benefiting nearshore anglers although the results were not clear cut. Since the inception of this project, it was estimated that anglers have harvested 30,129 nearshore rainbow trout. Of that total, 14,100 (46.8%) have been harvested by anglers fishing from piers or from the shore. However, the percent harvested by pier and shore anglers has varied greatly from a high of near 100% in 2003 to a low of 23% in 2005. This may indicate that the rainbow trout stocked as part of this experiment have not consistently improved nearshore fishing.

In the years that Arlee and Kamloops rainbow trout were both stocked, anglers have harvested more Arlee rainbow than Kamloops rainbow in both number and standardized return rate (# per thousand stocked). It appears that for both strains, fish stocked in stocked in 2003 and 2004 have returned well, while fished stocked in 2005 have returned poorly.

The 1999 LMSFMP sought to reduce angler crowding on the Root and Kewaunee Rivers by shifting some of each rivers quota to nearby streams. After evaluation of return rates, egg production needs and angler harvest biologists decided to move a portion of the Root River quota to nearby streams. But because of a more variable return rate, it was decided not to move fish out of the Kewaunee River.

The 1999 LMSFMP also tried to improve fishing in Class 1 and Class 2 streams by changing the allotment of Chambers Creek and Ganaraska stocked into both classes of streams to widen the spring fishing window. After reallocation, Class I streams are stocked with 6,000 Chambers Creek, 5,100 Ganaraska, and 11,110 Skamania. Class II streams are stocked with 3,250 Chambers Creek and 3,250 Ganaraska steelhead. Like the moving fish away from the Root River, reallocation of steelhead strains did not add additional fish to the lake but only redistributed fish we were already stocking, making it difficult to determine by our current creel survey if fishing actually improved for anglers fishing in small streams.

Another recommendation of the 1999 LMSFMP was to study the survival of recently stocked smolts in the Kewaunee River. Two areas, water quality and out-migration were studied (Hogler and Surendonk 2009). Continuous water quality monitors placed in the Kewaunee River in 2000 and 2004 had mixed results. Data collected in 2000 indicated that water quality in the river dropped below the State Standard for dissolved oxygen (5 mg/l) in warmwater stream multiple times during spring and summer months. It is likely that poor agricultural land practices were responsible for the violations. In 2004 water quality was much improved when no violations of State Standards were noted. In 2009 a major manure runoff event in the upper Kewaunee River during stocking caused concerns regarding survival of recently stocked smolts and forced Wisconsin to stock a portion of the Kewaunee River steelhead quota into another stream.

To monitor the out migration of trout and salmon we established two monitoring stations and used a barge electroshocking unit to capture fish. Shocking began shortly after stocking was completed in spring and continued until steelhead were not captured at the upstream site. Our electroshocking surveys from 2004 through 2009 have documented that (1) smolts survive stocking and (2) that they are able to pass downstream of the dam at BAFF and make it to lower river sections on the way to Lake Michigan. We also noted that different species appeared to have different out-migration patterns with the salmon (Chinook and Coho) leaving the stream quickly while brown trout moved downstream more slowly. Steelhead were intermediate in the speed of their downstream movement.

The final component of the 1999 LMSFPM was to establish spawning protocols for steelhead that would maintain the integrity of each strain by spawning throughout the runs at the steelhead egg collection facilities on the Root and Kewaunee Rivers. Although the protocols were established, personnel and budget shortages, reduced run sizes and VHS have made following the protocols difficult. During most years however, collecting gametes throughout the run has been achieved at one of the two egg collection facilities.

Since the completion of the 1999 LMSFMP several new issues have emerged. Most importantly is the decline in our ability to annually produce 500,000 yearling steelhead. The reduction of stocked steelhead by nearly 40% has hurt the steelhead fishery. Wisconsin will need to develop a hatchery plan that will increase the production of steelhead back to the annual target goal of 500,000 yearlings.

Additionally the loss Skamania has reduced the diversity of the steelhead fishery in both Lake Michigan and tributary streams. Since it is likely that the DNR policy on VHS will continue prohibit holding adult Skamania at a hatchery with other fish, we will need to develop a medically isolated holding facility for Skamania if Wisconsin wants to continue to use our own feral broodstock to raise and stock Skamania into Lake Michigan.

Finally we need to fully follow broodstock collection protocols. Since the inception current steelhead program we have lost or nearly lost the late fall run of Chambers Creek, distinct spring runs of Chambers Creek and Ganaraska and the strong late summer run of Skamania. It is likely egg collection practices have caused a partial loss of these traits.

Steelhead continue to be highly prized by Wisconsin anglers despite reductions in stocking number and reduced stream runs. Wisconsin will continue to manage steelhead by strain and will work toward achieving stocking and harvest goals.

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LAKE STURGEON

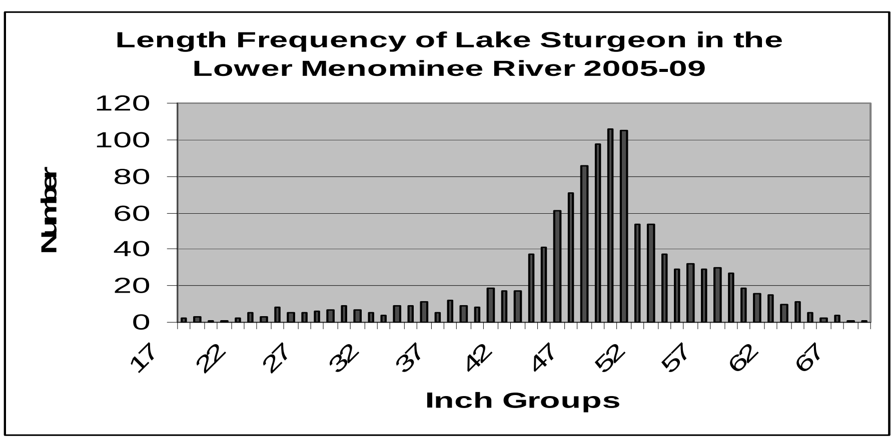
Michael Donofrio, Brad Eggold, and Michael Baumgartner

Introduction

Lake sturgeon populations were decimated by the early 1900s through over fishing by commercial fishermen, altered stream flows, interruption of migration routes with dams and water quality degradation in Wisconsin's Lake Michigan's major rivers (Milwaukee, Manitowoc, Kewaunee, Menominee, Peshtigo, Oconto, and Fox). Passage of the Clean Water Act with associated permits for industry and implementation of new Federal Energy Regulatory Commission licenses have improved conditions for fisheries in general. Lake Sturgeon populations have also benefited in the last 15 years and natural reproduction currently occurs on the Menominee, Peshtigo, Oconto, and Fox Rivers. These populations are self sustaining without benefit of stocking. The results of tagging studies and genetic analysis indicate a distinction between the Fox and Oconto River sturgeon and another population on the northern tributaries of Green Bay (Menominee and Peshtigo). The Menominee River contains the largest population in Lake Michigan waters with contributions from stocks of Wisconsin's Peshtigo River and Michigan's Cedar and Whitefish rivers. The Menominee River supports a hook and line fishery from 1946 to the present. The exploitation was highest in 2005 at 172, although recent regulation restrictions reduced the total harvest to 5 from 2006-09 fall seasons. Lake sturgeon stocking is occurring on the Milwaukee and Manitowoc/ Kewaunee rivers and recovering is dependent on those stocking efforts and continued habitat improvements.

Menominee River Population Assessment

Field sampling, two one day electrofishing surveys with two electrofishing boats, in 2009 produced 142 lake sturgeon from the lower Menominee River. Similar efforts produced 194 fish in 2008, 132 fish in 2007, 276 lake sturgeon in 2006 and 278 in 2005. From 2005-9, most of the fish (85%) were subjectively labeled as adults (>107 cm in total length), but several sub-adults sturgeon were observed during the surveys. The overall average total length during these sampling events was 122 cm. From 2005-09, the smallest sturgeon recorded was 44 cm and several fish were over 173 cm in length. The population estimate for the 42 inch and larger segment of the population was 2,287 with confidence intervals of 2,060 to 2,554 in 2009.



The agencies continue to participate in genetic analysis research of Lake Michigan's lake sturgeon performed by Michigan State Univ. through Great Lakes Fishery Trust grants. That research indicated that Fox and Oconto river populations are closely associated with linkage to the Lake Winnebago population. The Menominee and Peshtigo rivers form one population and ranged north to the Cedar and Whitefish rivers in Michigan's Upper Peninsula. That theory is supported by movement studies from Menominee River recaptured lake sturgeon. Sturgeon recaptured from 2005-09 in the Menominee River originated in the Peshtigo River (10%), Cedar River (5%), Green Bay (2%) and Whitefish River (1%).

We proceeded with our movement study through ultrasonic transmitters implanted in lake sturgeon at the Menominee, Peshtigo and Oconto rivers. We currently have sonic tags in 71 adults (Menominee (35%), Peshtigo (27%), and Oconto (28%)). Their movements are monitored continuously through 2 stationery receivers in each of those 3 rivers. Since we have recaptures from the Cedar and Fox rivers, we installed additional receivers in those rivers. These fish were sexually labeled as 21% F2, 4% F3, 27% F4, and 48% M2. The average length of the females was 60.2 inches and males were 54.6 inches. The movements between rivers will be monitored through 2012.

Milwaukee River SRF

The Milwaukee SRF was deployed in 2009 on April 8, 2009 and put into service on April 24, 2009. Wisconsin DNR personnel artificially spawned 5 females from the Wolf River and transferred those fertilized eggs to the trailer on April 25 and April 26, 2009. One batch of eggs was disposed of due to poor eye-up leaving 4 batches of eggs. Approximately 25,000 eggs from four females were transferred to the trailers. Eggs from each female were placed into a separate hatching jar.

During the initial egg incubation, formalin treatments were applied to the eggs on 4 consecutive days. These treatments drastically reduced egg mortality and lead to increased number of hatched larval lake sturgeon. By May 1, lake sturgeon larvae began to hatch and could be seen in the incubation jars. Over the course of the next seven days hatching continued until all larvae were in the smaller fry tanks. During the month of May and into June, sturgeon were fed brine shrimp followed by grated blood worms and finally whole blood worms.

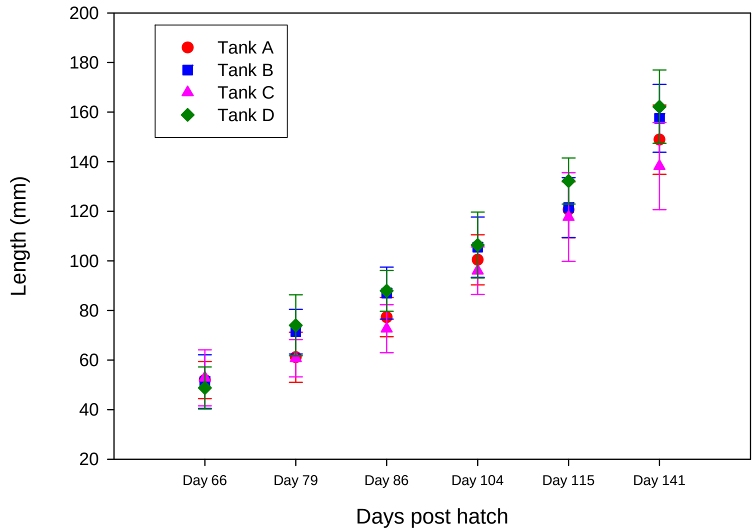
It was estimated that following hatching, there were approximately 666 – 4,000 larvae per fry tank. Numbers of larvae were lowered to 1,500 fish in two tanks and 1,000 in two tanks. The number of lake sturgeon in each tank was set based on experiences in 2007 and 2008 that suggested higher levels would result in excessive mortalities. However, once again we did see some high mortalities of fish in the two tanks that started at 1,500 but much lower mortalities in the other two. This indicates that a starting level of 1,500 fish may be too high and next year the tanks should start at 1,000 fish.

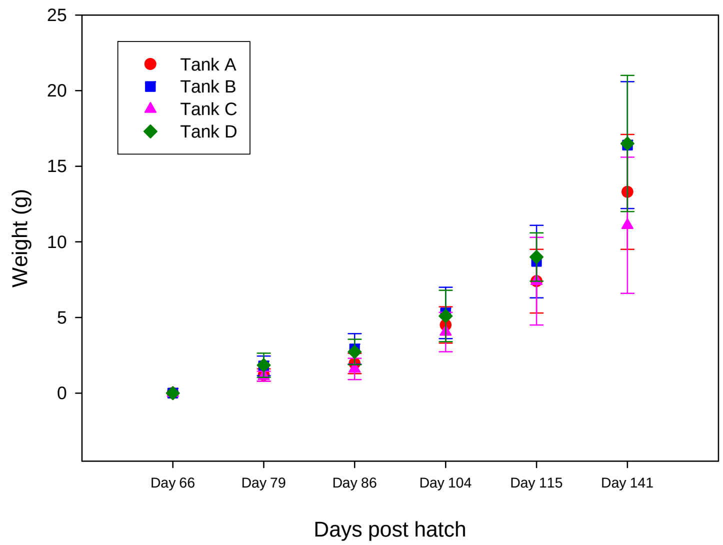
VHS testing was conducted very early in 2009 (June 15, 2009) which allowed us to stock smaller fingerlings on two separate occasions. On July 30, 2009, we stocked 760 fish and 236 were stocked on August 31, 2009. From September 1 until the fish were stocked on October 3 only a few more fish died. Because of the early success in number of hatched larvae, we were able to stock 1,042 on October 3, 2009. This year represented the highest number of fish stocked from the facility in the 4 years of operation.

The Lake Michigan Lake Sturgeon Rehabilitation Plan was used as a guideline during the collection of gametes for the Milwaukee and Kewaunee SRF. We collected 4 females and mated them with at least 4 and in most cases 5 males per female. This gave us 20 families of fish. The individual batches from a female were then put into separate hatching jars at the Milwaukee and Kewaunee SRF. Because of lower densities of larvae in the fry tanks (1,500 per tank) and better feeding protocols we ended up with 1,042 and 1,035 lake sturgeon for stocking in the Milwaukee and Kewaunee Rivers, respectively. The lake sturgeon in the Milwaukee SRF were stocked out below the Thiensville Dam in the City of Thiensville on October 3, 2009 and the lake sturgeon produced at the Kewaunee SRF were stocked out below the Buzz Besadny Fisheries Facility on September 24, 2009.

Total length and weight has been measured biweekly for the fish in the Milwaukee River SRF and are summarized below. Lake Sturgeon in the four tanks (A – D) exhibited similar growth patterns for the first 66 days. At that point, lake sturgeon in tanks that started with lower numbers (1,000) were able to grow longer and heavier probably due to lower densities in these tanks. On day 86, small fish were stocked in an effort to reduce the numbers in the tanks to enhance their growth. This seemed to work as fish grew at a much faster rate once the smaller fish were removed.

Average length and weight of Lake Sturgeon
at the Milwaukee Streamside Rearing Facility, 2009





Sturgeon were stocked on July 30 (Day 86) and 325 were left in each tank.

Kewaunee River SRF

The Manitowoc SRF was not operated in 2008 because the amount of staff time that was required to operate the SRF in 2007 could not be maintained in 2008. In 2009 WDNR relocated that facility to the Kewaunee River at the Besadny Fisheries Facility for long-term operation at that site. The SRF was put in place early in April. Eggs were delivered to the Kewaunee SRF in two batches on April 25th and 26th with eggs from three females delivered on 4/25 and two females on 4/26. The eggs from one of the females on 4/25 were disposed of and replaced with eggs from one of the females from 4/26. Eggs were incubated for 12 days until completely hatched by 5/8. An estimated 70 to 80 percent of the eggs hatched. Sac fry from two of the females were transferred to the larger tanks while two families remained in the smaller “fry tanks”. Due to ease of tank maintenance the two families remaining in the “fry tanks” were transferred to the larger tanks on May 30th. Mortalities from all tanks were relatively low during the sac fry stage at less than 40/day.

All tanks were feeding on Brine shrimp by May 25th and by May 29th some of the fish were already eating chopped up Blood worms. Fish were fed a combination of brine shrimp and chopped blood worms until June 19th when they were moved to all blood worms. Mortalities increased during this period mostly due to the fish not converting over to eating brine shrimp or to blood worms. These fish eventually starve to death. June 19th weight counts showed the fish to range from 7.38 fish/gram up to 8.9 fish /gram. Fish were fed at about 45% to 50% of their body weight per day.

On July 1 a certified vet performed a fish health check and collected virology samples from all families. Fish were inventoried by weighing and hand counting them back into the tanks on July 8th. Tank 1 (female 1) contained 827 fish that were 2.1 fish/g. Tank 2 (female 4) had 670 fish that were 1.96/g. Tank 3 (female 5) had 647 fish at 1.33/g. Tank 4 (female 3) had 530 fish that were 1.53/g. Mortalities during this time period are very low at about 0 to 5 per tank per day.

On July 23rd weight counts showed that the fish were growing extremely well. The fish from the 4 tanks ranged from 155/lb (about 2.8” long) to 225/lb (2.5” long). From July 8th to July 23rd mortalities per tank continued at very low levels. Fish were being fed a combination of whole blood worms and krill at about 30% of their body weight per day.

On August 11th, after virology tests results showed no VHS was present, 1,109 fish (15.6 lbs) that averaged 4” were stocked into the Kewaunee River. All the fish stocked were given a Left Ventral fin clip. The largest fish from each family were selected to be returned to the tanks for continued rearing. The fish continued to grow well under very good rearing conditions. Fish were being fed a combination of whole blood worms and krill, with more krill than blood worms, at about 25% of their body weight per day.

On September 1st another 244 left ventral clipped fish (6.26 lbs) were stocked to get each tanks numbers down to near the desired final stocking numbers of 250 per tank. The stocked fish averaged 5.6” in length. Clipped fins were collected and preserved in ETOH and later transferred to UWSP for genetic analysis and storage. Fish were being fed mostly krill at about 16-20% of their body weight per day with occasional additions of blood worms and frozen earth worms.

On September 24th all remaining fish were left vent clipped, PIT tagged, individually weighed (g) and measured (mm) prior to final stocking. Seven fish were also implanted with sonic tags to track their downstream movements after stocking. The sonic tags were set up to send out signals for about 50 days. Five hydrophone receivers were placed in the river at various sites to track any downstream movement of the tagged fish.

At the time of stocking, sturgeon averaged 190.5mm (7.5”) and 27.9g (1.0 oz) at the Kewaunee River SRF. The fish from the Kewaunee SRF grew quite well after about mid July probably due to lower tank densities and converting the fish to Krill as soon as possible. From first feeding until about mid July the fish were fed at least 3 times per day. After mid July they were fed 3 times per day during the weekdays and only 1-2 times per day on most weekend days. It was felt that by mid July the fish were large enough to be able to handle not getting a full ration of food over the weekend time periods. Also, belt feeders were not used as extensively as at the Milwaukee River SRF due to the feeling that the feed would be fresher, more palatable, and retain the nutrient content if fed freshly thawed.

In 2009, we used the same system to track lake sturgeon after stocking on the Kewaunee River that had been previously done on the Milwaukee River in 2007 and 2008. This system, developed by VEMCO Inc., uses surgically implanted sonic tags in the fish and under water hydrophones placed throughout the river to detect fish passage. The sonic tags send a coded ping every 30 to 90 seconds that gets transmitted from the fish into the water and then detected by the hydrophones. The main benefit to this new system is that daily and weekly surveys do not have to be conducted because the detection is conducted by the under water hydrophones. These hydrophones continuously check for the sonic tags and the data can be downloaded once the tags have stopped working.

On September 21, 2007, DNR staff implanted 7 sonic tags in lake sturgeon larger than 35 grams. The hydrophones were deployed at 5 locations throughout the Kewaunee River 2 days before stocking. Specifically these units were placed at County Road F (0.3 miles from stocking location), Footbridge (1.3 miles from stocking location), County Road E (4.3 miles from stocking location), Railroad Bridge (5.8 miles from stocking location) and Hwy 42 (6.5 miles from stocking location). A total of 1,035 lake sturgeon were stocked downstream of the Buzz Besadny Fisheries Facility on September 24, 2009.

Similar to the 2006 - 2008 movement patterns of stocked lake sturgeon observed in the Milwaukee River, these fish initially moved quickly downriver and were detected at the County Road F and Footbridge locations the night of stocking. All seven fish moved passed this hydrophone between the hours of midnight and 3:00 a.m. the night of the stocking.

Six of the seven tagged fish moved at least 1.5 miles downstream from the stocking site within the first two weeks after stocking. In that 1.5 mile stretch of river there are a number of deep water runs that would be sufficient to hold fish for long periods of time, even through the winter. This may explain why only one of the tagged fish was detected beyond the second receiver site. This one individual fish, within a 30 day time period had migrated almost 6 river miles from the stocking location. More movement data is needed to draw and reliable conclusions from this information.

Menominee River Sport Fishery

The Menominee River is the only river open to sport harvest in Lake Michigan waters. Licensed, modern day harvest of lake sturgeon on the Menominee River has occurred since 1946. A mandatory registration system was enacted in 1983. The harvest in that year was 19 sturgeon and the minimum size limit was 50". The bag limit was reduced from 2 to 1 fish per season in 1992. In 1997, Tom Thuemler of WDNR wrote, "An alternative (regulation approach) would be complete closure of the season every other year. This would halve the exploitation rates and yet still allow some harvest, and might be acceptable if catch and release only season operated in the year when harvest was prohibited".

In 2000, the minimum size limit differed in alternating years with a 70" limit in even years and a 50" limit in odd years. The hook and line harvest of lake sturgeon from the Menominee River increased to the following in selected years: 80 in 1989, 109 in 1998, 167 in 1999, 185 in 2001, and 210 in 2003. The harvest in the three 70" size limit years (2000, 2002, and 2004) averaged at 0 fish. While the alternating year's size limits reduced the overall harvest, the average harvest for the last 6 years (1999- 2004) was 94 fish. Fishing pressure since 1999 has increased by 12%/ harvest year. The harvest in 2005 was recorded as 172 lake sturgeon with 136 stemming from waters below the Menominee Dam.

The Menominee River is jointly managed with the State of Michigan. The agencies decided that current harvest extractions were negatively impacting the recovery of lake sturgeon in the Menominee River and Green Bay. The State of Michigan adopted the following regulation for the 2006 hook and line season: catch and release only below the Menominee Dam, one lake sturgeon per angler with a minimum size limit of sixty inches above that dam and open season from first Saturday in September to September 30. Wisconsin Department of Natural Resources adopted the same regulations in 2006. Those regulation changes reduced the harvest to one lake sturgeon in 2006, 0 in 2007, one in 2008, and three in 2009.

LAKE WHITEFISH

Scott Hansen

Commercial Harvest

Lake whitefish *Coregonus clupeaformis* harvest in Wisconsin's waters of Lake Michigan continued at high levels for the 2009 calendar year with 1,489,176 dressed weight pounds of fish harvested (Figure 1). The 2009 harvest increased over 150,000 pounds from 2008 and exceeds the 20 year average of approximately 1.39 million pounds. Commercial whitefish harvest in Wisconsin is regulated though quota years beginning in July through June with a closed period during spawning. The initial quota established in 1989-90 was 1.15 million pounds. It increased to 2.47 million pounds during the 1998-99 quota year and has remained there since. The 2008 – 09 commercial harvest was 1,338,808 pounds. This ranks as the fifth lowest harvest on record since the last quota increase (Table 1).

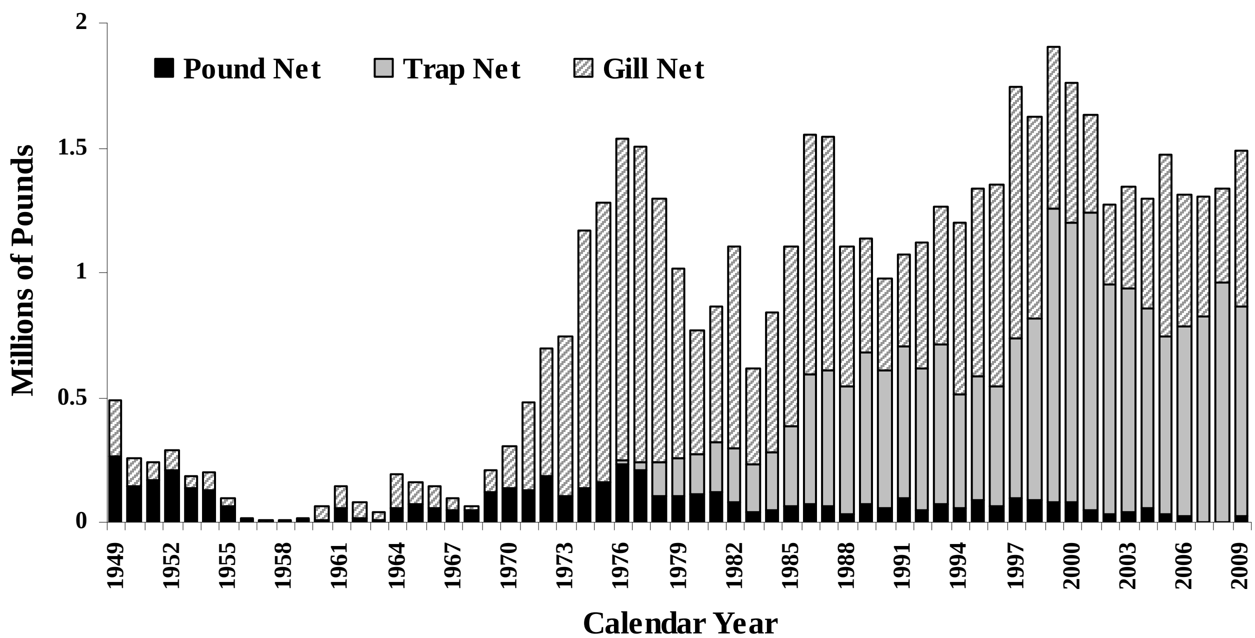


Figure 1. Lake whitefish calendar year commercial harvest reported by gear type in pounds (dressed weight) from Wisconsin waters of Lake Michigan including Green Bay from 1949 through 2009.

Wisconsin commercial fishermen have used trap nets as a legal gear to harvest lake whitefish from Lake Michigan since 1976. The use of trap nets has increased steadily since 1990 and on average has annually accounted for over 50 percent of the whitefish harvest. For the calendar year, the total proportion of whitefish harvested by trap nets dropped from 71.6% in 2008 to 56.2% in 2009 while the proportion of whitefish harvested by gillnets increased from 28.4% in 2008 to 42% in 2009 (Figure 1). Pound nets accounted for 1.9% of the harvest in 2009.

Table 1. Lake whitefish harvest in Wisconsin since the last quota increased to 2.47 millions pounds, broken down by zone through the 2008-2009 quota year. Quotas for zones 1 thru 3 were 225,518, 2,029,662, and 214,820, respectively.

Quota Year	Zone 1 Harvest	Zone 2 Harvest	Zone 3 Harvest	Total Harvest
1998-99	143,225	1,474,605	182,486	1,800,316
1999-00	57,659	1,516,187	193,592	1,767,438
2000-01	72,496	1,330,107	210,604	1,613,207
2001-02	39,333	1,301,209	129,084	1,469,626
2002-03	107,827	1,085,599	131,344	1,324,770
2003-04	81,525	1,050,697	111,389	1,243,611
2004-05	129,081	1,248,689	166,319	1,544,089
2005-06	173,563	1,104,843	118,823	1,397,229
2006-07	181,289	901,935	214,909	1,298,133
2007-08	180,835	938,005	215,228	1,334,068
2008-09	182,614	944,580	211,614	1,338,808

While trap net gear continues to be the primary gear type for whitefish harvest, its effort has generally declined since 2003 with the exception of a considerable increase of 452 pots lifted between 2005 and 2006 (Figure 2). The effort since then has continued to decline although there was a small increase of 81 pots lifted between 2008 and 2009. Meanwhile, after a spike in 2005 and subsequent decline the following two years, gillnet effort continues to increase since 2007 with an additional 280,000 feet of net fished between 2008 and 2009. Trap net catch per unit of effort (CPE) declined considerably in 2009 by over 67 pounds per lift (Figure 3). Gillnet CPE on the other hand increased by 21 pounds per 1000 ft fished between 2008 and 2009. Pound nets were fished in 2009 after a 2-year hiatus. This gear continues to be very effective with a 2009 CPE of over 2008 pounds per pound net lift. This ranks as the second highest CPE since 1979. However, the overall effort of 14 lifts for 2009 ranks as the lowest level of effort when pound nets are fished.

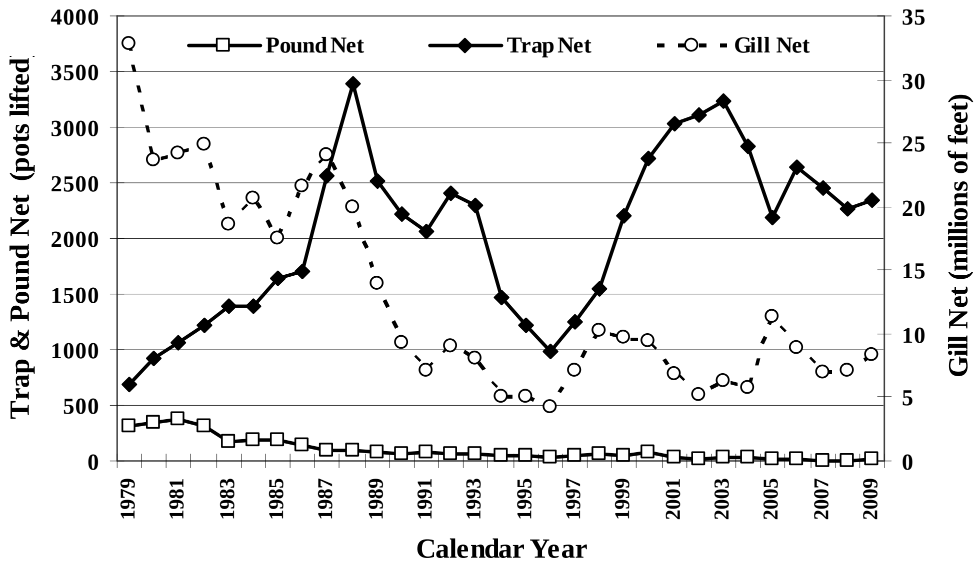


Figure 2. Trends in gill net, trap net, and pound net effort fished for lake whitefish in Wisconsin waters of Lake Michigan including Green Bay, 1979 – 2009. Gill net effort is in millions of feet; trap and pound net effort is number of pots lifted.

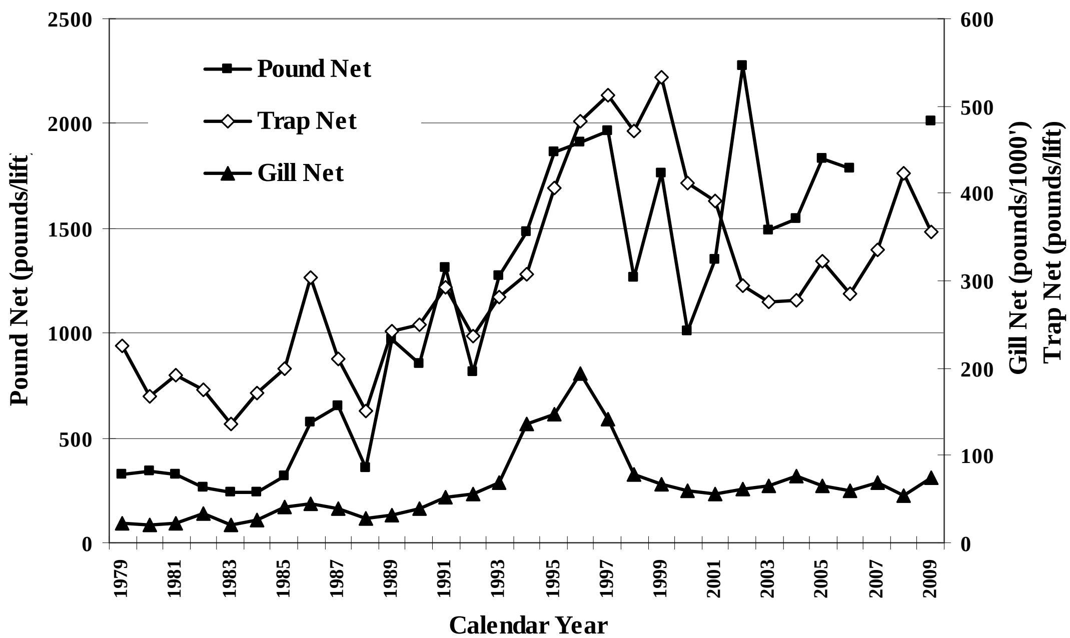


Figure 3. Trends in gill net, trap net, and pound net catch per unit of effort (CPE) in the Wisconsin waters of Lake Michigan including Green Bay, 1979 – 2009. Gill net CPE is pounds of whitefish harvested per 1,000 feet lifted; trap and pound net CPE is pounds of whitefish harvested per pot lifted.

Growth

Mean length and weight-at-age of lake whitefish from the North-Moonlight Bay (NMB) stock have demonstrated a general decline since around 1995 (Figures 4 and 5). However, while still low, mean length and weight for spring sampled fish have generally continued to rebound from historically low levels set in 2007. The average age for fish first recruiting to the commercial fishery (432 mm) remained at age seven in 2009 after bottoming out at age eight in 2007. Within the past 5 -10 years, obtaining a viable sample size of younger whitefish age classes near NMB has become difficult. In the spring of 2007 we began sampling for juveniles in Green Bay with some success. Spring sampling efforts in Green Bay have continued to increase and constitute the majority of the spring 2009 assessment data. However, a certain level of stock mixing is suspected to occur in Green Bay depending on the time of year. Therefore, the consistency in measuring growth of NMB fish over time may now be affected by fish from other stocks as a result of the respective differences in stock specific growth rates.

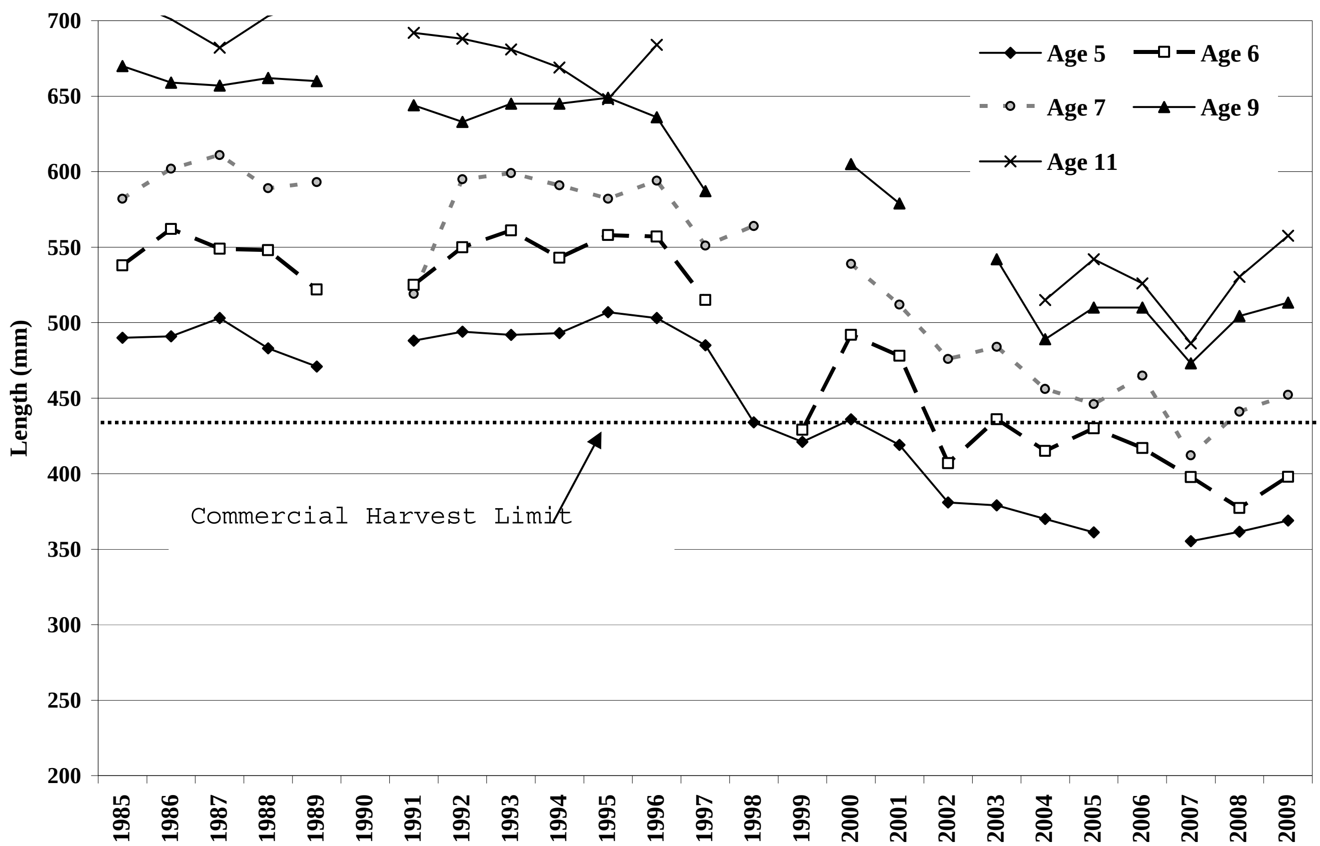


Figure 4. Mean length at age of spring sampled lake whitefish from 1985 thru 2009.

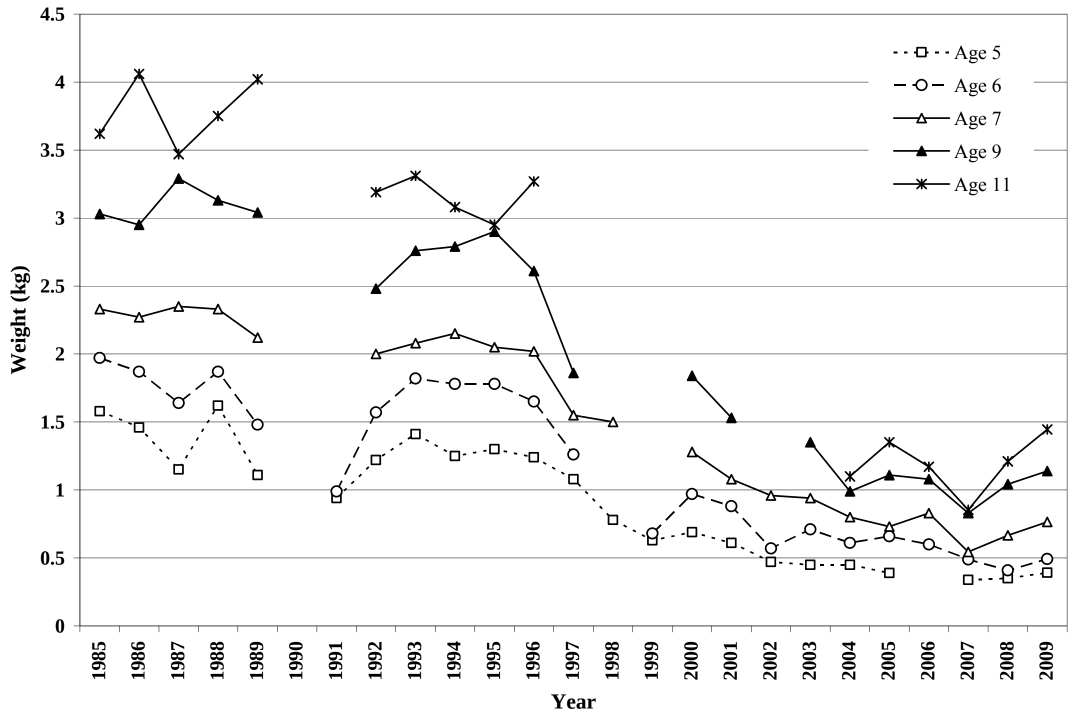


Figure 5. Mean weight at age of spring sampled lake whitefish from 1985 thru 2009.

Sport Angler Harvest

Beginning in the winter of 2006-2007, a sport fishery for lake whitefish developed on the bay of Green Bay at levels unprecedented in recent history. The winter creel season of 2007 recorded the first significant lake whitefish harvest of an estimated 1,559 fish.

Winter creel surveys for Green Bay are conducted during the months of January, February, and March and are designed primarily to assess the winter perch fishery. Because popular fishing areas for whitefish and perch do not necessarily overlap, lake whitefish sport harvest may be underestimated. For the winter of 2009, estimated whitefish harvest was 54,226 fish, a decrease of approximately 7,500 fish from the 2008 harvest. However, angler effort directed toward whitefish increased more than three-fold from 28,114 hours in 2008 to 88,733 hours in 2009. Harvest rates specific to whitefish in 2009 were 0.075, 0.282, and 0.981 fish per hour of fishing for January, February, and March, respectively. The overall average directed harvest rate was 0.371 per hour of fishing for the winter of 2009. This is a decrease of nearly 25% from the 2008 harvest rate for lake whitefish.

COMMERCIAL CHUB FISHERY AND CHUB STOCKS

Timothy Kroeff and David Schindelholz

The total chub harvest from commercial gill nets was 182,249 pounds for calendar year 2009, a decrease of 27% from 2008 (Tables 1 and 2). Commercial smelt trawlers harvested 19,370 pounds of unmarketable chubs incidental to the targeted smelt harvest and only 15 pounds of marketable chubs were reported for the year. This compares to 91,965 pounds of unmarketable chubs harvested in 2008 and 1,542 pounds of marketable chubs harvested.

Table 1. Harvest, quota, number of fishers and effort (feet) for the Southern Chub Fishing Zone gill net chub fishery 1979-2009. The actual quota is broken down into three separate periods and runs from July 1 of the previous year to June 30 of the current.

YEAR	HARVEST	QUOTA	FISHERS	EFFORT (x1,000 FT)	CPE
1979	992,143	900,000		12,677.2	78.3
1980	1,014,259	900,000		21,811.6	46.5
1981	1,268,888	1,100,000		18,095.6	70.1
1982	1,538,657	1,300,000		16,032.6	96.0
1983	1,730,281	1,850,000		19,490.0	88.8
1984	1,697,787	2,400,000		30,868.7	55.0
1985	1,625,018	2,550,000		32,791.1	49.6
1986	1,610,834	2,700,000		34,606.1	46.5
1987	1,411,742	3,000,000	59	32,373.9	43.6
1988	1,381,693	3,000,000	60	58,439.0	23.6
1989	1,368,945	3,000,000	64	48,218.1	27.6
1990	1,709,109	3,000,000	54	41,397.4	41.3
1991	1,946,793	3,000,000	58	45,288.3	43.0
1992	1,636,113	3,000,000	53	40,483.7	40.4
1993	1,520,923	3,000,000	58	42,669.8	35.6
1994	1,698,757	3,000,000	65	35,085.5	48.4
1995	1,810,953	3,000,000	59	28,844.9	62.8
1996	1,642,722	3,000,000	56	27,616.6	59.5
1997	2,094,397	3,000,000	53	28,441.8	73.6
1998	1,665,286	3,000,000	49	23,921.1	69.6
1999	1,192,590	3,000,000	46	25,253.2	47.2
2000	878,066	3,000,000	41	22,394.7	39.2
2001	1,041,066	3,000,000	44	26,922.8	38.7
2002	1,270,456	3,000,000	47	24,940.5	50.9
2003	1,069,148	3,000,000	43	22,613.0	47.3
2004	1,057,905	3,000,000	43	21,468.9	49.3
2005	1,213,345	3,000,000	43	24,119.8	50.3
2006	807,031	3,000,000	40	19,110.4	42.2
2007	410,025	3,000,000	43	13,837.4	29.6
2008	227,026	3,000,000	39	9,823.2	23.1
2009	165,158	3,000,000	37	7,960.8	20.7

Table 2. Harvest, quota, number of fishers and effort (feet) for the Northern Chub Fishing Zone

gill net chub fishery 1981-2009.

YEAR	HARVEST	QUOTA	FISHERS	EFFORT (x1,000 FT)	CPE
1981	241,277	200,000		4,920.4	49.0[a]
1982	251,832	200,000		3,469.8	72.5
1983	342,627	300,000		6,924.7	49.5
1984	192,149	350,000		6,148.4	31.2
1985	183,587	350,000		3,210.0	57.2
1986	360,118	400,000		7,037.2	51.2[b]
1987	400,663	400,000	23	6,968.6	57.5
1988	412,493	400,000	23	8,382.3	49.2
1989	329,058	400,000	25	8,280.8	39.7
1990	440,818	400,000	23	8,226.4	53.6
1991	526,312	400,000	22	9,453.5	55.7
1992	594,544	500,000	24	11,453.1	51.9
1993	533,709	500,000	24	15,973.6	33.4
1994	342,137	500,000	24	8,176.2	41.8
1995	350,435	600,000	24	5,326.4	65.8
1996	332,757	600,000	24	4,589.7	72.5
1997	315,375	600,000	23	4,365.6	72.2
1998	266,119	600,000	23	3,029.0	87.9
1999	134,139	600,000	23	1,669.7	80.3
2000	77,811	600,000	21	2,199.5	35.4
2001	36,637	600,000	21	972.4	37.7
2002	63,846	600,000	21	1,098.6	58.1
2003	102,692	600,000	21	2,326.5	44.1
2004	50,029	600,000	21	1,354.0	36.9
2005	50,831	600,000	21	1,376.8	36.9
2006	36,285	600,000	19	1,011.1	35.9
2007	6,590	600,000	18	216.0	30.5
2008	23,942	600,000	18	845.0	28.3
2009	17,091	600,000	18	831.4	20.6

[a] For the years 81-85, 90 & 91, 98-09 totals were by calendar year.
[b] For the years 86-89 & 92-97 the totals were through Jan. 15 of the following year.

By zone, the harvest in the south was 165,158 pounds, which was a decrease of 27% from 2008, or 5.5% of the allowed quota of 3 million pounds. The 2009 chub catch for this zone is easily the lowest on record since chub fishing reopened in 1979. The southern zone is basically waters from Algoma south to Illinois. In the north, 17,091 pounds were reported caught, a 29% decrease from 2008. Only 3% of the northern quota of 600,000 pounds was caught. This is the second lowest yearly catch since chub fishing reopened in 1981. The northern zone is basically waters from Baileys Harbor north to Michigan. The southern zone showed a 10% decrease in CPE from the previous year while the CPE in the north dropped by 27% from the year before. These catch rates for both zones were almost identical and also the lowest on record since chub fishing reopened. Gill net effort in the south decreased by 19% or 1,862,400 feet while effort in the north decreased 13,600 feet or 2%. In the south, 14 of the 37 permit holders reported harvesting chubs, while in the north, 7 of 18 permit holders reported harvesting chubs.

Population assessments with graded-mesh gill nets (1,300 ft. per box), were conducted off Algoma and Baileys Harbor in September 2009 and off Kenosha in November 2009 (1 box per lift) set along with standard 2-1/2 inch gill nets. Two assessment lifts were made off both Algoma and Baileys Harbor while one was made off Kenosha. Net nights totaled 18 for all sights combined. Samples were collected out of standard mesh gear at all sights and aging results were combined.

Catches from graded-mesh gill nets continue to be poor off Algoma and Baileys Harbor. Because of such poor catches, data was pooled off these two sites. Chubs up to 19 years of age were collected off Kenosha and up to 20 years of age off Algoma/Baileys Harbor (Figure 1). Chubs ages ranged from 5 to 19 caught off Kenosha and 4 to 20 off Algoma/Baileys Harbor. Female chubs out-numbered male chubs in all assessment nets but at younger ages males were more prevalent. It is believed that female chubs outlive males.

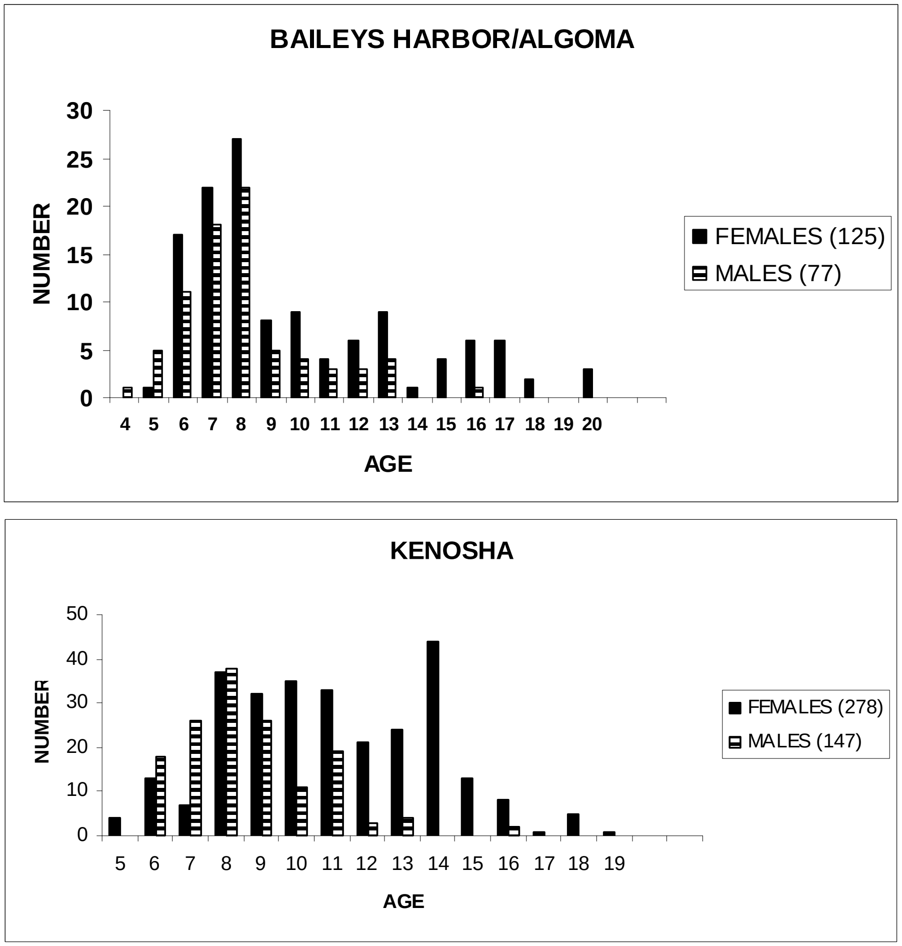


Figure 1. Age composition by number and sex of chubs captured during graded-mesh assessments along the Wisconsin L. Mich. shoreline, 2008-09

Catches of chubs in the standard 2-1\2 inch mesh were poor off Algoma/Baileys Harbor and for reporting means were combined with standard mesh fish caught off Kenosha. Ages from standard mesh ranged from 6 to 21 years of age (Figure 2). Sex ratios continue to be high on the female side with the catch showing 80% females in 2009, identical to the 2008 percentage. Some comparisons to earlier years showed 88% in 2007, 80% in 2006, 90% in 2005 and 80% in 2004. An advantage of the female dominated population in the commercial fishery is an added profit in the sale of chub roe to the caviar market during the late fall and winter.

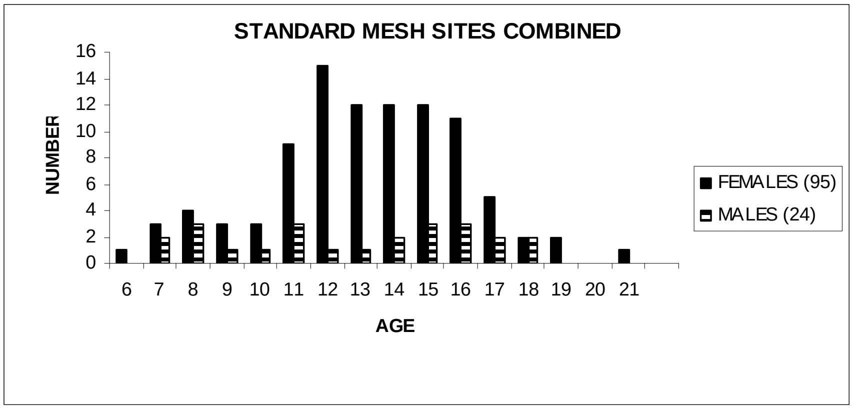


Figure 2. Age composition by numbers and sex caught from standard mesh gill nets off Algoma/Baileys Harbor and Kenosha combined.

Acknowledgement

We are grateful to Phil Anderson, a commercial fisherman out of Kenosha, for the setting and lifting of assessment nets off Kenosha, essential to the completion of this project

GREEN BAY FORAGE TRAWLING

Steve Hogler and Steve Surendonk

In 2003, the Wisconsin DNR began a project to assess forage fish on Green Bay that utilized sampling protocols and trawl gear developed by the U.S.G.S. for forage assessment on Lake Michigan. We trawl during daylight hours in September using a 39-foot headrope trawl net. A five minute trawl at 2 MPH is made at ten foot depth increments following contours beginning at 50 feet along two transects that cross the commercial trawling zone. Transects in 2003 began at the entrance buoy to Sturgeon Bay and ran northwesterly toward either Marinette or Peshtigo Point. In 2004 new transects as shown in Figure 1 were established to improve coverage and have been sampled each year since.

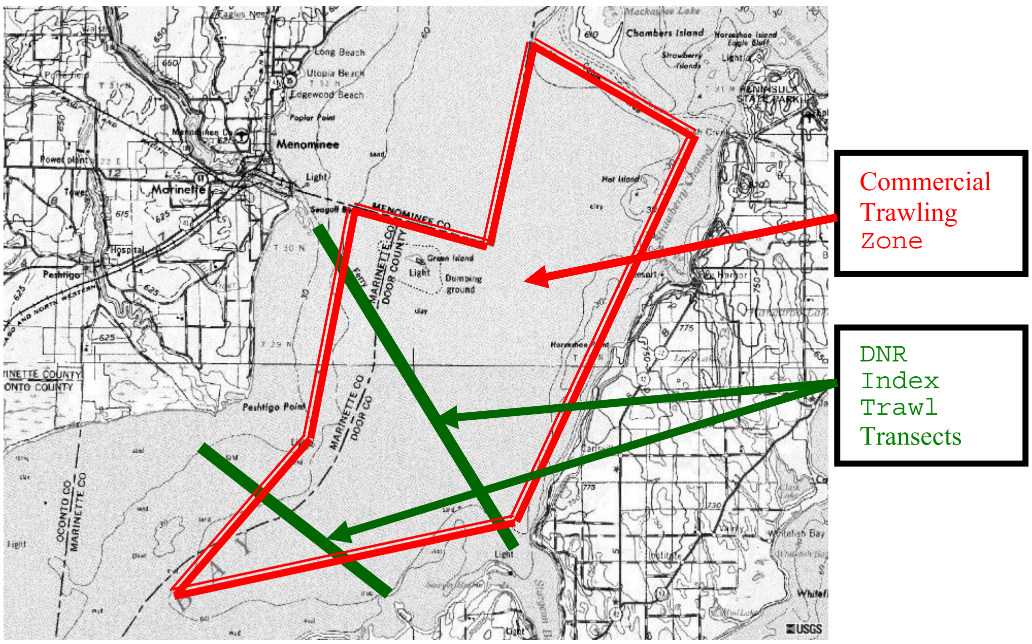


Figure 1. The location of the index trawling transects in relation to the Green Bay commercial trawling zone.

In 2009, both transects were sampled starting at 50 feet and continued across Green Bay in ten foot increments with a total of six- 5 minute drags made along each transect. The catch from each trawl drag was bagged and retained for laboratory analysis. For each sample, individual fish were sorted by species and weighed in aggregate. A subsample of fish from each drag was measured to develop length frequencies. Dreissenid mussels were sorted from the fish catch and an aggregate weight measured. Catch from similar depths (east and west) along each transect were combined to determine the catch by depth.

Along the north transect the total weight of the catch and CPE (kg/hour trawled) decreased with depth from 50 feet through 80 feet before sharply increasing at 90 feet (Figure 2). Overall, with all drags combined by weight, two fish species, round goby and lake whitefish and dreissenid mussels accounted for 91.5% of the biomass captured along the north transect. The diversity of the catch was the greatest at 50 feet and 60 feet and the lowest at 80 feet.

At 50 feet and 60 feet the catch by weight was dominated by dreissenid mussels and round goby (Figure 2). Other common species collected at these depths included yellow perch, trout-perch and rainbow smelt. Rainbow smelt and lake whitefish were the dominant species at 70 feet. Other commonly captured species at this depth included alewife and dreissenid mussels. At 80 feet round goby dominated the catch with rainbow smelt and alewife caught in much lower weights. Lake whitefish, round goby and white sucker dominated the catch at 90 feet. Fish captured along the north transect and reported in the category listed as other included trout-perch, spottail shiner and ninespine stickleback.

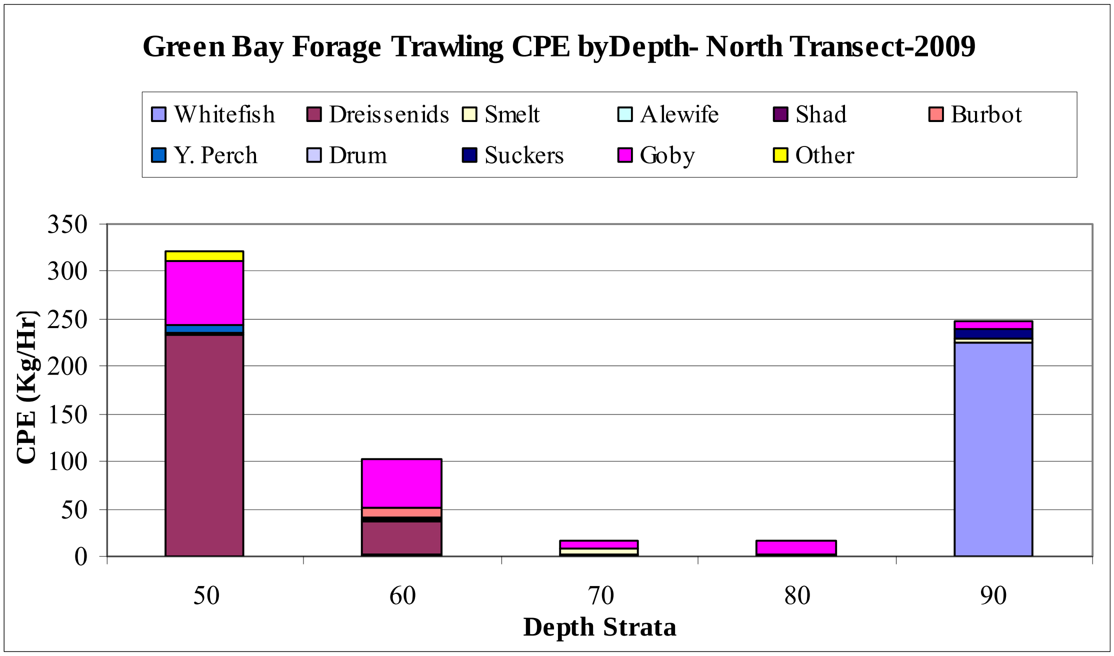


Figure 2. The 2009 CPE (kg/hr) of fish captured by species and depth strata on the north transect on Green Bay.

Unlike the north transect, CPE (kg/ hour trawled) across the south transect increased from 50 feet to 60 feet before decreasing at 70 feet and 80 feet (Figure 3). However, similar to the north transect, Dreissenid mussel, lake whitefish and round goby dominated the catch and accounted for 70.8% of the catch by weight. Alewife was also commonly caught along this transect and the diversity of the catch was similar at all depths.

Dreissenid mussels and round goby dominated the catch at 50 feet. Other commonly caught species at this depth included rainbow smelt, yellow perch and trout-perch. At 60 feet the catch was dominated by dreissenid mussels and round goby with rainbow smelt, lake whitefish and yellow perch captured in much lower weights. At 70 feet and 80 feet, lake whitefish was the dominant species captured. Alewife, round goby, white sucker and rainbow smelt were also commonly captured at these depths.

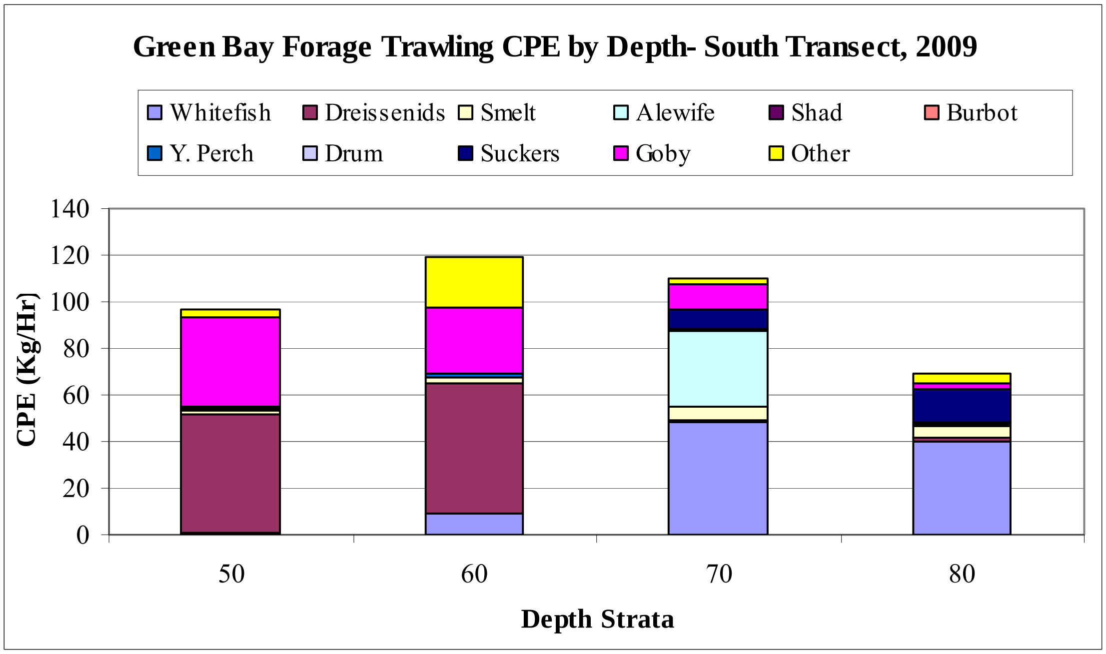


Figure 3. The 2009 CPE (kg/hr) of fish captured by species and depth strata on the south transect on Green Bay.

Seven years of trawling data allows us to make several general statements about the survey results. First, total catch and CPE decreased in 2009 from 2008 levels and was our lowest catch of the time series (Figures 4 and 5, Appendix 1 and 2). The catch trends noted on each transect mirrored each other with similar catches in 2003 and 2004, sharply increased catches in 2005 and 2006 and lower, but mostly steady catches from 2007 through 2009. It appears that in the years of our highest catches we captured large numbers of adult lake whitefish and white sucker. Although present in o

Second, there appears to be a difference in the catch between the north and south transects although they are less than 10 km apart (Figures 1, 4 and 5). During the first five years of trawling, the catch along the north transect was consistently more diverse than the catch on the south transect which tended to be dominated by one or two species. It was believed that the diversity of fish species found along the north transect was a reflection of the diversity of habitat that is sampled along that transect. The southern transect is dominated by open water habitats at all depth strata, while the northern transect has a protected bay on the eastern end and a shallow water flat on the western end (Figure 1). However, during the past two years the southern transect has become more diverse while diversity has declined along the northern transect. It is not clear why, although we suspect warmer water temperatures and perhaps low dissolved oxygen levels near the bottom may account for the differences that we noted in 2009.

Third, round goby and dreissenid mussels are well established in Green Bay. In 2009 dreissenid mussels and round goby were captured in nearly every tow and accounted for 32.8% and 22.3% of our total catch by weight respectively. Both are slightly more abundant along the north transect than on the south transect.

Fourth, lake whitefish based on our catch are abundant in Green Bay. Although our catch trend for adult whitefish has been variable with fewer caught the past several years, the catch trend for young of year and age 1+ lake whitefish has been increasing throughout this survey.

Finally, on Green Bay, the rainbow smelt population trend remains unclear. Total rainbow smelt CPE and young of year abundance decreased in 2009 after an increase in 2008 following several years of poor catches (Figures 4 and 5). Past history has shown that CPE obtained during this survey is a poor predictor of rainbow smelt population trends in Green Bay. Low rainbow smelt catches in 2003 and 2004 did not predict that the highest CPE of rainbow smelt caught during this time series would be in 2005. Likewise good rainbow smelt CPE in 2005 did not predict the low CPE measured in 2006.

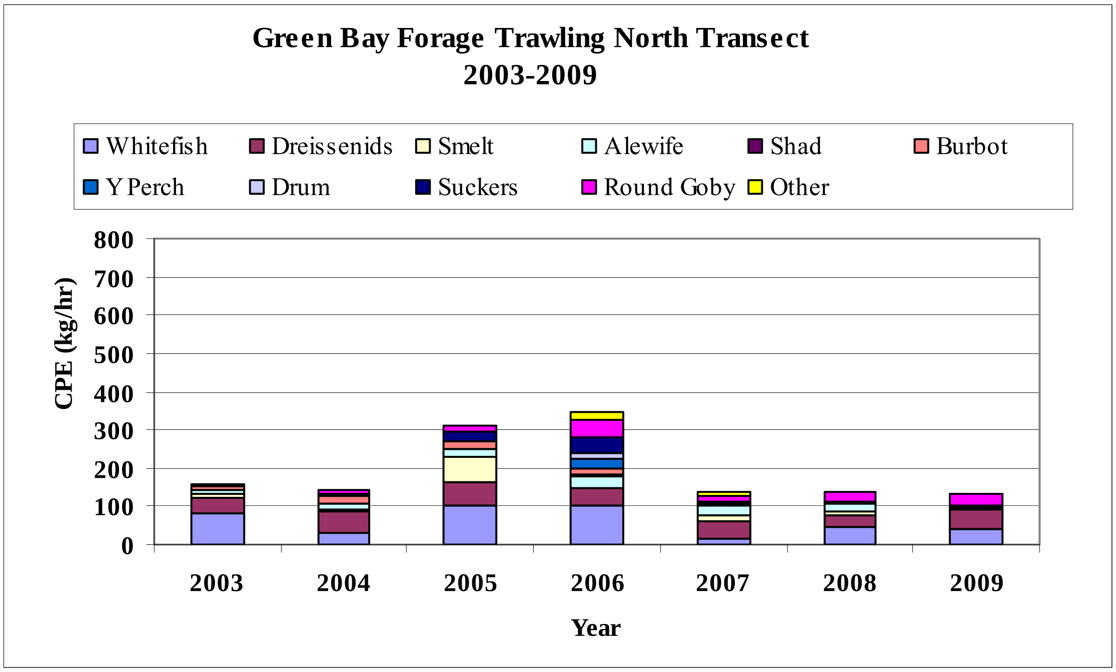


Figure 4. CPE by species for fish and mussels captured during trawling on Green Bay along the north transect, 2003-2009.

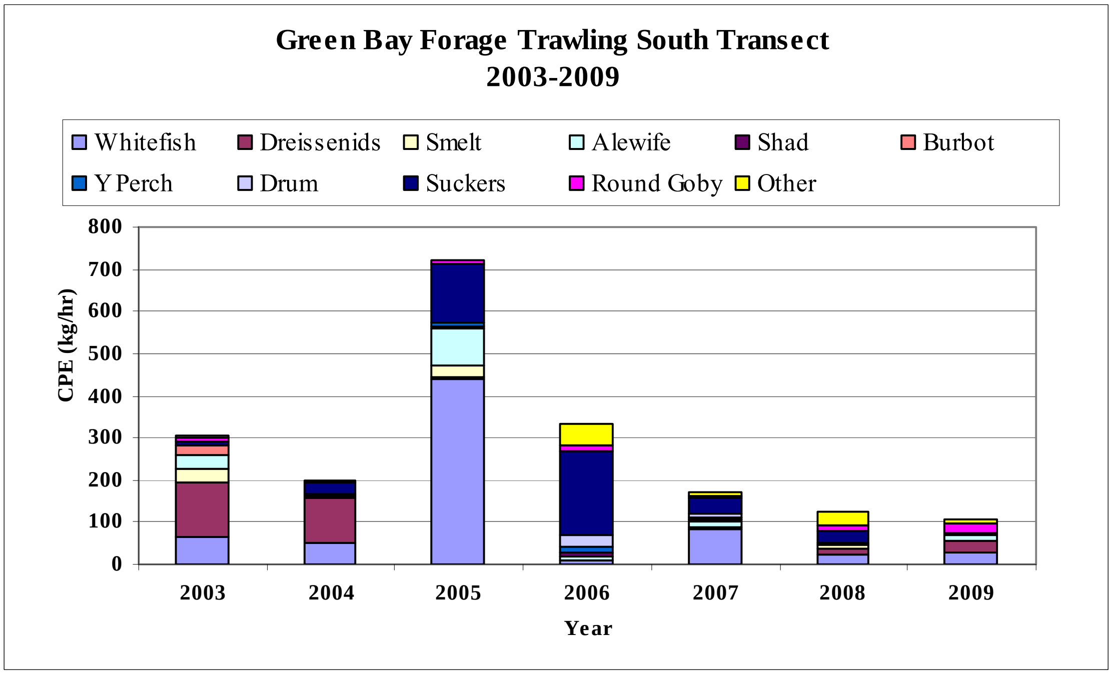


Figure 5. CPE by species for fish and mussels captured during trawling on Green Bay along the south transect, 2003-2009.

Appendix 1. Green Bay forage trawling CPE (kg/hour trawled) by species on the north transect 2003-2009.

	2003	2004	2005	2006	2007	2008	2009
Whitefish	80.6	32.7	99.4	102.9	17.3	44.7	39.0
Dreissenids	44.1	55.7	65.4	44.5	42.2	33.1	50.7
Smelt	6.2	4.7	63.7	1.2	14.6	9.3	2.4
Alewife	11.7	14.1	21.5	28.6	26.8	19.4	0.2
Gizzard Shad	0.0	0.0	0.0	3.9	0.8	0.0	0.4
Burbot	8.7	20.0	21.7	16.8	2.9	1.9	3.6
Yellow Perch	0.2	2.8	0.8	25.2	7.1	0.2	1.3
F.W. Drum	0.0	0.0	0.0	17.7	0.0	0.0	0.0
Suckers	3.1	2.9	20.7	41.2	1.9	5.8	1.8
Round Goby	2.5	7.6	18.2	43.1	13.0	22.6	33.1
Other	2.5	0.7	2.0	19.3	11.5	0.5	1.7
Total	159.5	141.3	313.3	344.4	138.1	137.5	134.2

Appendix 2. Green Bay forage trawling CPE (kg/hour trawled) by species on the south transect 2003-2009.

	2003	2004	2005	2006	2007	2008	2009
Whitefish	65.0	52.9	439.6	9.8	81.4	23.2	25.9
Dreissenids	129.8	102.5	5.6	0.4	3.6	15.2	27.6
Smelt	31.4	4.1	24.9	0.2	3.2	5.8	4.1
Alewife	32.5	4.8	90.4	9.1	12.5	3.3	11.2
Gizzard Shad	0.0	0.0	0.1	6.1	3.8	0.0	0.0
Burbot	23.5	0.0	5.0	3.4	0.0	0.0	0.0
Yellow Perch	0.1	2.1	9.7	14.3	5.0	4.1	1.0
F.W. Drum	0.0	0.6	0.2	26.0	12.5	0.0	0.0
Suckers	7.1	25.1	137.5	201.1	34.5	26.5	5.3
Round Goby	10.5	5.0	8.5	10.8	3.4	13.5	20.0
Other	4.4	2.9	1.5	52.6	12.4	33.1	9.2
Total	304.1	200.2	722.9	333.8	172.3	124.7	104.3

SMELT WITHDRAWAL BY THE COMMERCIAL TRAWL FISHERY

Steve Hogler and Steve Surendonk

Historically, commercial trawling targeted three main species of fish in the Wisconsin waters of Lake Michigan. Much of the harvest was a general forage catch that caught large numbers of fish, chiefly alewife *Alosa pseudoharengus*, rainbow smelt *Osmerus mordax*, and bloater chub *Coregonus hoyi*. The other portion of the trawl fishery was a targeted rainbow smelt harvest. With the adoption of new rules in 1991 the general forage harvest component of the fishery was eliminated. Targeted rainbow smelt trawling rules were established for the waters of Lake Michigan and Green Bay and the quota was set at 1,000,000 pounds, of which no more than 25,000 pounds could be harvested from Green Bay.

During 2009, commercial trawlers reported catching 22,845 pounds of rainbow smelt during the calendar year (Figure 1). The 2009 reported harvest was the lowest since 1983 and well below the average harvest of 337,577 pounds for the previous three years. In 2009 trawlers harvested only 13% of what they harvested during the previous year.

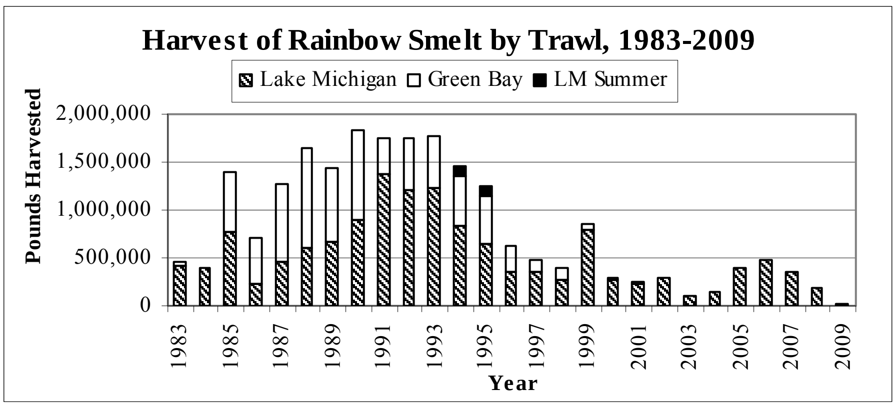


Figure 1. Reported rainbow smelt harvest by trawl from the Wisconsin waters of Lake Michigan for the years 1983 through 2009.

In 2009, trawlers harvested 22,835 pounds of rainbow smelt from Lake Michigan (Figure 1) with a CPE of 75 pounds per hour trawled (Figure 2). The 2009 rainbow smelt harvest on Lake Michigan was the lowest on record since mandatory reporting began in 1983 and was only 1.7% of the record harvest of 1,366,419 pounds in 1991 (Figure 1). Similarly, CPE in 2009 sharply declined from previous year and was the lowest on record (Figure 2).

Commercial trawlers fished on Green Bay in 2009 making it only the second time in the past five years they have done so during the summer rainbow smelt season. In 2009 harvest was minimal with 10 pounds harvested yielding a CPE of 5 pounds per hour trawled (Figures 1 and 2). The lack of fishing effort on Green Bay in 2009 continued the trend of declining harvest, CPE and effort noted on the Wisconsin waters of Green Bay since 1991.

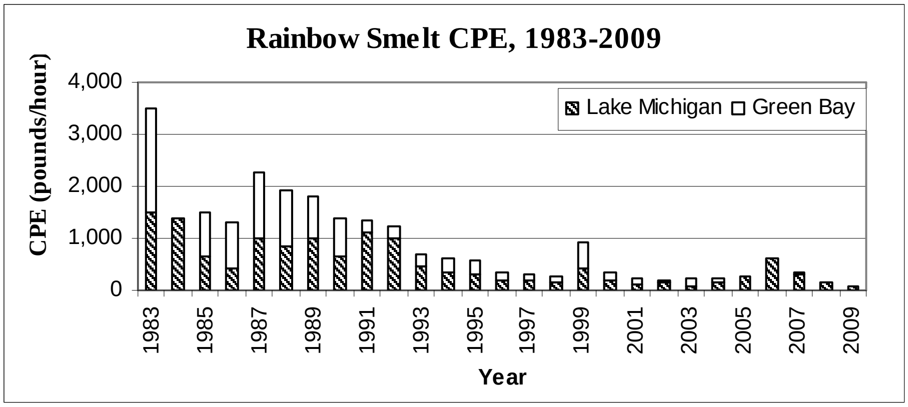


Figure 2. Rainbow smelt CPE in pounds per hour trawled on Lake Michigan and Green Bay during the years 1983 through 2009.

Commercial rainbow smelt trawlers experienced a very poor Lake Michigan season in 2009 continuing the trend of poor harvests noted since 2000. In addition to the low harvest of rainbow smelt from Lake Michigan, the lack of effort and harvest of rainbow smelt from Green Bay seems to indicate that in Green Bay the rainbow smelt population is below what is needed to make commercial harvest feasible.

The decrease in rainbow smelt harvest by trawlers in 2009 was not unexpected. Historically, increases or decreases in the rainbow smelt harvest by trawlers have been broadly predicted by U.S.G.S. biomass estimates based on fall forage surveys. Bottom trawling surveys conducted by the U.S.G.S. in 2008 indicated that the estimate of rainbow smelt biomass in 2008 was just slighter higher than the previous estimate which was the lowest on record (Bunnell et al 2009). Surveys using acoustic sampling found that the 2008 rainbow smelt biomass estimate was similar to the 2007 estimate (Warner et al 2009). In addition, Warner reported that rainbow smelt were not evenly distributed throughout the lake with the highest biomass in northern Lake Michigan and in the southeast corner of the lake.

It appears that the trend of increasing abundance of rainbow smelt measured in 2004-2006 U.S.G.S. surveys and by increasing commercial harvest did not translate into a long term increase in rainbow smelt biomass as evidenced by lower biomass estimates in 2007 and 2008 and the declining commercial harvest of rainbow smelt. The reason for the decline in harvest in the commercial rainbow smelt fishery the past three years is not clear, and could be related to increased predation pressure on rainbow smelt by salmonids, patchy distribution of adult rainbow smelt in Lake Michigan, poor overwinter survival of young of year rainbow smelt, changes in lakewide food webs or from other unknown causes. Since the status of the rainbow smelt population in Lake Michigan and Green Bay remains uncertain, the viability of the commercial smelt fishery also is unknown.

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