Lake Michigan Committee
2006Annual Meeting
Windsor, Ontario
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Lake Michigan Management Reports

Lake Michigan Fisheries Team
Wisconsin Department of Natural Resources

CONTENTS

INTRODUCTION

These reports summarize some of the major studies and stock assessment activities by the Wisconsin Department of Natural Resources on Lake Michigan during 2005. They provide specific information about the major sport and commercial fisheries, and describe trends in some of the major fish populations. The management of Lake Michigan fisheries is conducted in partnership with other state, federal, and tribal agencies, and in consultation with sport and commercial fishers. Major issues of shared concern are resolved through the Lake Michigan Committee, which is made up of representatives of Michigan, Indiana, Illinois, Wisconsin, and the Chippewa Ottawa Resource Authority. These reports are presented to the Lake Michigan Committee as part of Wisconsin's contribution to that shared management effort.

This compilation is not intended as a comprehensive overview of available information about Lake Michigan fisheries. For additional information, we recommend that you visit the Department's Lake Michigan web page at http://dnr.wi.gov/org/water/fhp/fish/lakemich/index.htm. Specific points worth noting in these reports include the following:

- ✓ We enjoyed a remarkable sport harvest of chinook salmon in 2005. Not shown here are data showing that size-at-age of chinook salmon continued to decline in 2005. Lakewide chinook stocking will be reduced 25% in 2006 in hopes of achieving a better match between the abundance of predators and the available biomass of their prey. We rely on lakewide forage surveys conducted by the US Geological Survey to keep track of trends in prey abundance. The survey completed in 2005 indicated that the biomass of alewives in 2005 was similar to that in 2004.
- ✓ Natural reproduction by yellow perch in Green Bay has been very good in recent years. We are encouraged about prospects for recovery of the Green Bay yellow perch population, so in 2006 the allowable commercial harvest will be increased to 60,000 pounds and the sport fishing daily bag limit will be increased from 10 to 15.
- ✓ We have some evidence for a strong 2005 year class of yellow perch in Lake Michigan, although we are not yet ready to recommend increased sport or commercial harvests of the adult fish.
- ✓ Lake whitefish size-at-age appears to continue to decline. This may be related to lakewide declines in abundance of the amphipod *Diporeia* and increases in abundance of the quaga mussel.
- ✓ Commercial smelt harvests have increased in recent years, reflecting a modest lakewide increase in smelt abundance. This reverses a declining trend of over 10 years.

For further information regarding any individual report, contact the author at the address, phone number, or e-mail address shown at the end of the report, or contact the Department's Great Lakes Fisheries Specialist, Bill Horns, at 608-266-87782 or william.horns@dnr.state.wi.us.

SPORTFISHING EFFORT AND HARVEST

The open-water fishing effort was 2,790,886 hours during 2005, 1.14% above the five-year average of 2,759,499 (Table 1). The shore and stream fisheries accounted for the majority of the fishing effort decreases in 2005, mostly affected by limited rainfall in spring and fall, leaving most Lake Michigan tributaries water conditions low and clear. However, the ramp and charter fishing effort increased in 2005 by 10.52% and 11.57%, respectively.

Wisconsin Lake Michigan salmonid fishermen had another excellent season in 2005. Although salmon were on the smaller side, they made up for it in their abundance, as salmon fishing has never been better. Both shore and boat anglers continue to have phenomenal success fishing for Lake Michigan salmon. Salmon and trout harvest was 568,298, 16.6% above the five-year average. Chinook dominated the majority of the harvest with 418,918 fish taken, a 33.9% increase over the five-year mean (Tables 2 - 4). This is the highest Chinook salmon harvest in Wisconsin Lake Michigan waters since the start of the creel survey in 1969. Coho salmon harvest decreased to 59,244 fish, 12% below the five-year mean.

The estimated open-water harvest of yellow perch was 307,804 fish, an increase from the last few years (Table 2). In recent years, the yellow perch harvest has been supported mainly by the 1998 year-class. The overall harvest primarily consisted of Green Bay perch which were mostly from the 2003 year-class. The Green Bay totals exceeded those from Lake Michigan waters. Walleye harvest was estimated at 9,402, a slight increase from past years. Northern pike harvest was up to 1,850, and smallmouth bass harvest declined to 8,471 fish, possibly influenced by the tremendous trout and salmon fishing, as more anglers are opting to spend their time fishing for these species rather than targeting smallmouth bass.

For more summaries, check out the Lake Michigan website at http://www.dnr.state.wi.us/org/water/fhp/fish/lakemich/managementreports.htm.

Table 1. Fishing effort (angler hours) by various angler groups in Wisconsin waters of Lake Michigan and Green Bay during 2005 and percent change from the 5-year average (2001 – 2005).

YEAR	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	TOTAL
2005	1,564,578	375,808	277,672	171,597	158,003	243,208	2,790,886
% change	10.52%	3.61%	11.57%	- 4.68%	- 29.77%	- 25.68%	1.14%

Table 2. Sport harvest by fishery type and species for Wisconsin waters of Lake Michigan and Green Bay during 2005.

SPECIES	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	**TOTAL**
Coho salmon	26,221	18,042	13,314	928	413	326	**59,244**
Chinook salmon	171,274	112,058	108,906	5,490	4,409	16,781	**418,918**
Rainbow trout	21,383	13,554	9,837	798	651	2,267	**48,490**
Brown trout	17,150	1,698	1,808	2,005	3,047	1,781	**27,489**
Brook trout	12	0	6	0	0	0	**18**
Lake trout	5,495	4,493	4,051	63	37	0	**14,139**
Northern pike	1,564	0	0	0	0	286	**1,850**
Smallmouth bass	4,178	3,020	0	537	736	0	**8,471**
Yellow perch	276,015	16,309	0	6,508	4,593	4,019	**307,804**
Walleye	8,818	230	0	45	0	309	**9,402**
TOTAL	**532,110**	**169,404**	**137,922**	**16,374**	**14,246**	**25,769**	**895,825**

Table 3. Trout and salmon harvest by species in Wisconsin waters of Lake Michigan, 1986-2005.

Species	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	TOTAL
Brook Trout	4,587	1,369	5,148	2,192	5,927	1,659	4,431	1,967	7,481	1,914	419	299	159	574	199	263	144	126	1	18	38,877
Brown Trout	68,806	82,397	59,397	55,036	45,092	59,164	51,554	64,546	52,397	49,654	38,093	43,224	27,371	37,187	40,966	26,421	35,220	23,654	20,918	27,489	908,586
Rainbow Trout	26,483	56,055	60,860	87,987	51,711	67,877	79,525	104,769	114,776	117,508	77,099	94,470	110,888	84,248	71,829	72,854	74,031	48,548	25,529	48,490	1,475,537
Chinook Salmon	356,900	396,478	176,294	189,251	111,345	139,080	103,564	87,365	99,755	162,888	183,254	130,152	136,653	157,934	136,379	191,378	275,454	317,619	360,991	418,918	4,131,652
Coho Salmon	127,919	111,886	136,695	105,224	64,083	44,195	70,876	74,304	110,001	65,647	104,715	138,423	59,203	56,297	87,927	47,474	102,313	50,625	76,944	59,244	1,693,995
Lake Trout	96,858	113,930	89,227	94,614	75,177	85,841	52,853	61,123	53,989	69,332	36,849	57,954	82,247	39,819	31,151	40,408	39,865	23,881	14,209	14,139	1,173,466
TOTAL	**681,553**	**762,115**	**527,621**	**534,304**	**353,335**	**397,816**	**362,803**	**394,074**	**438,399**	**466,943**	**440,429**	**464,522**	**416,521**	**376,059**	**368,451**	**378,798**	**527,027**	**464,453**	**498,592**	**568,298**	**9,422,113**
Harvest Per Hour	0.1469	0.1593	0.1068	0.1220	0.0979	0.1103	0.0980	0.1213	0.1256	0.1426	0.1481	0.1619	0.1451	0.1331	0.1614	0.1382	0.1789	0.1719	0.1904	0.2036	0.1400

Table 4. Trout and salmon harvest by angler group in Wisconsin waters of Lake Michigan, 1986-2005.

Fisheries Type	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	TOTAL
Ramp	255,559	266,036	222,428	173,224	118,439	150,840	111,260	145,689	167,388	193,752	176,085	190,976	155,953	141,903	170,081	156,470	236,241	196,235	195,953	241,535	3,666,047
Moored	186,611	225,586	98,908	184,011	97,206	103,633	111,441	110,507	134,315	128,743	125,017	129,332	141,538	100,078	68,872	85,435	110,094	111,148	130,418	149,845	2,532,738
Charter	124,282	150,249	133,861	125,969	85,773	88,490	71,113	81,490	81,909	84,898	86,346	94,556	84,867	73,622	91,665	76,868	106,631	100,037	123,995	137,922	2,004,543
Pier	47,643	44,280	26,527	7,548	6,946	8,701	10,867	9,144	15,130	14,621	6,218	5,002	4,200	4,614	4,402	7,327	10,629	8,464	11,329	9,284	262,876
Shore	27,947	30,043	22,945	13,268	14,538	16,830	16,602	13,645	16,370	17,676	19,676	16,726	8,997	12,685	13,971	18,308	20,111	14,995	11,175	8,557	335,065
Stream	39,511	45,921	22,952	30,284	30,433	29,322	41,520	33,599	23,287	27,253	27,087	27,930	20,966	43,157	19,460	34,390	43,321	33,574	25,722	21,155	620,844
TOTAL	**681,553**	**762,115**	**527,621**	**534,304**	**353,335**	**397,816**	**362,803**	**394,074**	**438,399**	**466,943**	**440,429**	**464,522**	**416,521**	**376,059**	**368,451**	**378,798**	**527,027**	**464,453**	**498,592**	**568,298**	**9,422,113**

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WISCONSIN'S 2005 WEIR HARVEST

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.

Strawberry Creek is a rather small creek with no public land above the SCW. As a result all fish returning to SCW are harvested. Surplus eggs are sold under contract to a bait dealer and salmon carcasses are removed. The Kewaunee River is a rather large tributary to Lake Michigan and there is a considerable amount of public frontage below and above the BAFF. As a result a portion of the salmonids captured at BAFF but not needed for hatchery egg production are released for the sport stream fishery. A large sport stream fishery has developed on the Root River, and salmonids captured at the RRSF but not needed for hatchery egg production are also released.

Salmonid egg harvest quotas vary from one year to the next based on projections to satisfy WDNR hatchery needs and accommodate egg requests from other agencies. In 2004 the projected salmonid egg quotas were: 3.0 million chinook salmon eggs, 2.0 million coho salmon eggs, 1.5 million steelhead eggs.

Low Stream flow and low Lake Michigan water level was a potential problem for Chinook harvest at SCW again in the fall of 2005. However, the 3,500 foot pipeline and pump capable of pumping approximately 1,500 – 2,000 gallons of water per minute, that was installed in 2000 was utilized again for the sixth consecutive fall during 2005. This pump and pipeline delivered water to Strawberry Creek above the SCW and created an artificial flow sufficient for attracting and harvesting chinook. As a result SCW was able to operate despite the low water conditions and all of the Chinook salmon egg quota was collected at SCW in 2005. Coho egg collection was also limited by the low flow and low water conditions. The RRSF managed to collect ~ 0.444 million coho eggs and ~ 0.349 million were harvested at BAFF. Surplus eggs from other state agencies were required to fill coho egg quotas in 2005.

The Chinook salmon capture at BAFF during the fall of 2005 was above the 15 year average (Table 2) despite the intentional passage of Chinook not needed for egg production. The run of Chinook to BAFF was also influenced by lower numbers of Chinook imprinted to return to BAFF during the fall of 2005 and low water level and low flow conditions. Because Chinook were bypassed without handling, it is uncertain how large the run would have been if the BAFF had been fully operational.

Table 1. Chinook salmon returns and egg collection at Strawberry Creek, 1981 through 2005.

Harvest Year	Total fish Live and Dead	Adipose clipped fish	Total Weight (pounds)	Hatchery Egg Production[1]
1981	4,314	-	74,209	9,786,000
1982	3,963	-	60,206	7,728,000
1983	3,852	48	66,091	6,954,000
1984	5,208	64	76,905	7,652,000
1985	5,601	582	90,860	7,085,000
1986	4,392	322	53,700	5,052,000
1987	7,624	701	99,100	4,929,000
1988	3,477	408	43,645	3,997,000
1989	1,845	301	20,849[2]	1,350,000
1990	3,016	501	47,091[2]	2,378,000
1991	3,009	377	43,630[2]	1,649,000
1992	4,099	382	51,878[2]	1,677,100
1993	4,377	582	66,094[2]	2,156,666
1994	4,051	733	63,195[2]	3,426,026
1995	2,381	408	30,001[2]	2,221,446
1996	6,653	1,185	97,134[2]	4,720,000
1997	4,850	969	78,085[2]	4,060,944
1998	5,035	1,092	61,427[2]	3,489,144
1999[3]	1,934	535	21,081[2]	633,000
2000[4]	6,649	2,201	75,400[2]	3,672,771
2001[4]	8,125	2,566	119,438[2]	3,775,982
2002[4]	11,027	3,678	160,994[2]	3,820,396
2003[4]	6,086	1,614	81,551	3,421,976
2004[4]	10,917	1,039	145,196	3,435,828
2005[4]	5,500	321	61,600	3,068,280

1 Chinook salmon eggs harvested for hatchery production (does not include eggs sold for bait).
2 Annual average weight per fish used to estimate total weight (2005 average weight was 11.2 pounds).
3 During 1999 extreme low flow conditions persisted throughout the summer and fall in Strawberry Creek, and these conditions are known to have limited the ability of chinook to return to the weir. All values for 1999 were affected by these low flow conditions.
4 From 2000 through 2005 extreme low stream flow and low lake levels persisted. A pipeline was installed which delivered approximately 1,500 – 2,000 gallons of water per minute, and allowed weir operation.

Table 2. Yearly summary of chinook salmon returns and egg collection at the Besadny Anadromous Fisheries Facility, 1990 through 2005.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Total number fish examined	Adipose clipped	Number of eggs harvested
1990	1,307	1,797		3,104	214	1,081,000
1991	2,390	966		3,356	21	1,880,000
1992	2,254	995	625	3,874	120	2,148,000
1993	2,180	726	354	3,260	241	880,000
1994	813	847	62	1,722	452	471,000
1995	1,182	1,362	77	2,621	737	1,360,000
1996	952	2,029	212	3,193	629	700,000
1997	144	1,139	235	1,518	148	0
1998	695	2,858	452	4,005	72	1,155,080
1999	1,803	3,189	806	5,798	496	3,291,346
2000	720	1,733	321	2,774	741	0
2001	4,322	1,066	48	5,092	2,063	0
2002	4,929	174	1,121	6,224	2,713	0
2003	1,075	*	122	1,197	22	184,224
2004	2,496	*	325	2,821	13	0
2005	2,537	*	721	3,268	0	0

*During weir operation in 2003, 2004, and 2005 chinook egg harvest at BAFF was not anticipated and bypass gates were intentionally left open at times to allow fish to move upstream without being trapped. It is unknown how many chinook were able to move upstream through the bypass.

The Coho salmon return to BAFF in the fall of 2005 was 937 (Table 3). This was below the fifteen-year average. Approximately 0.349 million Coho salmon eggs were collected at BAFF in the fall of 2005. Low flow in the Kewaunee River no doubt affected the Coho return over the past five years, but is not likely the only factor responsible for the low returns of coho at BAFF.

Steelhead return to BAFF in 2005 was 449 (Table 4), with most observed during the spring. The 2005 spring run total declined substantially from what was observed during the 2004 spring run. The 2005 run was typical of the runs of the past five years, but was far less than those observed in 1993 through 1996. The summer/fall run of steelhead was poor in 2005 and was similar to those from 2000 through 2003. The reduction in return number is likely due to the poor return rate for several year classes that were stocked between 1998 and 2002. Poor survival of these year classes may be due to poor flow on the Kewaunee River, low lake levels, high harvest of adult fish, or from mortality of recently stocked smolts.

Table 3. Yearly summary of coho salmon returns and egg collection at the Besadny Anadromous Fisheries Facility, 1990 through 2005.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Hatchery transfer	Total number of fish examined	Adipose clipped	Number of eggs harvested
1990	1,889	1,813		185	3,887		1,374,000
1991	780	287		73	1,140		790,000
1992	307	596			958		163,000
1993	448	130	326	725	1,671		529,000
1994	433	185	97		746		350,000
1995	698	2,744	325		3,767		535,000
1996	632	989	248		3,328[1]	54	688,000
1997	773	337	52		1,162	251	524,000
1998	847	1,518	67		2,432	299	607,898
1999	809	536	143	150	1,638		1,445,423
2000	768	656	205		1,629		1,115,000
2001	124	34	17		175		109,000
2002	184	37	20		241		160,000
2003	255	11			266		156,222
2004	1,593	335	153		2,081		1,187,000
2005	323	385	229		937		349,230

[1] Coho salmon total includes 1,459 fish sacrificed for disease control.

The fall 2005 season at the RRSF was another dry one, although stream flow was sufficient enough for us to obtain a reasonable sample of Chinook salmon: 3,623 were captured. Only 841 Coho salmon were captured. (Tables 5 and 6). No Chinook salmon eggs were collected for hatchery production at RRSF in the fall of 2005 as all Chinook eggs were collected at SCW. Approximately 444,000 Coho eggs were collected.

Table 4. Steelhead returns and egg collection at the Besadny Fisheries Facility, 1990 through 2005.

Year	Harvested	Passed upstream	Dead fish	Hatchery transfer	Fish examined	Adipose clipped	Eggs harvested
1992 – Spring		2,892	446		3,338		
1992 – Fall		66		408	474		
1993 – Spring		2,096	177		2,273		
1993 – Fall		30		175	205		
1994 – Spring		2,804	164		2,968		
1994 – Fall		321		200	521		
1995 – Spring		1,696	151		1,847		756,000
1995 – Fall		457	9	121	587		
1996 – Spring		1,964	180		2,144		454,000
1996 – Fall		24	18	151	193		
1997 – Spring		1,955	136		2,091		780,000
1997 – Fall		85	6	40	131		50,600
1998 – Spring		746	130		876		400,000
1998 – Fall		41	2	7	50		15,000
1999 – Spring		608	124	0	732		508,000
1999 – Fall		61	7	77	145		100,000
2000 – Spring		220	120	0	340		259,000
2000 – Fall		2	0	5	7		0
2001 – Spring		324	89	0	413		269,000
2001 – Fall		6	0	7	13		Unknown
2002 – Spring		307	69	0	376		Unknown
2002 – Fall		3	0	0	3		0
2003 – Spring		307	64	0	371		80,000
2003 – Fall		0	0	0	0		0
2004-Spring		720	15	0	735		Unknown
2004-Fall		16	0	24	40		Unknown
2005 – Spring		407	36		443		250,000
2005 – Fall		6	0	0	6		Unknown

Table 5. Yearly summary of chinook salmon returns and egg collection at the Root River Steelhead Facility, 1994 through 2005.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Hatchery transfer	Total number of fish	Adipose clipped	Number of eggs harvested
1994	129	1,726	3		1,858	3	
1995	300	2,663	16		2,979	1	1,020,000
1996	62	5,440	87		5,589		644,000
1997	76	3,974	52		4,102		0
1998	127	3,845	5		3,977	2	93,000
1999	338	5,381	303		6,022		800,000
2000	267	6,972	143		7,382		No data
2001	288	9,697	229		10,214		No data
2002	120	10,011	308		10,439		No data
2003	0	149	0		149		No data
2004	0	377	15		392		No data
2005	15	3,608	0		3,623		No data

Table 6. Yearly summary of coho salmon returns and egg collection at the Root River Steelhead Facility, 1994 through 2005.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Hatchery transfer	Total number of fish	Adipose clipped	Number of eggs harvested
1994	285	513	15		813		
1995	199	2,115	1,040		3,321	3	330,000
1996	161	3,940	305		4,406		2,200,000
1997	65	6,909	16	655	7,645		1,750,000
1998	90	3,336	246	328	4,000	1	760,000
1999	60	978	5	107	1,150		150,000
2000	75	2,921	181	231	3,408		1,200,000

2001	71	942	23	291	1,327		800,000
2002	217	2,076	63	192	2,548	140	850,000
2003	72	126	0	0	198	7	150,000
2004	111	1,148	12		1,271	60	550,000
2005	79	657	56	49	841	19	444,000

The steelhead return at RRSF in 2005 was 1,003 (Table 7). Most of these steelhead (887 or 88 percent) returned in the spring and were likely either Chambers Creek or Ganaraska strain. The steelhead returning in fall (116 or 12 percent) were primarily Skamania strain. Approximately 0.77 million steelhead eggs were collected in spring and 254,000 in fall 2005 at the RRSF.

Table 7. Yearly summary of steelhead returns and egg collection at the Root River Steelhead Facility, 1994 through 2005.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Hatchery transfer	Total fish examined	Adipose clipped	Number of eggs harvested
1994 – Fall		583	47	218	848	2	200,000
1995 – Spring	120	2,582	18		2,720	2	1,008,000
1995 – Fall		208		330	538	1	300,000
1996 – Spring	150	2,970	49		3,169		775,000
1996 – Fall		105		248	353		240,000
1997 – Spring	2	2,918	125		3,045		777,000
1997 – Fall		228	2	408	638		500,000
1998 – Spring		382			382		320,000
1998 – Fall		64	1	86	151		184,000
1999 – Spring		2,131			2,263		
1999 – Fall		19	1	50	70		
2000 – Spring	64	2,107	0	0	2,171		1,552,476
2000 – Fall	0	59	0	160	219		145,922
2001 – Spring	69	790			859		788,000
2001 – Fall		176		314	490		No data
2002 – Spring	123	1,180		0	1,303	2	1,425000
2002 – Fall		48	3	250	301		No data
2003 – Spring	83	977	0	0	1,060		560,000

2003 – Fall	0	6	0	230	236		No data
2004 – Spring	62	966	0	0	1,028		900,000
2004 – Fall	0	102	0	296	398		319,000
2005 – Spring	65	819	3	0	887		774,000
2005 – Fall	0	25	0	91	116		254,000

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GREEN BAY YELLOW PERCH

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 fall trawling surveys (Figure 2). More recent fall trawling surveys; however, show a trend towards improved recruitment. Surveys in 2002, 2004, and 2005 indicate reasonably strong year classes were produced and the 2003 survey indicates an extremely strong year class was produced (Figure 2).

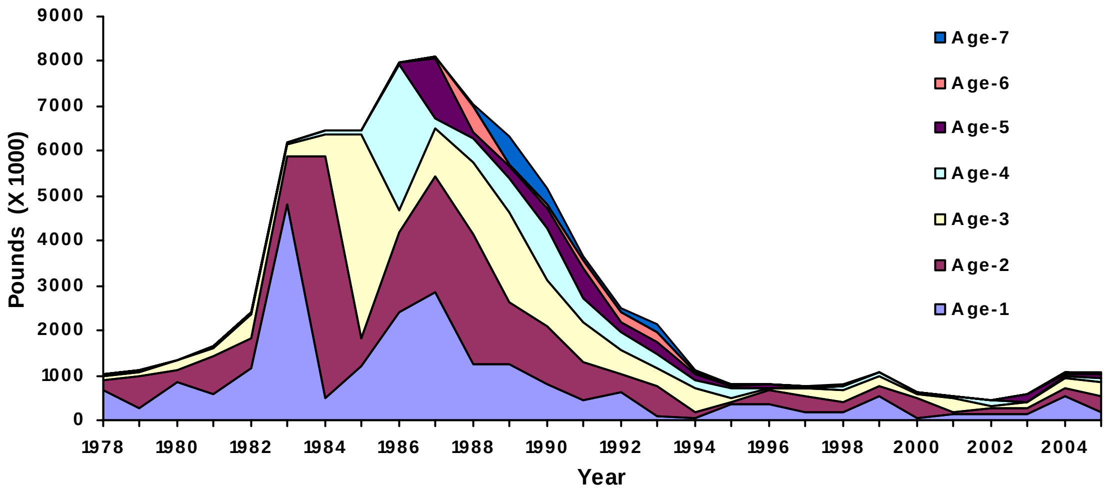

Figure 1. Estimated yellow perch population biomass in Green Bay from 1978 to 2004.

Population assessments

The spring spawning assessment continued for the 28th year on Green Bay at Little Tail point. Double ended fyke nets were set at three standard locations on April 15th and fished until April 21st. A total of 441 females and 503 males were sampled. A majority of the mature females sampled were age-2 (2003 year class) and age-3 (2002 year class) females. Age-2 females comprised 35% of the sample and age-3 females 28%. Age-4 (2001 year class) and age-7 (1998 year class) females were also abundant. Age-4 females comprised 16% of the sample and age-7 females 14%.

In 2005, larval sampling continued for the 8th year, with support from University of Wisconsin Sea Grant for equipment and a boat. Larval yellow perch were collected using a High Speed Miller Sampler at two locations off of Little Tail Point. Sampling occurred every three to four days from May 4th through June 17th. Samples were sent to University of Wisconsin-Milwaukee's Great Lakes Water Institute for identification and analysis. Visual observations revealed good numbers of larval yellow perch present in the samples.

Index station seining continued for the 24th consecutive year at 15 sites spread over 130 miles of

Green Bay shoreline. Seining was implemented on the weeks of June 20-23, July 5-7, and July 11-14. The average number of young-of-year yellow perch per site was 59, 55, and 27 respectively over the three week sampling period and the percent of sites with young-of-year perch present were 73%, 93% and, 86% respectively.

Annual late summer trawl surveys continued for the 28th year to monitor trends in yellow perch abundance and to estimate mortality rates of individual year classes. Trawling was conducted at 78 index sites, 46 shallow sites established from 1978-1980 and at 32 additional deep-water sites added in 1988. The average number of yellow perch collected per trawl hour has been adjusted based on the amount of habitat standard and deep sites represent creating a weighted area average value. In 2005, the relative abundance of young-of-year yellow perch (1148) ranked as the 4th highest since the deep water-sites were added in 1988 (Figure 2). Yearling and older yellow perch abundance decreased at index sites from 945 in 2004 to 242 in 2005 (Figure 3). The relative abundance for 2005 was the 7th lowest since 1988 and below the 18 year combined average of 673.

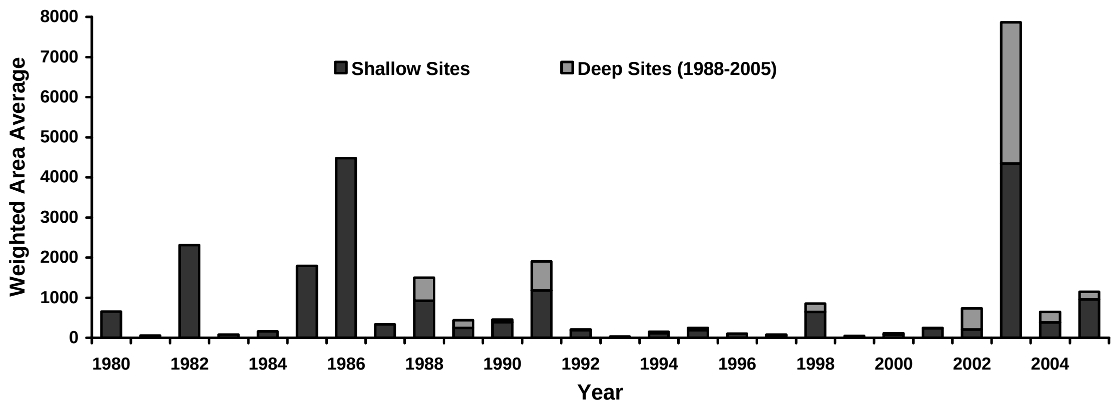

Figure 2. Relative abundance (weighted area average) of young-of-year yellow perch collected during fall index trawling surveys in Green Bay from 1980 to 2005.

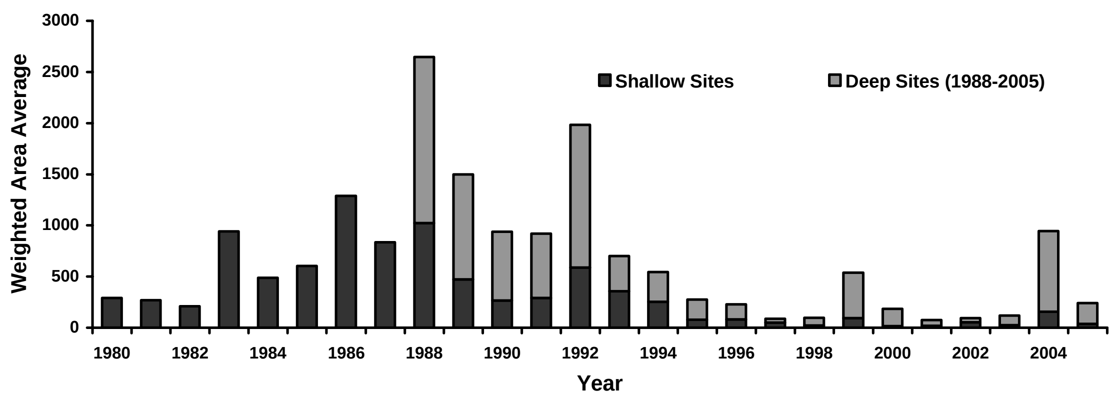

Figure 3. Relative abundance (weighted area average) of yearling and older yellow perch collected during fall index trawling surveys in Green Bay from 1980 to 2005.

Harvests

Sport fishing harvest is estimated from an annual creel survey and fish obtained through the survey are used to describe the age and size composition of the catch. Sport fishing harvest has fluctuated with changes in yellow perch abundance and in 2004 reached the lowest level in the 20 years of the survey (Figure 4). In 2005; however, harvest of yellow perch increased to 260,128 (Figure 4). The harvest rate (0.32/hour) and catch rate (0.66/hour) of yellow perch also increased. A total of 391 yellow perch harvested by sport fisherman were aged in 2005 using established WDNR protocols. A majority of the yellow perch were age-2 (2003 year class) and age-3 (2002 year class) yellow perch. Age-2 perch comprised 63% of the sample and age-3 perch 25%. A majority of the perch caught (80%) were between 7-10 inches.

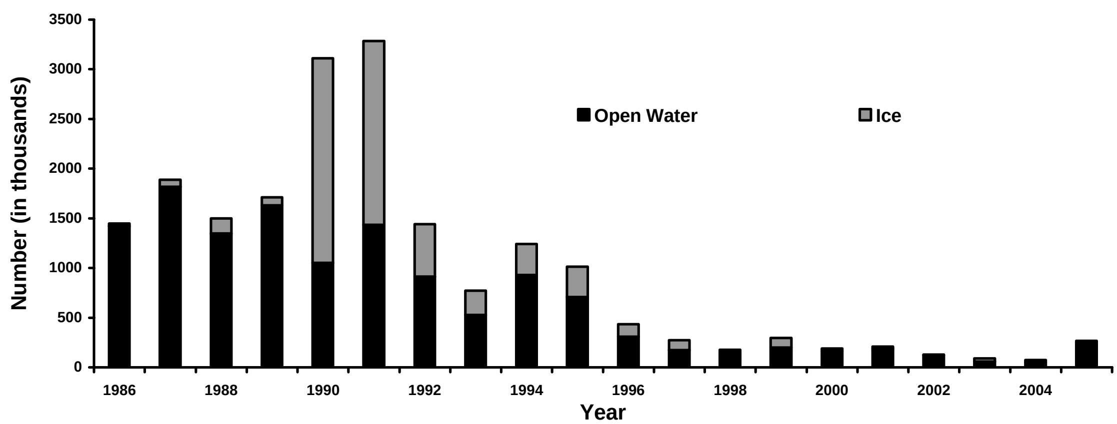

Figure 4. Estimated sport harvest of yellow perch in Green Bay from 1986 to 2005.

The annual commercial harvest is reported by fishers and fish sampled at commercial landings are 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 license year runs from July 1st to June 30th. The zone 1 (Green Bay) quota has ranged over the past decade from the current low of 20,000 pounds to a high of 475,000 pounds (Figure 5).

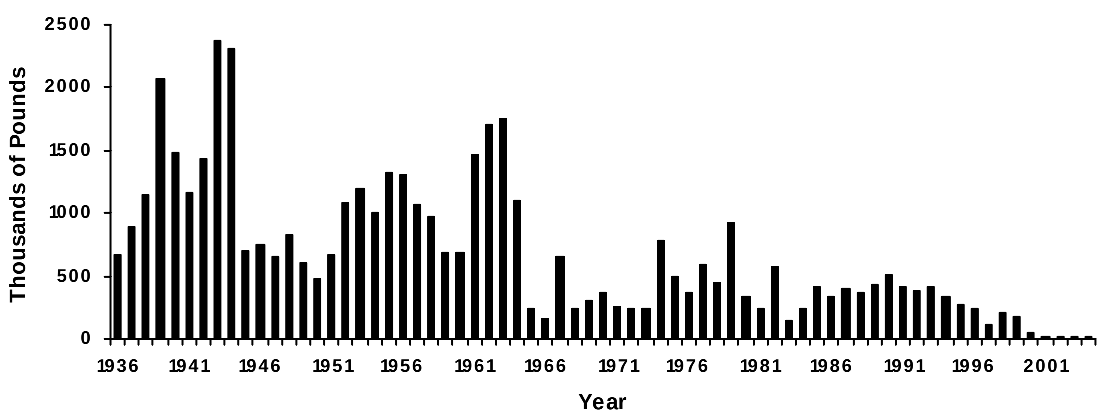

Figure 5. Commercial harvest of yellow perch in Green Bay from 1936 to 2005.

During the commercial fishing year 2004/2005 commercial fishers harvested a total of 19,221 pounds (Figure 5). Both a gill net and a drop net fishery took place, with drop nets only being fished in September and October in 2004. The harvest rate (catch/effort) in both gear types increased from the 2003/2004 quota year. A majority of the commercial harvest during 2005 was age-2 (2003 year class) and age-3 (2002 year class) yellow perch. Age-2 perch comprised 21% of the catch and age-3 perch 63%. Age-4 perch comprised an additional 9% of the catch.

Management Plans

The current rule regulating the commercial and sport fisheries in Green Bay is set to expire in June 2006. The Department is proposing to increase the daily bag limit from 10 to 15 and increase the commercial quota from 20,000 pounds to 60,000 pounds. If approved this rule change would go into effect for the 2006/2007 fishing season, beginning May 20th. The decision to increase the daily bag limit and commercial quota was based on improved production observed in fall trawling surveys from 2002 to 2005 and increases in catch/effort in both the sport and commercial fisheries, which indicate increasing yellow perch abundance. The WDNR is also trying to allocate the harvest of yellow perch more equally between the sport and commercial fishery (Figure 6) while protecting the resource from overfishing.

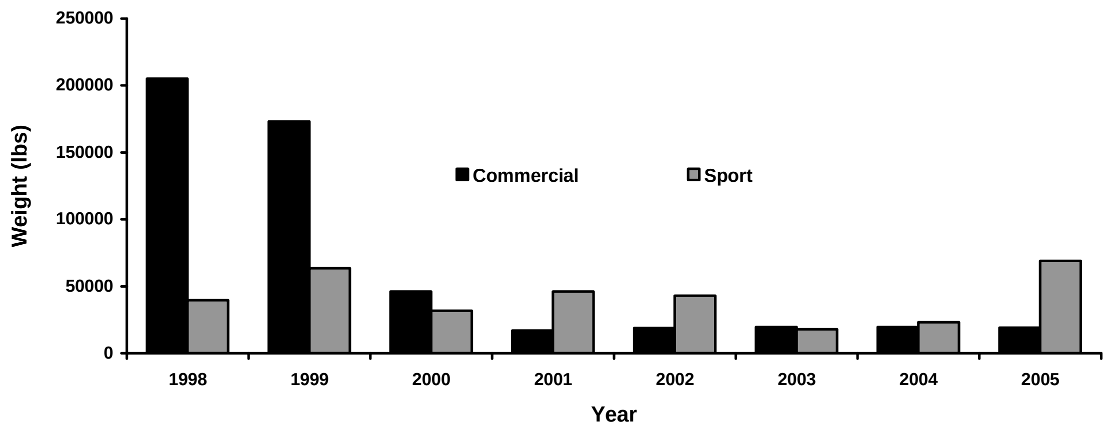

Figure 6. Commercial harvest and estimated sport harvest in Green Bay from 1998 to 2005.

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LAKE MICHIGAN YELLOW PERCH

This report is a summary of the status of young and adult perch in Lake Michigan assessed through several annual assessments in Wisconsin waters during 2005-06. This work contributes to basin-wide cooperative assessments coordinated though the Yellow Perch Task Group and reported elsewhere.

Beach seining

In southeastern Wisconsin, beach seining was done to assess young of the year (YOY) yellow perch. In 2005 we sampled at fifteen sites between Kenosha and Sheboygan from August 29, 2005 to September 7, 2005 using a 25' bag seine with ¼" delta mesh. Surface water temperature remained generally in the 70s ^{0}F. Dense algal growth and strong winds often worked against effective seining. Catch per effort (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. Figure 1 shows the catch per effort of YOY yellow perch for the sites in the Southeast Region (SER) since 1989. No YOY yellow perch were captured in 1994 sampling as well as 1999 sampling. Our 2005 survey produced the highest catch rate of YOY yellow perch since 1989 (Figure 1). We captured 1,934 YOY yellow perch with an overall CPE of 39, which indicates very successful hatch. The majority of the fish were captured in Milwaukee and Racine index sites. We did not capture any YOY perch at Kenosha and Port Washington index sites. The size range of YOY yellow perch ranged from 47 mm to 84 mm in Milwaukee, 44 mm to 89 mm in Racine, and 36 mm to 78 mm in Sheboygan waters. By and large, YOY alewife dominated the catch followed by spottail shiner and longnose dace. Spottail shiners were represented in good numbers through out the area.

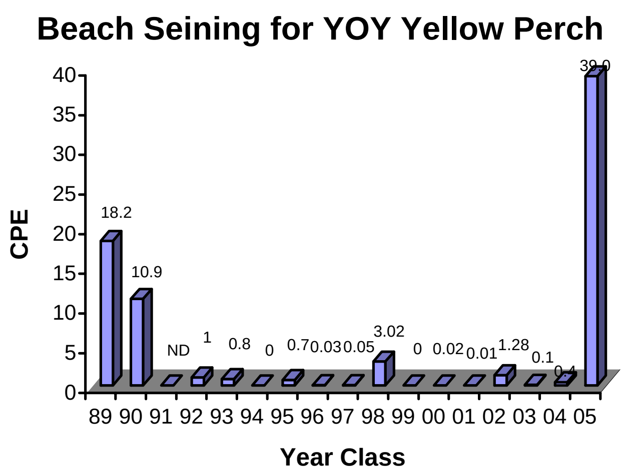

Figure 1. CPE (fish/100' seine haul) of YOY yellow perch in summer beach seining.

In addition to using a standard bag seine, a 200-foot Swedish monofilament gill net (100 ft of 6 mm and 100 ft of 10 mm bar length mesh) was used to capture YOY yellow perch in the nearshore waters. The majority of YOY yellow perch were captured in 6 mm mesh in 2005 assessment. The net was set on rocky bottom in approximately 6 ft of water, and allowed to fish for one night. Two index sites were sampled – Wind Point, about 17miles south of Milwaukee, and Fox Point, about 9 miles north of Milwaukee. We lifted the net at Fox Point on 9/13/05 and on 9/15/2005 at Wind

Point. Catches at the Wind Point were comprised of alewife, smelt, yellow perch, longnose dace, spottail shiner, Johnny darter and sculpin. We caught 555 YOY yellow perch at Wind Point and 225 YOY yellow perch at Fox Point. The 6 mm mesh captured YOY perch ranging from 50 mm to 80 mm in total length, while 10 mm mesh captured YOY perch ranging from 80 mm to 90 mm. YOY yellow perch dominated the catch at Fox Point followed by spottail shiner and alewife. Other species captured included longnose dace, bloater chub, fathead minnow and goby. Catch per 100 ft of gill net effort worked out to be the greatest (195 per 100 ft) since we started the gillnet assessment for YOY yellow perch three years ago.

Spawning Assessment

This assessment has been conducted on the Green Can Reef and in the Milwaukee harbor since 1990 (Table 1). The objective is to quantify the relative abundance of mature female perch in previously identified spawning areas.

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]
1990	2,212	1,922	290	1	13	19,200
1991	3,474	2,600	874	2	25	14,400
1992	7,798	5,242	2,556	1	33	14,400
1993	2,085	1,188	897	0	43	14,400
1994	401	330	71	0	18	9,600
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

[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

In 2005, first sampling was done on 5/25/2005 at three different depths ranging from 52-56 ft (Gang

1), 38-45 ft. (Gang 2) and 27-33 ft. (Gang 3), for a total effort of 1200 ft net. A total of 987 yellow perch were captured of which 34 were females. About 50% of females were ripe at this time. The bottom water temperature was 47 ^{0}F. The second lift was taken on 6/1/2005. A total of 284 (30 females) yellow perch were captured in 800 ft of gill net. At this time, only 5 females out of the 30 perch were green. The remaining ones were either ripe or spent. By this time the spawning activity had already peaked out. In addition, we also collected anal spines from 110 perch for age determination, of which 69% belonged to 1998 year-class, 16% belonged to 2001 year-class and 11% belonged to 2002 year-class. Although the 1998 year-class still dominated the spawning population, 2001 and 2002 year-classes also contributed in sizable numbers.

Yellow perch egg deposition survey was conducted by the WDNR dive team. The survey documented one of the greatest egg densities, 493 egg masses, resulting in 11.74 egg mass per 1000 square meters. Only one egg skein was recorded during 2004 dive survey. Number of egg skeins per 1000 m^2 was 10.04 in 2003 and 11.53 per 1000 m^2 in 2002.

Graded Mesh Gill Net Assessment

The WDNR conducts standardized graded mesh gill net assessments annually in the winter, in grids 1901 and 1902 off Milwaukee. The mesh sizes used in these assessments run from 1 to 3 inches stretch on 1/4 inch increments. Yellow perch begin to recruit to this assessment gear by age 2 and are fully recruited by age 3. A total of four lifts, each with 2800' effort were taken from 12/6/2006 to 12/9/2006 at depth ranges from 70' to 84'. Table 2 shows the relative abundance as catch per effort of perch, by age, for this assessment from 1989 through 2006.

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	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	626	724	159	49	60	0	0	0	0	0	42	323	1	0	2	3	0	3
3	1854	1037	865	276	98	25	0	0	4	2	57	65	243	4	0	1	61	29
4	1012	938	323	715	402	58	28	0	14	6	215	9	20	118	0	0	12	249
5	1563	394	327	281	757	218	65	0	11	29	93	27	2	4	33	1	0	37
6	1880	381	83	181	165	141	120	19	18	35	57	2	2	3	0	27	11	0
7	155	90	82	126	49	48	76	51	77	20	45	0	1	1	0	1	226	23
8	1	0	32	73	16	11	65	71	251	43	63	8	2	0	0	0	6	417
9	0	0	0	14	0	0	24	31	109	110	44	9	1	0	0	0	0	7
10	0	0	0	0	0	0	2	12	15	60	33	11	1	0	0	0	0	0
11	0	0	0	0	0	0	0	3	0	15	9	1	1	1	0	0	0	0
12	0	0	0	0	0	0	0	0	0	4	7	0	0	1	1	1	2	0
%M	69	61	72	82	86	89	90	95	89	80	58	36	36	38	52	60	64	53
%F	31	39	28	18	14	11	10	5	11	20	42	64	64	62	48	40	36	47

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

The data show variability in catch rates by calendar year. These data show very low CPEs of older fish and higher CPEs of younger fish until the late 80s. Almost the entire 90s had very low numbers of age 3 and under, while the population was skewed toward older 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 proportion of age 8 and older perch has been extremely reduced to almost zero except in 2006 (Table 2) when the dominant 1998 year-class reached age 8. The fast growing 1998 year-class seems to have recruited to the fishery at the end of age 2 and continued to dominate the catch until recently. The average size of age 8 male was 277 mm (total length) and female was 315 mm (total length). The oldest yellow perch recorded was a 9 year old male (317 mm total length). As a more positive note, in the 2006 graded mesh assessment, we found good number of 2002 year-class (age 4) yellow perch contributing about 33% of the total catch, following right behind 1998 year-class (55%). The average size of age 4 male yellow perch was 216 mm and female 245 mm in total length.

Since 2000 the sex ratio of the yellow perch population got shifted toward predominantly female and lasted until 2002. This trend is reversed again since 2003 with greater number of males. This pattern is more evident with the 1998 year-class as the larger females get fished out. However, in the absence of commercial harvest, the impact on fast growing larger perch is much less.

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 5 fish/day since September 1996, which is reflected in the total harvest (Table 3). Our creel survey data on the sport caught yellow perch indicated that the majority of catch consisted of a single year-class. The 1998 year-class dominated the sport harvest in 2001 representing 86.5% of the catch. Similar trend is evident from the 2004 winter graded mesh assessment that the1998 year-class comprised 87% of the catch. Overall sport harvest has decreased significantly in recent years producing 98,000 in 2002 yellow perch compared to 134,000 in 2001; 88,778 yellow perch in 2003 and further decreased to 51,521 in 2004. Compared to 2002 harvest, there is 50% drop in the sport harvest in 2005 accounting for 48,000 perch. Because of the decreased density, the perch seem to be growing at a faster rate and attaining larger size at age, and hence the larger individuals in the angler harvest.

The 1998 year-class continued to dominate the catch until 2004 accounting for 67%, while 2001 and 2002 year-classes contributing 13% each. This shows that these two year-classes are growing well and recruiting to the fishery. The age distribution of sport harvest perch from 2005 reinforced this data where in 2002 year-class contributed 40% and 2001 year-class contributed 20% of the harvest. The 1998 year-class comprised only 37% of the sport harvest perch. A similar pattern was evident in the 2006 graded mesh assessment data where in the contribution of 1998 year-class dropped from 71% in 2005 to 55% in 2006 (Table 2). Apparently, 2002 year-class is adding significantly to the yellow perch population in Lake Michigan (Milwaukee, Racine and Kenosha counties in the southeastern Wisconsin).

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)
1986	373	411
1987	550	639
1988	431	932
1989	267	719
1990	256	649
1991	326	887
1992	282	960
1993	267	546
1994	254	290
1995	128	247
1996	15[a]	95[b]
1997	Closed	31[b]
1998	Closed	38[b]
1999	Closed	34[b]
2000	Closed	75[b]
2001	Closed	134[b]
2002	Closed	98[b]
2003	Closed	89[b]
2004	Closed	52[b]
2005	Closed	48[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)

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, the 1998 year-class was the strongest yearclass in recent years which is supporting the fishery. Although 2001 and 2002 year-classes starting to appear in the fishery, the 1998 year-class continue to dominate comprising 67% of the sport caught yellow perch, and 86% of the spawning population in 2004. The sport harvest of 1998 year-class in Lake Michigan is gradually decreasing. 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. The yellow perch population in the southern Lake Michigan is still dominated by a single year-class of 1998, which grew faster and attained larger size.

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LAKE WHITEFISH

The reported commercial harvest of lake whitefish *Coregonus clupeaformis* from the Wisconsin waters of Lake Michigan (Figure 1) during 2005 was up slightly to 1,474,723 pounds with 2.4 percent of the total harvest from pound nets, 47.9 percent in trap nets, and 49.7 percent in gill nets. The total annual quota of whitefish for Wisconsin commercial fisherman has been increased four times since it was first established at 1.15 million pounds in quota year 1989-90 and is currently at 2.47 million pounds.

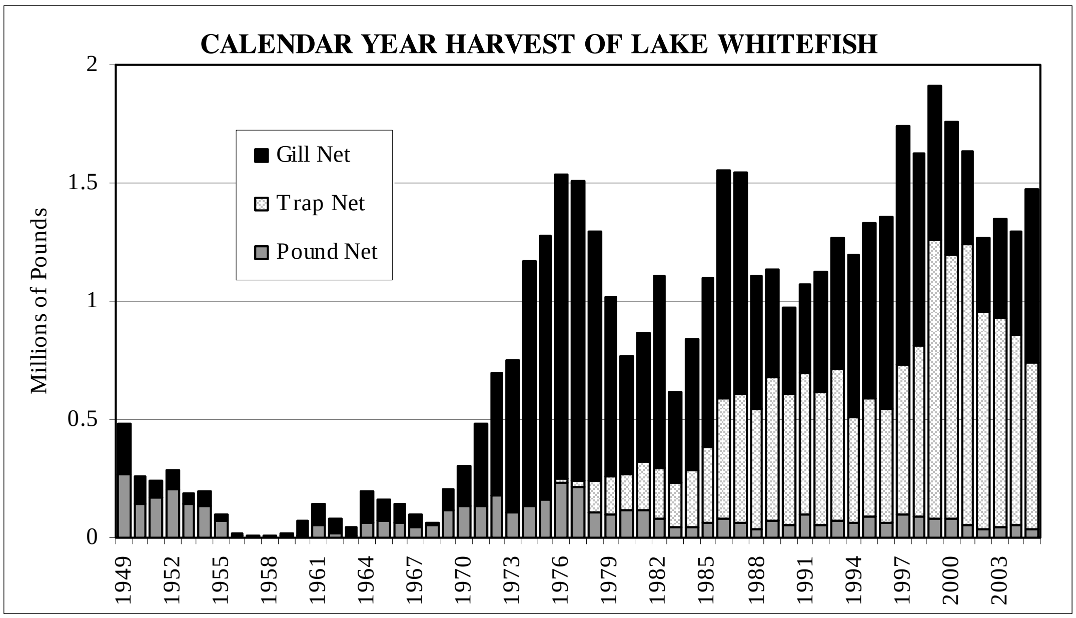

Figure 1.-Lake Whitefish reported commercial harvest by gear in pounds (dressed weight) from Wisconsin waters of Lake Michigan including Green Bay, from 1949 through 2005.

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 had increased steadily, and over the last 15 years had accounted for over 50 percent of the whitefish harvest. 2005 is the first year since 1998 that trap nets have accounted for less than 50 percent of the harvest (Figure 1).

Trap net effort was down to just under 2,200 pots lifted per year, and gill net effort was up sharply to over 11 million feet fished per year (Figure 2). This was the largest amount of gill net fished for whitefish since 1989. Catch per unit of effort (CPE) was up slightly in trap nets and pound nets, and down slightly in gill nets (Figure 3).

The mean length and mean weight of lake whitefish in the NMB population has experienced a steady decline over the last two decades. In spring 2005, whitefish mean length and weight at age (ages 2-7) were the lowest values documented since 1985 (Figures 4&5). As a result of the decreased length and weight at age, the age at which whitefish are recruited to the commercial fishery has increased from age four (as recently as the early to mid 1990’s) to age six or seven.

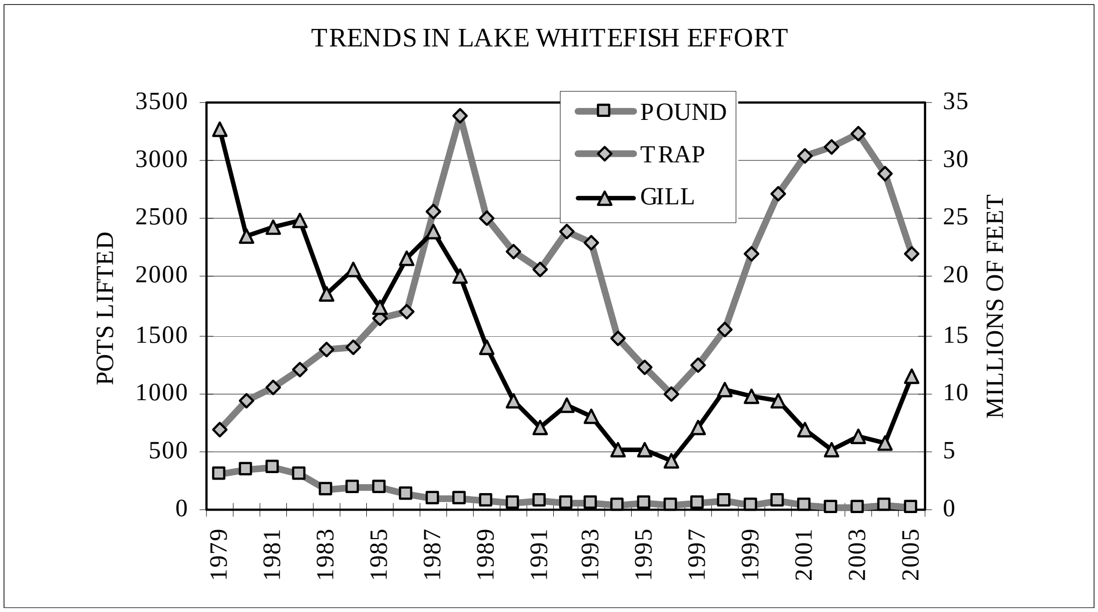

Figure 2.-Trends in gill net, trap net, and pound net effort, fished for lake whitefish in Wisconsin waters of Lake Michigan, including Green Bay, 1979 through 2005. (Gill net effort = millions of feet; trap net and pound net effort = number of pots lifted).

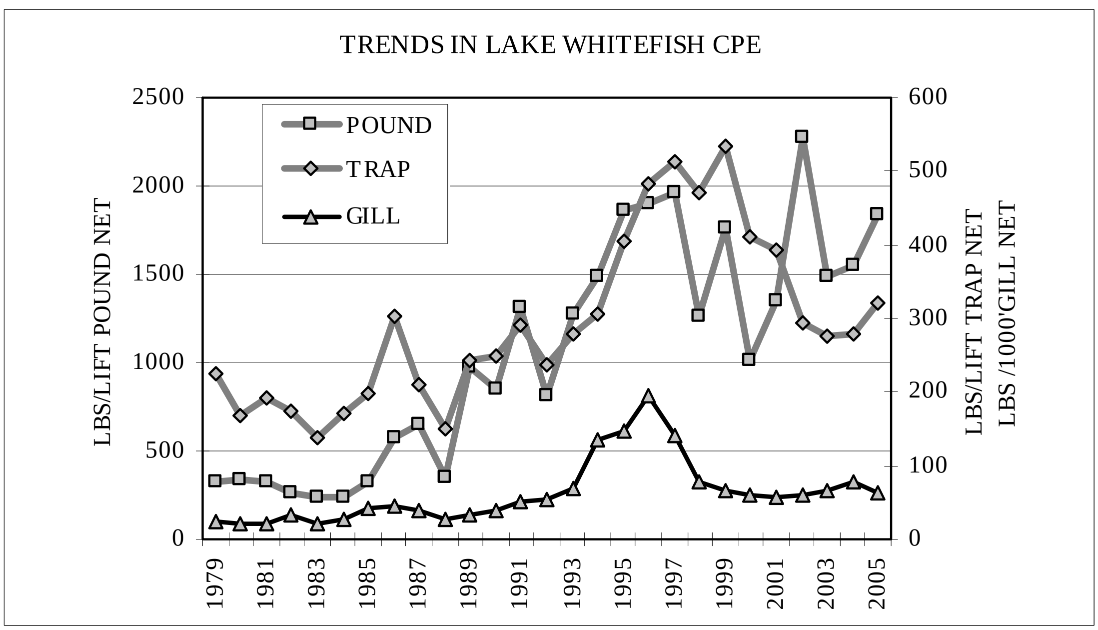

Figure 3.-Trends in gill net, trap net, and pound net, catch per unit of effort (CPE) in the Wisconsin waters of Lake Michigan including Green Bay, 1979 through 2005. (Gill net CPE = pounds of whitefish harvested per 1,000 feet lifted; trap net and pound net CPE = pounds of whitefish harvested per pot lifted).

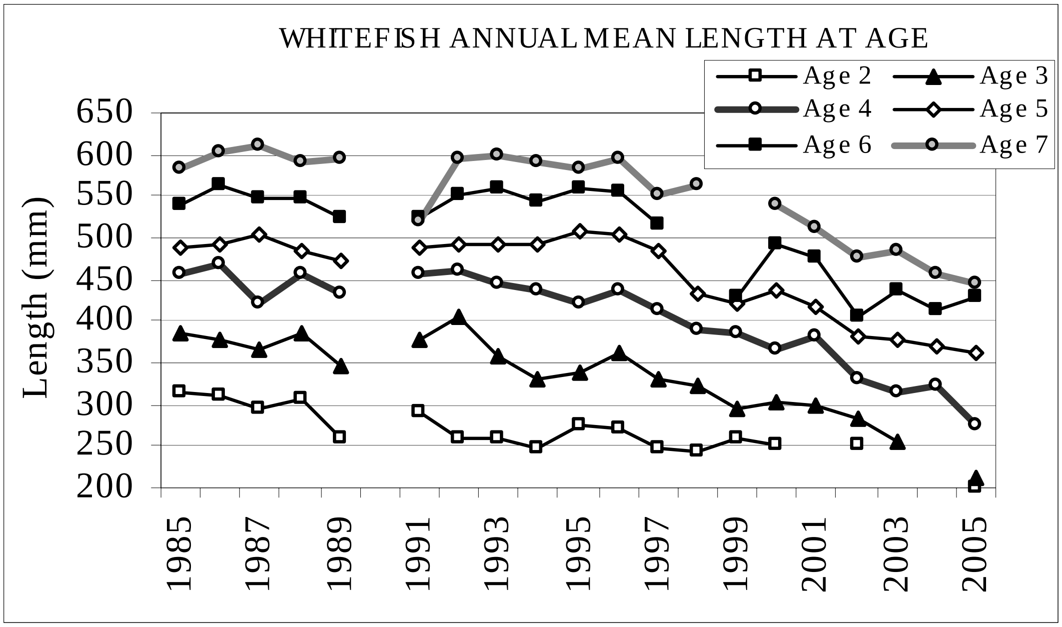

Figure 4.- Mean length of lake whitefish, at age, in spring, from the North/Moonlight Bay population, 1985-2005.

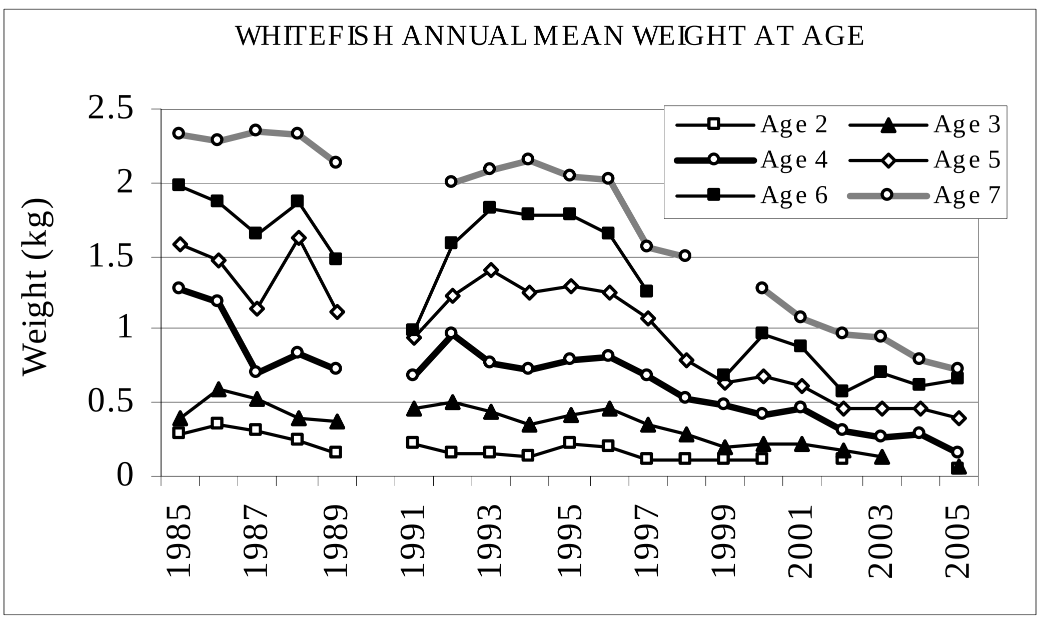

Figure 5.- Mean weight of lake whitefish, at age, in spring, from the North/Moonlight Bay population, 1985-2005.

Another way to analyze the apparent decrease in mean length and weight at age is to follow individual cohorts as they age. Figure 6&7, illustrate the size at age of six recent cohorts from the NMB stock. When the 1988 year class of NMB whitefish reached age four in the spring of 1992, it had a mean length of 462 mm and a mean weight of 0.96 kg. At this size the 1988 year class was at least partially recruited to the commercial fishery and vulnerable to the gear being used. When the 2000 year class reached age four in the spring of 2004 it averaged 322 mm and 0.29 kg. The minimum legal size for the commercial whitefish fishery is 432 mm. Only the fastest growing individuals from this cohort would have attained the minimum legal size.

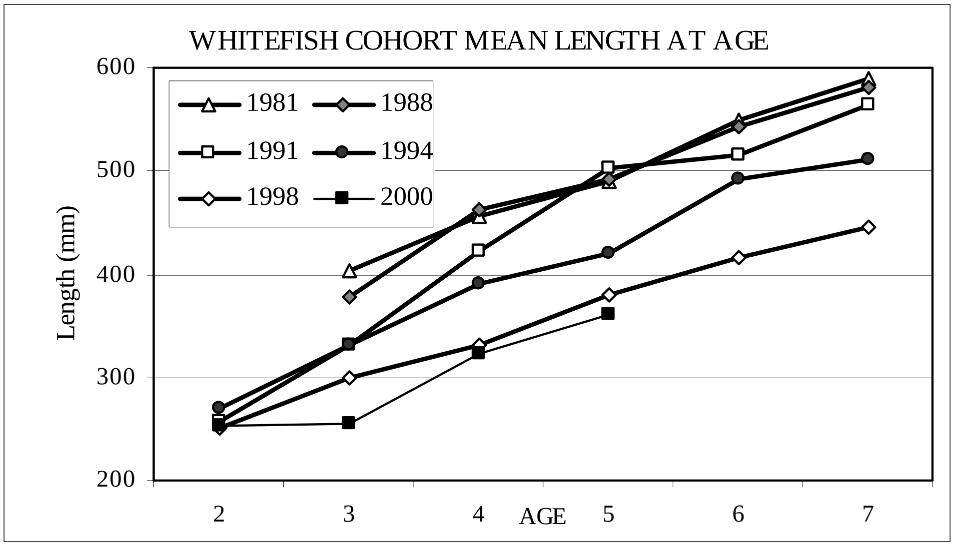

Figure 6.-Comparison of the spring time, mean length at age, of six cohorts from the North/Moonlight Bay stock of lake whitefish, 1981, 1988, 1991, 1994, 1998, and 2000.

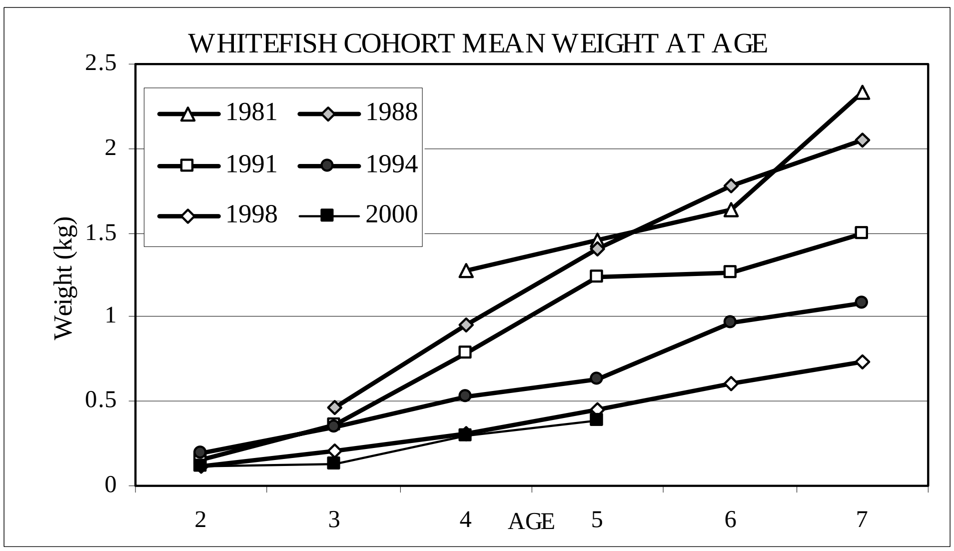

Figure 7.-Comparison of the spring time, mean weight at age, of six cohorts from the North/Moonlight Bay stock of lake whitefish, 1981, 1988, 1991, 1994, 1998, and 2000.

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THE COMMERCIAL CHUB FISHERY AND CHUB STOCKS

The total chub harvest from commercial gill nets was 1,264,176 pounds for calendar year 2005, an increase of 14% from 2004 (Tables 1 and 2). Commercial smelt trawlers harvested 74,780 pounds of unmarketable chubs incidental to the targeted smelt harvest which represents a 65% increase from 2004, when 45,313 pounds of unsorted fish were harvested. In addition to this take in 2005, 368 pounds were sorted as marketable catch.

By zone, the harvest in the south was 1,213,345 pounds, which was an increase of 14% over 2004, while in the north 50,831 pounds were reported caught, very similar to the catch in 2004. Harvests in the north continue to be low. Between zones, CPEs were higher in the south. The south showed a slight increase in CPE from the year before while the north showed the exact CPE as in 2004. Gill net effort in the south increased by about 12% or 2,651,800 feet and effort in the north remained the same. In the south, 30 of the 43 permit holders reported harvesting chubs while in the north 9 of 21 reported harvesting chubs.

Table 1. Harvest, quota, number of fishers and effort (feet) for the Wisconsin Southern Zone gillnet chub fishery 1979-2005. 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

Table 2. Harvest, quota, number of fishers and effort (feet) for the Wisconsin Northern Zone gill net chub fishery 1981-2005.

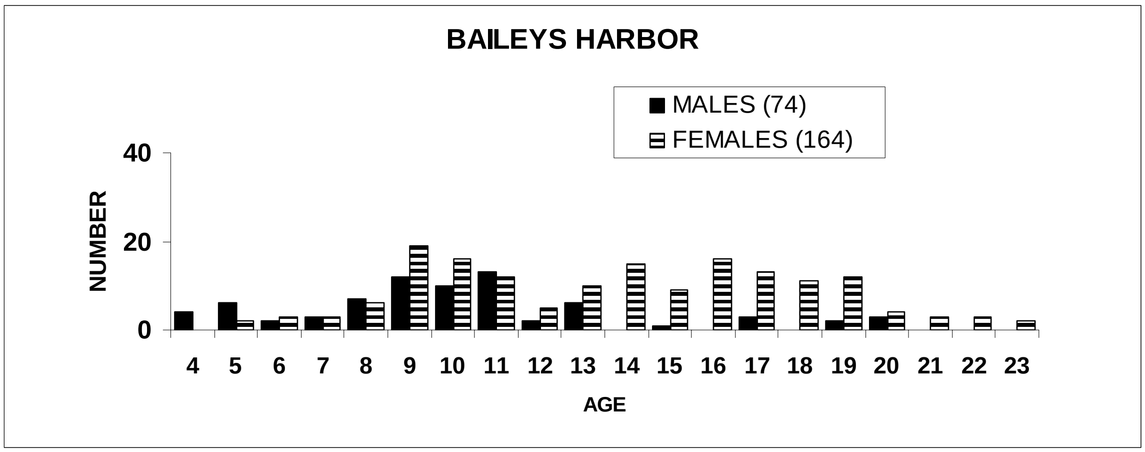
YEAR	HARVEST	QUOTA	FISHERS	EFFORT (x1,000 FT)	CPE
1981	241,277	200,000		4,920.4	49.0[a]
1982	251,832	200,000		3,469.8	72.5
1983	342,627	300,000		6,924.7	49.5
1984	192,149	350,000		6,148.4	31.2
1985	183,587	350,000		3,210.0	57.2
1986	360,118	400,000		7,037.2	51.2[b]
1987	400,663	400,000	23	6,968.6	57.5
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

[a] For the years 81-85, 90 & 91, 98-04 totals were by calendar year.
[b] For the years 86-89 & 92-97 the totals were through Jan. 15 of the following year.

Chub assessment in 2005 marked the fourth year that otoliths, a small piece of calcified material commonly referred to as ear stones, were extracted and used to age harvested chubs. This replaced the common scale reading method that had been used the past 25 years for aging purposes before 2002. The otolith method of aging has been found to be more accurate, especially when dealing with older populations of fish.

Population assessments with graded-mesh gill nets were conducted in the winter of 2005-06 off Sheboygan and Baileys Harbor and consisted of two lifts at Sheboygan and one at Baileys Harbor. Samples of chubs were also collected and aged from standard mesh gear off of Sheboygan. The use of otoliths for aging chubs indicates that scale reading may have under-aged fish in the 1990's as chub growth slowed.

Chubs up to 23 years of age were collected off Baileys Harbor and up to 20 years of age off Sheboygan (Figure 1). Ages were fairly well represented from ages 8 to 19 off both Baileys Harbor and Sheboygan. This does appear to be the first year in a while that younger age chubs are showing up, particularly off Sheboygan, where a significant number of male chubs showed up under the age of ten. Sex ratios of chubs from standard and graded mesh continue to show a predominance of females, however, the gap has continued to decrease over the last couple of years with an increase percent in males caught. In the graded mesh, 71% of the catch was female while the previous two years resulted in a 73% in 2004 and 82% in 2003. Sex ratios in the standard mesh catch continue to be high with a catch of 90% females compared to 80% females in 2004. An advantage of the female-dominated population to the commercial fishers is an added profit in the sale of chub roe to the caviar market during the late fall and winter months.



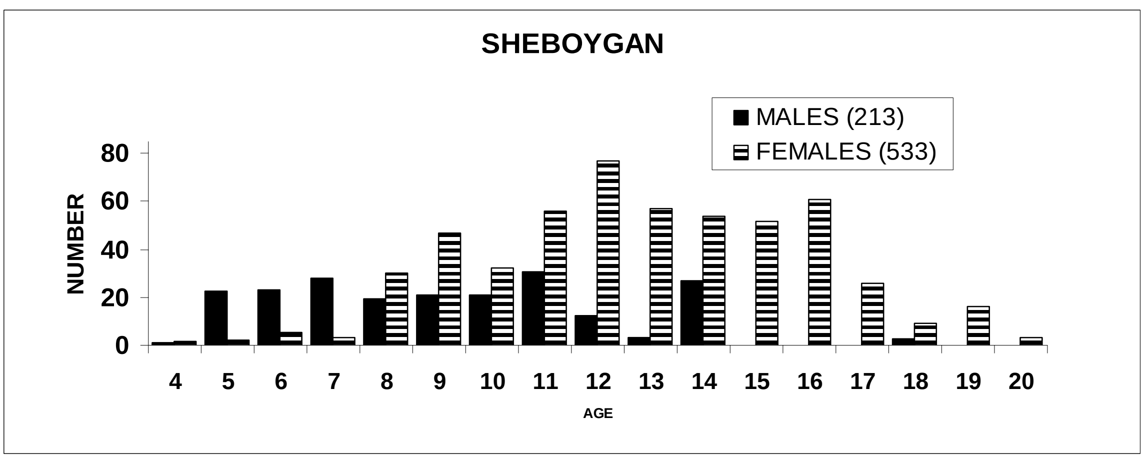


Figure1. Age composition by number and sex of chubs captured during graded mesh assessments at two locations along the Wisconsin Lake Michigan shoreline, 2005-06.

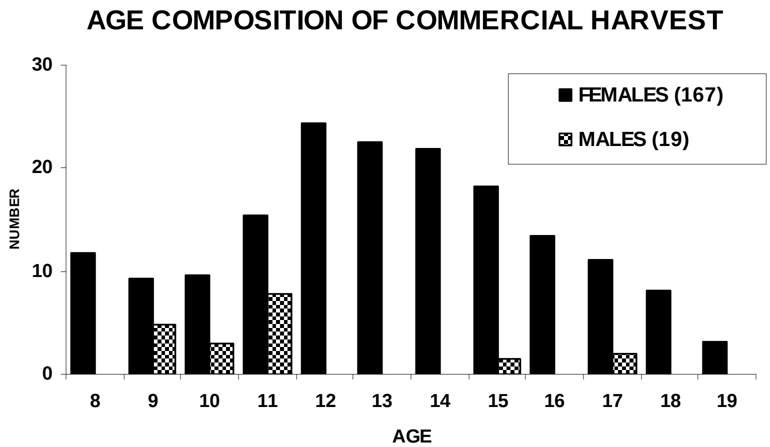


Figure2. Age composition of chubs by number and sex sampled from commercial nets (2 1/2 " mesh) off Sheboygan in 2005.

The following people were instrumental in varying aspects of this project: David Schindelholz for assistance with aging otoliths, and Pat McKee and Cheryl Peterson for data collection, entry and summary. Also, commercial fishermen Mark Nelson from Sheboygan and Ted Eggebraaten from Baileys Harbor were of great help in completing this assessment.

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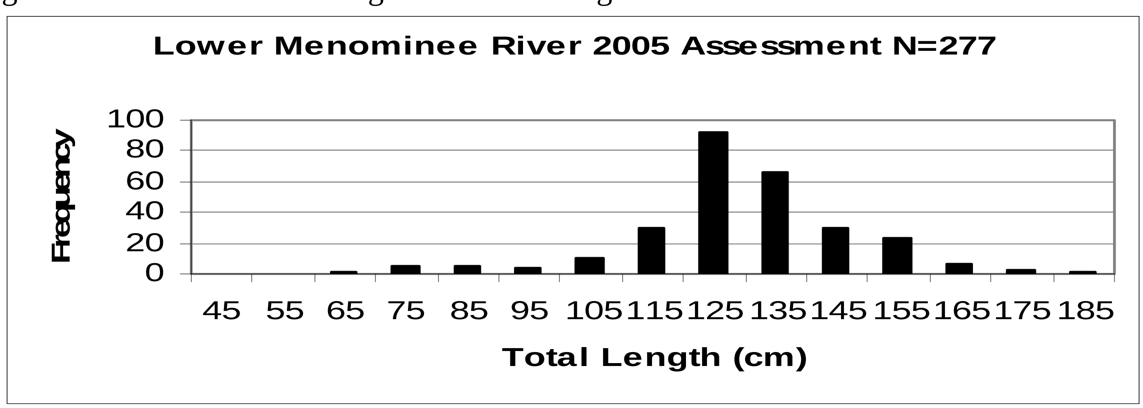
LAKE STURGEON

Introduction

Lake sturgeon populations were decimated by the early 1900s through altered stream flows, interruption of migration routes with dams and water quality degradation in Wisconsin's Lake Michigan's major rivers (Milwaukee, Manitowoc, 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 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. The Menominee River contains the largest population with mixing from Wisconsin's Peshtigo River and Michigan's Cedar and Whitefish rivers. The Menominee River supports a hook and line fishery with an extraction of 172 fish in 2005. Lake sturgeon stocking is occurring on the Milwaukee and Manitowoc rivers and recovering is dependent on those stocking efforts and continued habitat improvements.

Menominee River

In 2005, Menominee River lake sturgeon spring spawning sampling occurred from May 5-11 when 54 adults were captured in large mesh gill nets below the Menominee Dam. These sturgeon ranged 100 to 188 centimeters (cm) with an average of 137 cm. Subsequent larval sampling occurred and estimates of the number of larvae produced ranged from 1,815 to 2,070. An adult population estimate was calculated based on additional sampling in July, August and October surveys in the Menominee River as 762 lake sturgeon over 45 inches in length. That estimate was based on 166 marked sturgeon and the recapture of 16 individuals. A total of 277 lake sturgeon were surveyed in the lower Menominee River in 2005 with a size range of 65 to 188 cm and average of 124 cm. The spawning runs in the other major rivers were not assessed in 2005, but were estimated by Gunderman and Elliott of USFWS in 2002-03 as 59 sturgeon in Oconto, 117 sturgeon in the Fox and 461 sturgeon in the Peshtigo River.



The agencies continue to participate in genetic analysis research of Lake Michigan's lake sturgeon performed by Michigan State University through Great Lakes Fishery Trust grants. That research indicates 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. Recaptured sturgeon from the Menominee River originated in the Peshtigo River (8%), Cedar River (6%), and Whitefish River (1.5%). We hope to further document movements through ultrasonic transmitters implanted in lake sturgeon at the Menominee, Peshtigo and Oconto rivers.

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, 1 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 anticipates adopting the same regulations in 2006.

Milwaukee and Manitowoc Rivers

The Wisconsin Department of Natural Resources has developed a Lake Sturgeon Management Plan for the entire state. As part of this plan, certain Lake Michigan tributaries have been identified in the priority list of Wisconsin Lake Sturgeon Rehabilitation waters including the Milwaukee and Manitowoc Rivers.

The main goals of the rehabilitation of Lake Sturgeon in these rivers are to enhance the lake sturgeon population through stocking, identify life history information needs and identify critical habitat and barriers to migration. These goals fit with the vision of a Healthy Great Lakes Ecosystem described in the Strategic Vision of the Great Lakes Fishery Commission for the Decade of the 1990s[2] and with Wisconsin's Lake Sturgeon Management Plan.

Wisconsin DNR started the rehabilitation in Lake Michigan tributaries with the stocking of 8 juvenile/adult lake sturgeon from the Wolf River into the Milwaukee River. This stocking was allowed because of their large size and the fact that each lake sturgeon was radio tagged as part of a movement study in the Milwaukee River. A portion of the 2003 year-class were held over at our Wild Rose Fish Hatchery. Two hundred lake sturgeon were PIT tagged and fin-clipped and stocked in 2004. In 2004 and 2005, fingerlings were stocked in both rivers. Table 1 shows the current stocking strategy for Lake Sturgeon in both the Milwaukee and Manitowoc Rivers.

Table 1. Lake Sturgeon stocking plan for the Milwaukee and Manitowoc Rivers.

	Milwaukee River			Manitowoc River		
	Fingerlings[1]	Yearlings[1]	Juveniles /adults[1]	Fingerlings[2]	Yearlings[2]	Juvenile s/adults[2]
2003[3]	0	0	8	0	0	0
2004	2,000 WR	200 WR	6	0	0	0
2005	1,000 WR	100 WR	6	1,000 WR	100 WR	
2006	1,500 WR	100 WR	6	1,500 WR	100 WR	
2007	1,500 WR	100 WR		1,500 WR	100 WR	
2008	1,500 WR	100 WR		1,500 WR	100 WR	
"	"			"		
2031	1,500 WR			1,500 WR		

[1] Milwaukee River Lake Sturgeon will be marked with a right ventral fin-clip. Up to 25% of fingerlings will be PIT tagged. Up to 10 fingerlings, yearlings and juvenile/adults will be radio tagged.
[2] Manitowoc River Lake Sturgeon will be marked with a left ventral fin-clip.
WR = Wolf River Strain Lake Sturgeon

Since the start of this project, there has been a lot of debate on the proper techniques for stocking lake sturgeon into Lake Michigan. Wisconsin DNR has reached consensus with the other agencies to only stock 1,500 lake sturgeon in both the Milwaukee and Manitowoc Rivers in 2006. Along with this consensus, we agreed to work on building and using two stream-side rearing facilities for the propagation of lake sturgeon. We have written two grants, one to the Great Lakes Fishery Commission and one to the Great Lakes Fishery Trust, to provide money and support for these two facilities. Both of these projects have been funded. Therefore, both facilities should be functional in 2006. The Milwaukee River Stream-side Facility will be placed at the Riveredge Nature Center in Newburg, WI and the Manitowoc River Stream-side Facility will be placed at the former Oslo Dam Site owned by Manitowoc County Fish and Game Association.

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NEARSHORE RAINBOW TROUT STOCKING EXPERIMENT

There is a strong public demand for nearshore fishing opportunities on Lake Michigan. 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 the stocking of six ports with two strains of rainbow to facilitate the evaluation of the effectiveness of rainbow stocking and to identify what strain to stock in the future through direct comparison of the performance of each strain. After taking input from anglers, the Arlee strain of rainbow trout was selected to be stocked. Following the initial stocking of Arlee, a second strain, Kamloops rainbow trout was identified to be part of this study. The ports of Kenosha, Milwaukee, Sheboygan, Manitowoc, Algoma and Sister Bay were the locations selected for the experimental stocking of rainbow trout for this study. The stocking goal was to stock 10,000 rainbow of each strain at each port for three years to aid in the direct comparison of the two strains.

Stocking History

Arlee Rainbow Trout

The ports of Kenosha, Milwaukee, Sheboygan, Manitowoc, Algoma and Sister Bay each received a stocking of 12,000 Arlee in the spring of 2001. When stocked, the adipose left pectoral (ALP) clipped fish averaged 174 mm in length and 55.1 g in weight. In 2001, Arlee rainbow were stocked from April 16 through May 1.

In 2002 because of hatchery shortfalls, Manitowoc and Milwaukee each received a stocking of 7,500 Arlee on April 9, while the other four ports were not stocked. The left pectoral (LP) clipped fish averaged 170 mm in length and 54.5 g in weight when stocked.

In 2003, each of the six ports received 10,150 Arlee rainbow. The ALP clipped fish averaged 182 mm in length and 74 g in weight at the time of stocking. Stocking of Arlee in 2003 occurred between April 27 and May 9.

Stocking in 2004 was limited to 5,000 Arlee per each of the six ports because of hatchery shortfalls. The LP fish averaged 199 mm in length and 108 g in weight and were stocked between April 12 and April 19.

In 2005, each of the six ports stocked with Arlee rainbow trout received 10,590 fish. The ALP clipped fish averaged 178 mm in length and 72 g in weight and were stocked between March 30 and April 19.

Kamloops Rainbow Trout

The first stocking of Kamloops occurred in 2003, when each of the six study ports received 10,300 Kamloops. The adipose right pectoral (ARP) clipped fish averaged 148 mm in length and 32 g in weight. In 2003, Kamloops rainbow trout were stocked between April 17 and April 19.

In 2004, each of the six study ports received a stocking 10,066 Kamloops rainbow. The right ventral (RV) rainbow averaged 147 mm in length and weighed 36 g at the time of stocking. The Kamloops rainbows were stocked between April 20 and April 27.

In 2005, each of the ports stocked received 8,495 Kamloops rainbow. The stocked fish were marked with a left ventral (LV) clip and had an average length of 152 mm and an average weight of 29 g. The rainbows were stocked between April 21 and April 27.

Harvest

2001

In 2001, anglers harvested an estimated 1,324 Arlee (Table 1). Harvested Arlee ranged in length from 229 to 432 mm and averaged 330 mm in length. Anglers fishing from piers or from the shore harvested most of the Arlee that were caught in 2001.

Table 1. The estimated 2001-2005 sport harvest of Arlee and Kamloops Rainbow Trout from the Wisconsin waters of Lake Michigan by fishery type. Percent harvest () is the percent of a given years harvest by strain and location.

Strain	Harvest Year	Harvest Location			Total Harvest
		Boat	Pier and Shore	Stream	
Arlee	2001	62 (5%)	1262 (95%)	0	1324
	2002	1,259 (78%)	285 (18%)	61 (4%)	1605
	2003	46 (5%)	813 (95%)	0	859
	2004	250 (26%)	585 (61%)	118 (12%)	953
	2005	600 (43%)	201 (14%)	600 (43%)	1401
Kamloops	2003	0	267 (100%)	0	267
	2004	73 (11%)	513 (78%)	73 (11%)	659
	2005	875 (50%)	525 (30%)	350 (20%)	1750

2002

In 2002, it was estimated that anglers harvested 1,605 Arlee (Table 1). Most of the harvested fish (1,116 of 1,605) were from the 2002 stocking. These LP clipped fish averaged 566 mm in length and 1.7 kg in weight. The 2001 stocked Arlee were also harvested, but in much lower number. The ALP clipped fish averaged 547 mm in length and weighed 2.3 kg. Unlike 2001, the boat fishery took the majority of the harvested Arlee in 2002. Shore and pier anglers also harvested a substantial number of Arlee in 2002, but harvested fewer than in 2001. However, the harvest estimate and average length and weight must be viewed cautiously because of the small number of fish handled that had the appropriate clips.

2003

It was estimated that anglers in 2003 harvested 1,126 Arlee and Kamloops rainbow trout (Table 1). Of this total, 859 (76%) were Arlee strain rainbow, with the remaining 267 (24%) Kamloops strain rainbow trout.

Anglers caught all three year classes of stocked Arlee during the 2003 fishing season. Arlee that were stocked in 2003 represented 58% of the catch, with the remainder of the catch evenly split between fish stocked in 2001 and 2002. Most (95%) of the Arlee harvest was from anglers fishing from piers or from shore, with only 5% of the harvest by boat anglers (Table 1). By 2003, fish stocked in 2001 had grown to average 658 mm in length and 3.1 kg in weight, with 2002 stocked fish averaging 610 mm in length and 2.4 kg in weight. 2003 stocked Arlee averaged 414 mm in length and 1.1 kg in weight when harvested.

It was estimated that anglers harvested 267 Kamloops rainbow trout during the 2003 fishing season (Table 1). All reported Kamloops harvest was from anglers fishing from piers or from the shore. Harvested Kamloops averaged 358 mm in length and 0.7 kg in weight.

2004

It was estimated that anglers harvested 1,612 Arlee and Kamloops rainbow trout in 2004 (Table 1). It was estimated that of this total, 953 (59%) were Arlee strain rainbow, with the remaining 659 (41%) Kamloops strain rainbow trout.

Anglers caught Arlee from all four years of stocking during the 2004 fishing season. Most of the Arlee harvested in 2004 were stocked in 2001. They represented 46% of the Arlee catch, with 2003 stocked fish accounting for 31%, 2002 stocked fish 15% and 2004 stocked fish 8% of the harvest. Most (61%) of the Arlee harvest was from anglers fishing from piers or from shore, with 26% of the harvest by boat anglers and 12% of the harvest by stream anglers (Table 1). Growth of stocked Arlee appeared to be good. Fish stocked in 2001, averaged 688 mm in length and 4.5 kg in weight in 2004. 2002 stocked fish averaged 655 mm in length and 2.6 kg in weight. Arlee stocked in 2003 averaged 521 mm in length and 1.5 kg in weight. 2004 stocked fish averaged 323 mm in length and 0.5 kg in weight.

It was estimated that anglers harvested 659 Kamloops rainbow trout during the 2004 fishing season (Table 1). Harvest of 2003 stocked Kamloops represented 78% of the catch with the remainder from 2004 stocked Kamloops rainbow. Most of the reported Kamloops harvest (78%) was from anglers fishing from piers or from the shore with the remainder of the harvest evenly divided between boat and stream anglers. Kamloops stocked in 2003 and harvested in 2004 averaged 424 mm in length and was 0.9 kg in weight. Only a single 2004 stocked Kamloops was measured and weighed in 2004 and it was 553 mm in length and 1.5 kg in weight.

2005

It was estimated that anglers in 2005 harvested 3,151 Arlee and Kamloops rainbow trout (Table 1). Of this total, 1,401 (44%) were Arlee strain rainbow and 1,750 (56%) were Kamloops strain rainbow trout.

Anglers caught all five year classes of stocked Arlee during the 2005 fishing season. Arlee that were stocked in 2004 represented 38% of the catch, 2002 stocked fish were 25% of the harvest with the remainder of the harvest spilt evenly between the other stocking cohorts. Most of the angler harvest of Arlee in 2005 came from boats (43%) and from streams (43%), with fewer Arlee harvested by shore or pier anglers (Table 1). Growth of stocked Arlee appeared to be good, however because few Arlee were measured and weighed in 2005, average lengths and weights should be viewed cautiously. In 2005, Arlee stocked in 2001, averaged 681 mm in length and 3.1 kg in weight, 2002 stocked fish averaged 709 mm in length and 3.5 kg in weight, 2003 stocked fish averaged 559 mm in length and 2.2 kg in weight and 2004 stocked fish averaged 592 mm in length and 2.1 kg in weight. The single harvested 2005 stocked fish was 305 mm in length and weighed 0.4 kg.

It was estimated that anglers harvested 1,750 Kamloops rainbow trout during the 2005 fishing season (Table 1). In 2005 anglers harvested Kamloops from all three years of stocking with the majority from the 2003 stocking (70%) or from 2004 stocking (20%). Most of the reported Kamloops harvest (50%) came from anglers fishing from boats with lower harvest from piers and shore anglers (30%) or from stream anglers (Table 2). Kamloops stocked in 2003 and harvested in 2005 averaged 625 mm in length and 2.56 kg in weight. 2004 stocked Kamloops in 2005 had an average length of 531 mm and an average weight of 1.4 kg. The single harvested 2005 stocked fish was 546 mm in length and weighed 0.8 kg.

Summary

The first five years of creel survey data is encouraging and indicates that the Arlee and Kamloops rainbow trout may be benefiting nearshore anglers. Since the inception of this project, 50.4% of the nearshore rainbow harvested has been by anglers fishing from piers or from the shore.

In years that Arlee and Kamloops rainbows were both stocked, anglers have harvested more Arlee strain rainbow than Kamloops rainbow (Table 1) but when return rates were standardized to reflect the return per thousand fish stocked, both strains returned at similar rates (Tables 2 and 3). We do not know at this time if Arlee, which are larger in size when stocked or Kamloops, which are longer lived will ultimately provide the greater return to anglers.

Table 2. Return rates (number per thousand stocked) to creel for Arlee Rainbow Trout stocking into Lake Michigan 2001 through 2005.

	Year Stocked				
Year Harvested	2001	2002	2003	2004	2005
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
Total	37.3	125.1	17.5	20.0	2.8

Table 3. Return rates (number per thousand stocked) to creel for Kamloops Rainbow Trout stocking into Lake Michigan 2003 through 2005.

	Year Stocked				
Year Harvested	2001	2002	2003	2004	2005
2001	--	--	--	--	--
2002	--	--	--	--	--
2003	--	--	4.3	--	--
2004	--	--	8.3	2.4	--
2005			19.8	5.6	3.4
Total	--	--	32.4	8.0	3.4

It also appears that the fish are growing well as anglers have caught fish over 8.0 kg in weight. Based on comparable age at harvest it appears that Arlee strain fish are larger in size than Kamloops strain fish. However, stocking must continue through 2006 before a final evaluation is made on the success of the program and a determination made what strain, if any, is stocked as normal production fish.

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WALLEYE IN SOUTHERN GREEN BAY AND THE LOWER FOX RIVER

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 DePere 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; the Sturgeon Bay area is still occasionally stocked with walleyes.

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. 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 1990-2005) and the lower Fox River (during late October or early November 1991-2005). These surveys were designed to target young-of-year (YOY) walleye and other gamefish, but all species were netted when possible. We plan to continue these index electrofishing surveys in the future.

The results of previous studies suggest that Green Bay walleye stocks remain in small areas and are quite discrete (Schneider et al. 1991). The walleye stock in southern Green Bay and the lower Fox River (generally residing between a line drawn across Green Bay from Longtail Point to Point Sable, and the DePere Dam) is likely distinct from other stocks in Green Bay. Walleye spawner abundance and YOY production have been variable since monitoring began (Kapuscinski and Lange 2005), but the stock has not been augmented since 1984 and is considered self-sustaining. The purpose of this report is to summarize data collected during the 2005 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

Species composition

A total of 22 species were sampled during our 2005 fall index surveys (Table 1). This catch composition suggests that a diverse fish community was vulnerable to our electrofishing efforts, however, gizzard shad, which were too numerous to sample, and walleye dominated the catch. Common carp, freshwater drum, and quillback carpsuckers were also relatively common, and muskellunge were the second most abundant predatory species sampled.

Table 1. Species, number captured (number), catch per hour (C/hour), and catch per mile (C/mile) of fish captured from electrofishing index surveys on southern Green Bay and the lower Fox River during 2005. Muskellunge and walleye sampled were separated by young-of-year (Y) and non-young-of-year (N). * Gizzard shad were to numerous to effectively sample.

	Southern Green Bay			Lower Fox River			Mean of both		
Species	Number	C/hour	C/mile	Number	C/hour	C/mile	Number	C/hour	C/mile
Black crappie	-	-	-	1	0.13	0.06	1	0.08	0.03
Bluegill	2	0.41	0.17	-	-	-	2	0.16	0.07
Brown bullhead	1	0.20	0.08	-	-	-	1	0.08	0.03
Channel catfish	2	0.41	0.17	-	-	-	2	0.16	0.07
Common carp	46	9.37	3.87	6	0.77	0.35	52	4.08	1.80
Flathead catfish	1	0.20	0.08	-	-	-	1	0.08	0.03
Freshwater drum	26	5.30	2.19	2	0.26	0.12	28	2.20	0.97
Gizzard shad	*	-	-	*	-	-	*	-	-
Largemouth bass	3	0.61	0.25	-	-	-	3	0.24	0.10
Musky (N)	-	-	-	21	2.68	1.23	21	1.65	0.73
Musky (Y)	-	-	-	5	0.64	0.29	5	0.39	0.17
Northern pike	-	-	-	3	0.38	0.18	3	0.24	0.10
Quillback carpsucker	5	1.02	0.42	57	7.28	3.35	62	4.87	2.14
Redhorse spp.	-	-	-	5	0.64	0.29	5	0.39	0.17
Sauger	-	-	-	1	0.13	0.06	1	0.08	0.03
Smallmouth bass	7	1.43	0.59	8	1.02	0.47	15	1.18	0.52
Trout perch	6	1.22	0.50	-	-	-	6	0.47	0.21
Walleye (N)	69	14.05	5.80	797	101.74	46.82	866	67.96	29.95
Walleye (Y)	-	-	-	9	1.15	0.53	9	0.71	0.31
White bass	3	0.61	0.25	7	0.89	0.41	10	0.78	0.35
White perch	19	3.87	1.60	-	-	-	19	1.49	0.66
White sucker	1	0.20	0.08	1	0.13	0.06	2	0.16	0.07
Yellow bullhead	1	0.20	0.08	-	-	-	1	0.08	0.03
Yellow perch	21	4.28	1.77	-	-	-	21	1.65	0.73

Recruitment of YOY walleye

Results of our 2005 electrofishing index surveys show that relative abundance of YOY walleye at the fall fingerling stage was extremely low (Figure 1). Poor year-class strength was likely caused by the variable water temperatures observed during the spawning and hatching periods (Hansen et al. 1998). Years with extremely low or no catches of YOY walleyes are not uncommon in the data set and do not pose a direct risk to the future spawning stock abundance. However, consecutive years with poor year-class production have lead to successive years with low abundance of spawners (Kapuscinski and Lange 2005).

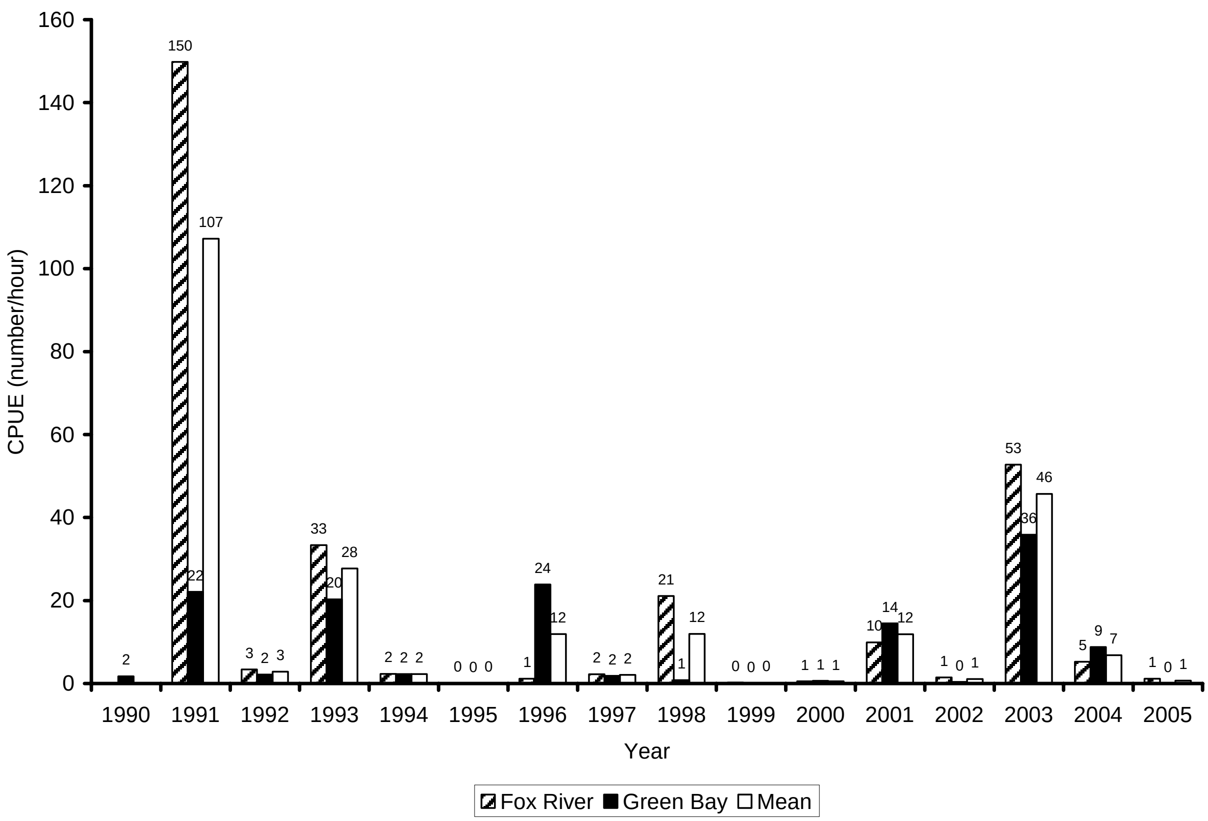


Figure 1. Relative abundance of young-of-year walleye in the lower Fox River (DePere Dam to mouth) and Green Bay (south of a line drawn from Longtail Point to Point Sable) as measured by catch per unit effort (CPUE; number per hour) from data collected in electrofishing index surveys during 1990-2005.

Walleye stock size structure

Walleye captured during our electrofishing index surveys averaged 417 mm total length (range 204-651). The length-frequency distribution of captured walleye indicates that the stock's size structure is not being negatively affected by year-class failures, low recruitment, slow growth, or excessive mortality (Figure 2). The proportional stock density, calculated as:

$$PSD = \frac{number \geq quality}{number \geq stock} * 100$$

Where *PSD* is the proportional stock density, and the species specific *quality* (380 mm) and *stock* (250 mm) length minimums proposed by Gabelhouse (1984) are inserted, was 73 (exact binomial 95% confidence interval 70-76; Zar 1999). The generally accepted PSD range for walleye stocks is 30-60 (Anderson and Weithman 1978). Comparing this suggested range to our results indicates that the southern Green Bay / lower Fox River walleye stock may be out of balance, because most fish sampled were greater than quality length (Figure 2). We propose that the stock is healthy despite the high PSD value because: 1) there is no negative trend in recruitment (Figure 1), 2) year-class failures have not been observed in more than two consecutive years during 1990-2005 (Figure 1), 3) the length-frequency distribution of the stock does not indicate excessive mortality at any size (Figure 2), 4) forage is abundant (Table 1; authors' observation), and 5) growth rates are above average (Schneider et al. 1991).

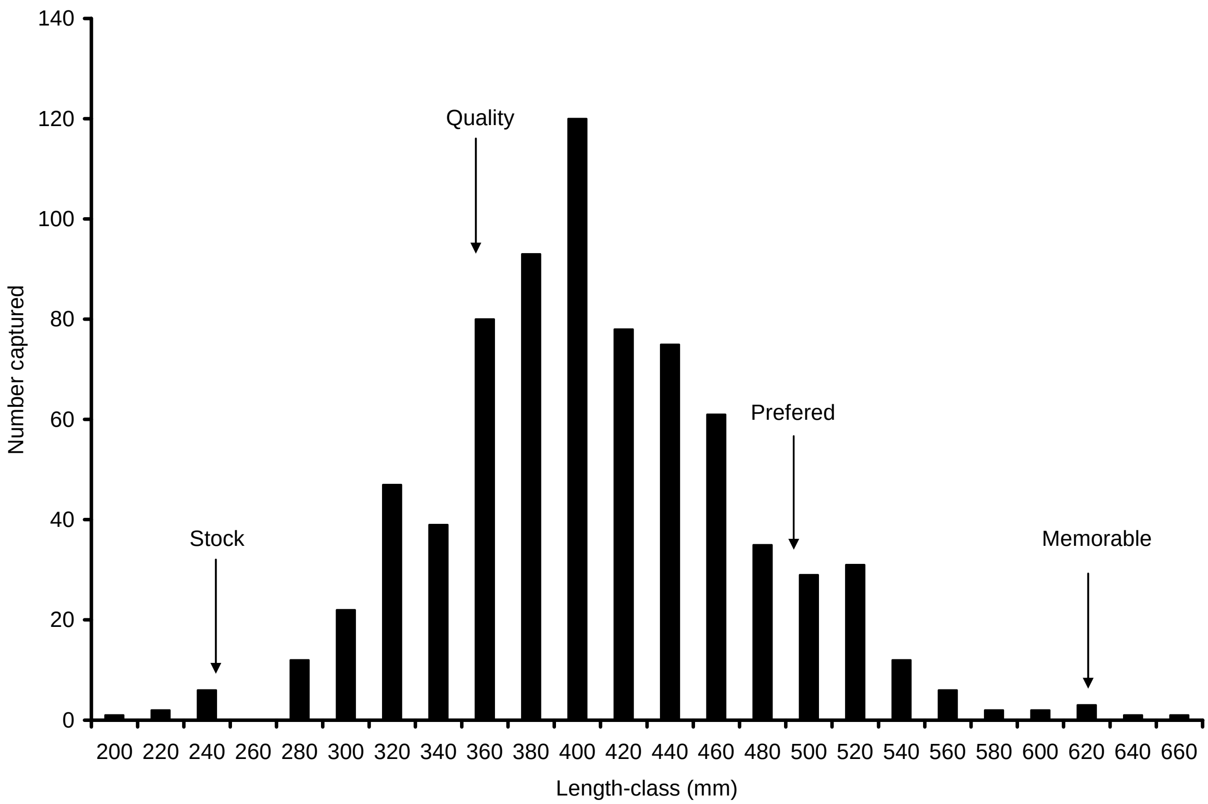
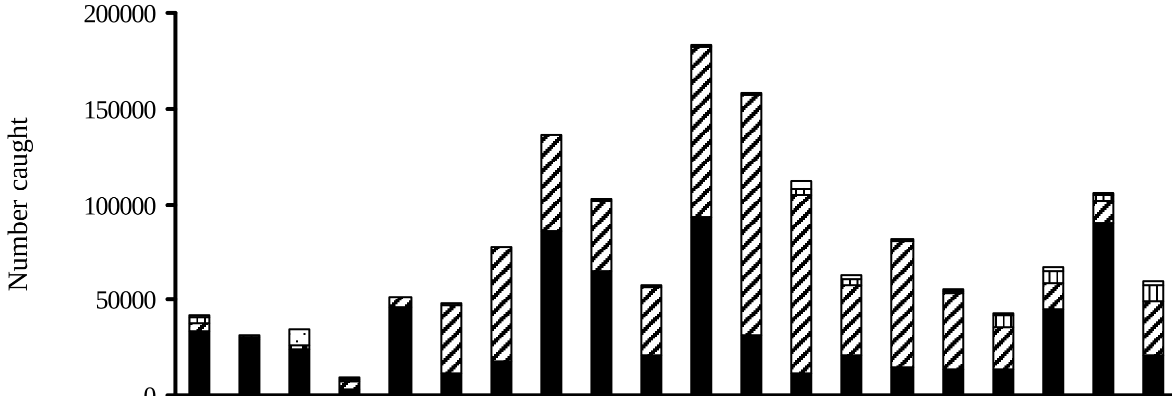


Figure 2. Length-frequency distribution of walleye sampled while electrofishing southern Green Bay and the lower Fox River during 2005. Stock, quality, preferred, and memorable size categories proposed by Gabelhouse (1984) are indicated.Figure 2.

Catch and Harvest

Total catch of walleye from Wisconsin waters of Green Bay was estimated at 59,173 during the 2005 open water season, a 56% decrease from the estimated 105,778 caught during 2004 (Figure 3). Total catch of walleye from Brown County waters during 2005 decreased compared to 2004, but catch increased from Door / Kewanee, Marinette, and Oconto County waters.

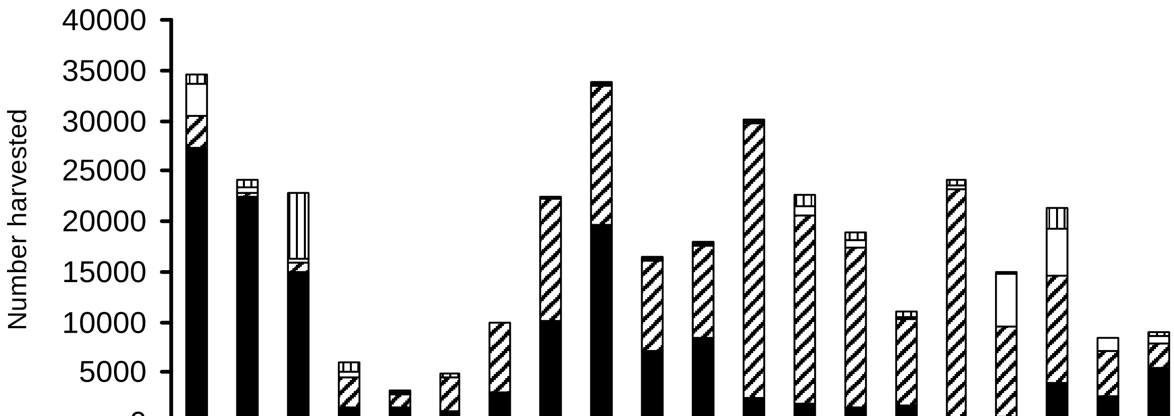


	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05
Door/Kewaunee Co.	878	905	7520	900	661	744	0	178	223	436	759	335	4147	2047	562	1140	1539	2555	1126	1663
Oconto Co.	3331	533	284	613	137	0	362	439	387	382	633	443	2284	2569	659	681	5750	6050	3104	7937
Marinette Co.	4868	691	1877	4023	5330	34987	59987	50383	36864	36193	89339	125864	93871	37216	65318	39810	21891	14341	11844	28119
Brown Co.	33124	29758	24409	3457	45648	11961	17515	85341	65190	20565	92915	31632	11354	20849	14953	14052	13779	44554	89704	21454

Year

Brown Co. Marinette Co. Oconto Co. Door/Kewaunee Co.

Figure 3. Estimated total walleye catch from Wisconsin waters of southern Green Bay and the lower Fox River by county during 1986-2005.



	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05
Door/Kewanee	878	733	6596	900	249	332	0	91	98	234	192	217	1132	763	465	601	218	2062	33	420
Oconto	3243	533	284	555	105	0	47	178	237	235	296	203	1031	806	281	392	5143	4569	1300	807
Marinette	3067	363	1039	3023	1468	3489	6864	12086	13863	8941	9072	27264	18750	15778	8511	22937	8980	10670	4478	2315
Brown	27367	22436	14891	1552	1409	1089	3074	10122	19627	7109	8455	2422	1784	1530	1688	263	617	3936	2558	5454

Year

Brown Marinette Oconto Door/Kewanee

Figure 4. Estimated total walleye harvest from Wisconsin waters of southern Green Bay and the lower Fox River by county during 1986-2005.

Total harvest of walleye from Wisconsin waters of Green Bay increased from 8,369 during 2004 to 8,996 during 2005 (Figure 4). Harvest decreased in Marinette and Oconto counties during 2005 compared to 2004, but harvest increased in Brown and Door / Kewanee counties. Trends in catch and harvest of walleye from Green Bay are not obvious. Catch and harvest of walleye from Door / Kewanee counties both increased during 2005 compared to 2004, but catch increased while harvest decreased for Marinette and Oconto counties, and catch decreased while harvest increased for Brown County. This indicates that anglers catching more walleyes may not translate into anglers keeping more walleyes. The relationship between catch and harvest of walleye from Green Bay is likely complicated by anglers: 1) targeting trophy walleye, 2) catching most of their walleye during the restricted spring season, 3) practicing catch and release, or 4) some combination of these three scenarios.

The Future of the Sport Fishery

The near future of the southern Green Bay / lower Fox River walleye stock and sport fishery appears to be very promising despite the apparent poor year-class produced during 2005. The size structure of the population indicates that the majority 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 1990-2005, and forage is abundant. A high spawner abundance and excellent sport fishery should be present over the next several years.

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SMELT WITHDRAWAL BY THE COMMERCIAL TRAWL FISHERY

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 have been established for the waters of Lake Michigan and Green Bay and the quota is now set at 1,000,000 pounds, of which no more than 25,000 pounds can be harvested from Green Bay.

By utilizing the required biweekly catch reporting forms, it can be determined that commercial smelt trawlers reported catching 394,944 pounds of rainbow smelt during calendar year 2005 (Figure 1). This reported harvest was 2.5 times greater than the 155,127 pounds reported in 2004. The 2005 harvest was the highest yearly harvest since 1999 and was well above the three and five year average harvests.

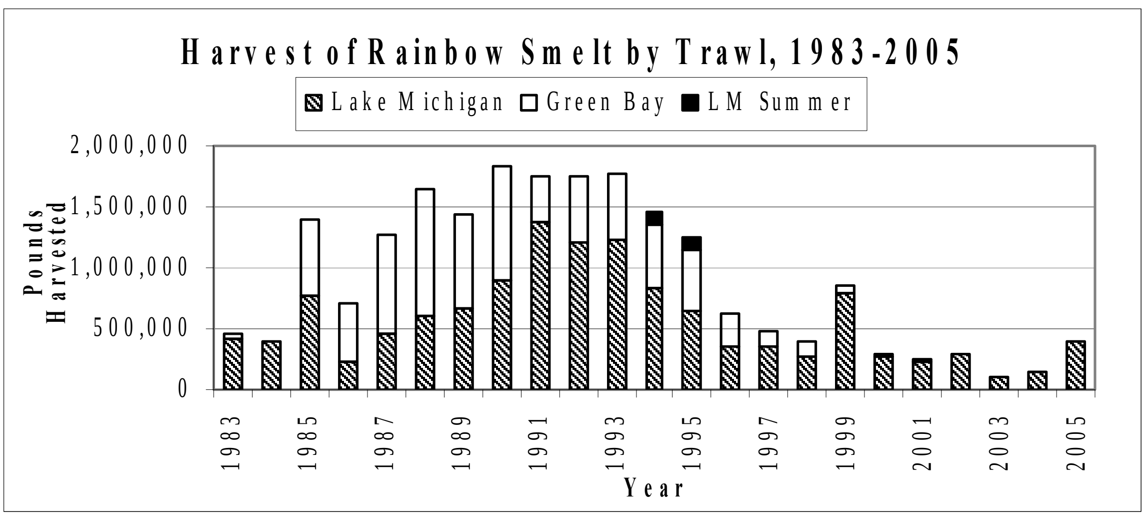

Figure 1. Reported rainbow smelt harvest by trawl from the Wisconsin waters of Lake Michigan for the years 1983 through 2005.

In 2005 the harvest of rainbow smelt from Lake Michigan was 394,944 pounds (Figure 1), with an average CPE of 281 pounds per hour trawled (Figure 2). The 2005 Lake Michigan rainbow smelt harvest was the highest since 1999 when trawlers harvested 794,151 pounds of rainbow smelt. CPE on Lake Michigan in 2005 increased substantially from the 143 pounds per hour reported in 2004 and was the highest CPE since 1999.

Commercial trawlers did not fish on Green Bay in 2005. The lack of fishing effort on Green Bay in 2005 continued the trend of declining harvest, CPE and effort noted since 1991 (Figures 1 and 2).

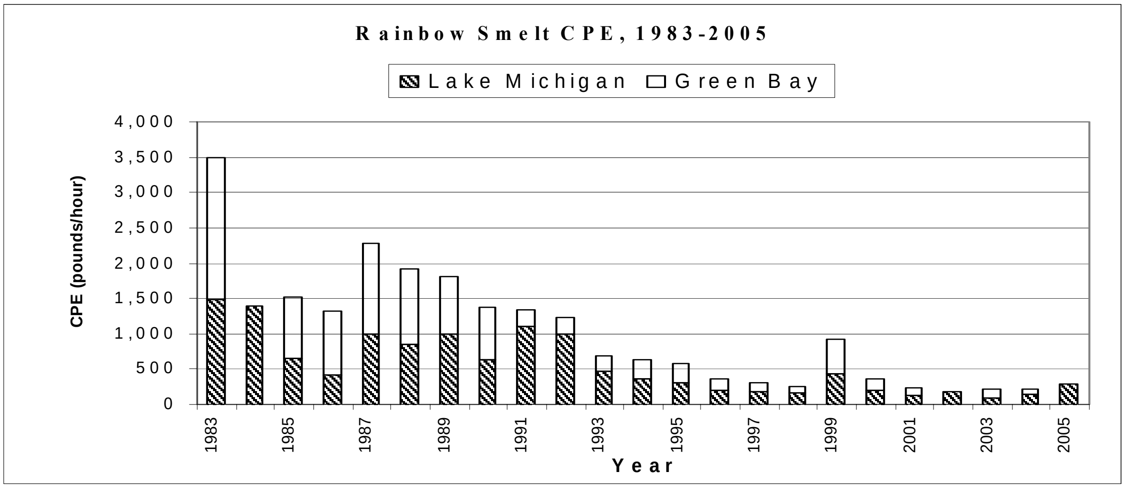

Figure 2. Rainbow smelt CPE in pounds per hour trawled on Lake Michigan and Green Bay during the years 1983 through 2005.

The commercial rainbow smelt harvest on Lake Michigan and Green Bay has declined dramatically since peaking in the early 1990's. Since 1997, annual harvest by commercial trawlers has been near 300,000 pounds although substantial variation from this level was noted in 1999, 2003 and 2004. The rebound in harvest of rainbow smelt by commercial trawlers in 2005 continued the improvement in harvest noted in 2004 over the record low harvest of 2003.

The increased rainbow smelt harvest by trawlers in 2005 was not unexpected. Increases and decreases in the rainbow smelt harvest by trawlers have been broadly predicted by U.S.G.S. biomass estimates based on fall forage surveys except for 1999, when trawlers reported a sharp increase in rainbow smelt harvest not forecasted by U.S.G.S. numbers in 1998. In 2004 the fall U.S.G.S lakewide forage survey indicated that the density of adult rainbow smelt had increased over what was observed in 2003. Increased adult rainbow smelt density in the fall of 2004 translated into increased rainbow smelt harvest in 2005.

It appears that in Lake Michigan, the rainbow smelt population may be increasing in number as indicted by improved densities noted by the U.S.G.S. and improved commercial harvest. 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. Recent U.S.G.S trawl data indicate a continuing growth in the lakewide rainbow smelt biomass, and a strong 2005 year class, so it is likely that commercial harvest will continue to increase. The long term status of the rainbow smelt population in Lake Michigan and Green Bay remains uncertain.

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GREEN BAY FORAGE TRAWLING

Wisconsin has adopted rules that set seasons, locations, depths, and quotas for the commercial harvest of rainbow smelt with trawls. The lakewide decline in the biomass of rainbow smelt has resulted in the reduction of the rainbow smelt quota from 2.358 million pounds with no more than 830,000 pounds to be harvested from Green Bay in 1998 to 1 million pounds of which no more than 25,000 pounds can be caught in Green Bay in 2003. The reduction of quota has been controversial especially on Green Bay where limited data exists on rainbow smelt population trends other than biweekly catch reports filed by commercial fishers or from onboard monitoring conducted in the late 1980's.

In 2003, the Wisconsin DNR began a project on Green Bay to assess forage fish using 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 net. Ten minute trawls at 2 MPH are made at ten foot depth increments following contours beginning at 50 feet along two preset transects that cross the commercial trawling zone (Figure 1).

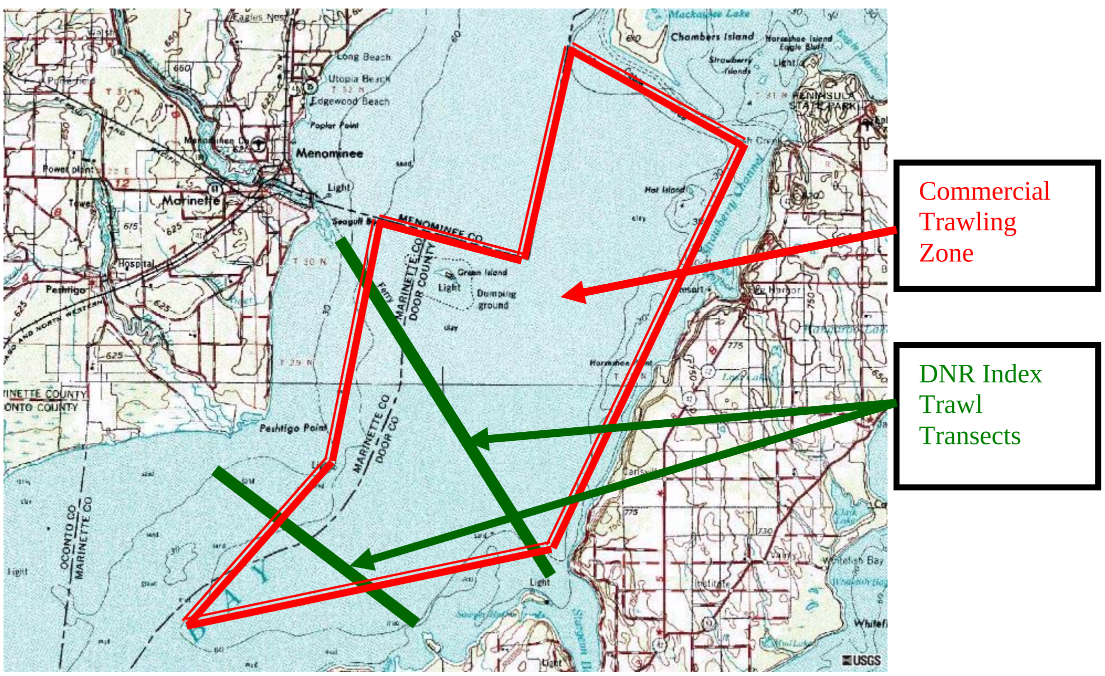

Figure 1. The location of the index trawling transects in relation to the Green Bay commercial trawling zone.

2003 Results

In 2003 transects were trawled starting at 50 feet in ten foot increments out to the deepest depth along each transect. The northern transect ran from 60 to 104 feet, while the southern transect ran from 50 to 80 feet. Individual fish were sorted by species, measured, and an aggregate species weight taken. Dreissenid mussels were sorted from the fish catch and had an aggregate weight measured.

When equivalent depth strata were combined, it was apparent that as depth increased, the composition of the catch changed (Figure 2). In shallower depths, 50 and 60 feet, rainbow smelt and alewife were major components of catch. Lake whitefish, round goby, burbot, yellow perch and a mixture of forage fish (trout-perch and shiners) were also captured. From 70 feet out to 104 feet lake whitefish dominated the catch. Gamefish captured at 80 and 100 feet included brown trout and smallmouth bass. The lake whitefish catch at all depths included both young-of-year and adult fish. Dreissenid mussels were collected at 50 and 60 feet and their biomass equaled or nearly equaled the fish biomass at those depths (Figure 3).

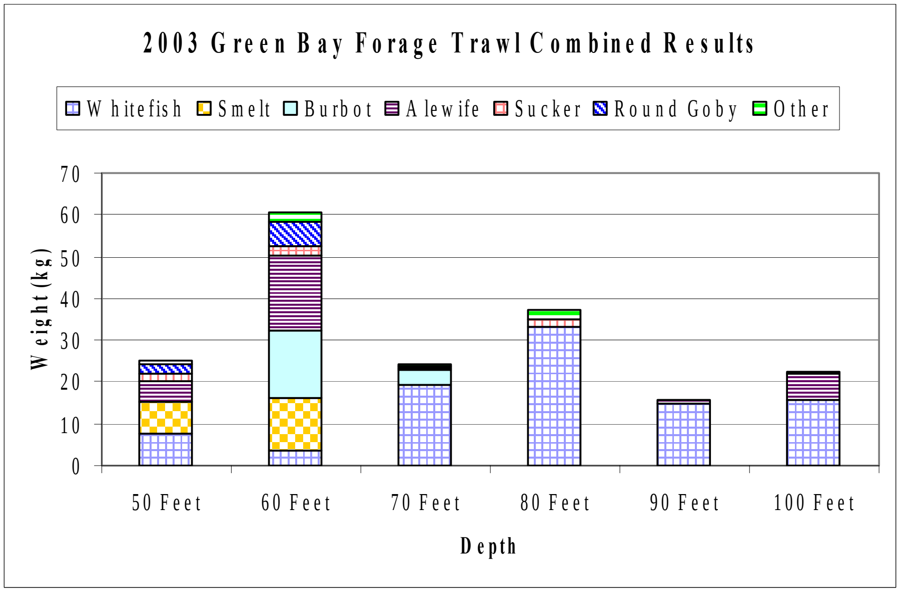

Figure 2. The 2003 weight composition of the fish catch by species and depth strata on Green Bay.

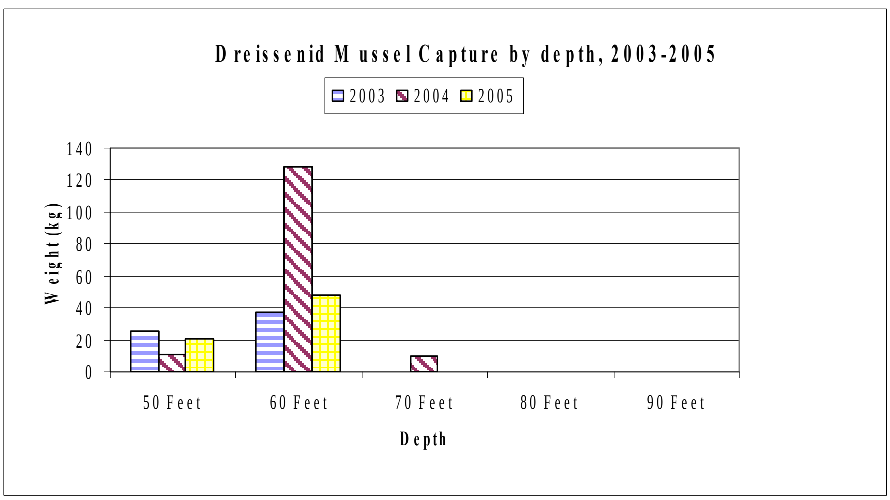

Figure 4. The weight of the dreissenid mussel catches by depth during trawl surveys on Green Bay, 2003 through 2005.

2004 Results

In 2004, there were some changes in protocol to increase sample coverage. Location of the southern transect was moved approximately 5 miles to the south. Transects were trawled starting and ending at about 50 feet in ten foot increments across the bay. The deepest sampling site on the northern transect was 94 feet and 80 on the southern. Fish and dreissenid mussels were handled as in 2003.

Depth strata were again combined to determine the catch (biomass) by depth. At 50 feet, native forage fish, round goby, lake whitefish and yellow perch were the most commonly captured species (Figure 4). Lake whitefish and rainbow smelt were also captured but in lower abundance. Alewife, forage species, round goby, lake whitefish and burbot were commonly captured at 60 feet. From 70 feet out to 90 feet, lake whitefish dominated the catch. At 90 feet burbot were also commonly caught. The lake whitefish catch at all depths included both young-of-year and adult fish. Dreissenid mussels were collected at 50, 60 and 70 feet (Figure 3). At 60 feet, the biomass of dreissenid mussels was nearly three times the biomass of the captured fish.

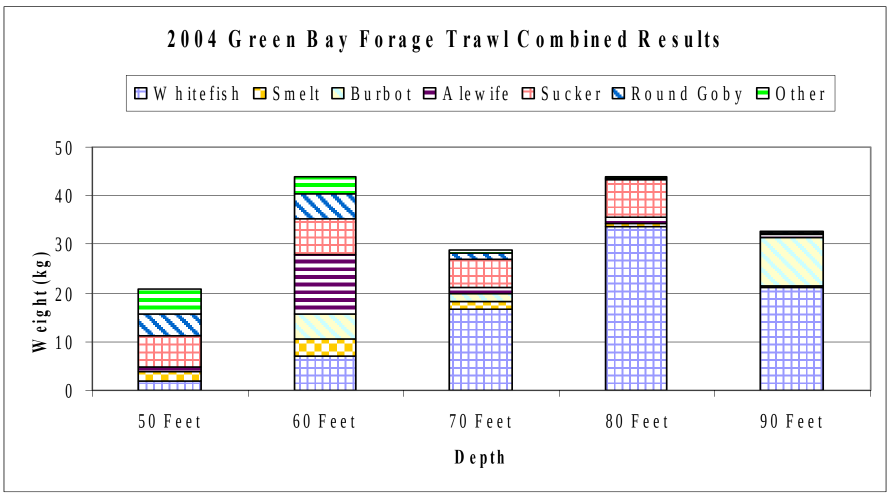

Figure 4. The 2004 weight composition of the fish catch by species and depth strata on Green Bay.

2005 Results

Trawling in 2005 closely followed the protocols that were established in 2004. Depth strata were again combined to determine the catch (biomass) by depth. At 50 and 60 feet, lake whitefish and suckers species were the most commonly captured species (Figure 5). Alewife, rainbow smelt and round goby were also captured but in lower abundance. From 70 feet out to 90 feet, lake whitefish dominated the catch with alewife, suckers species and rainbow smelt present but in much lower abundance. Dreissenid mussels were collected at 50 and 60 feet (Figure 3). At 60 feet, the biomass of dreissenid mussels was slightly more than the biomass of captured fish.

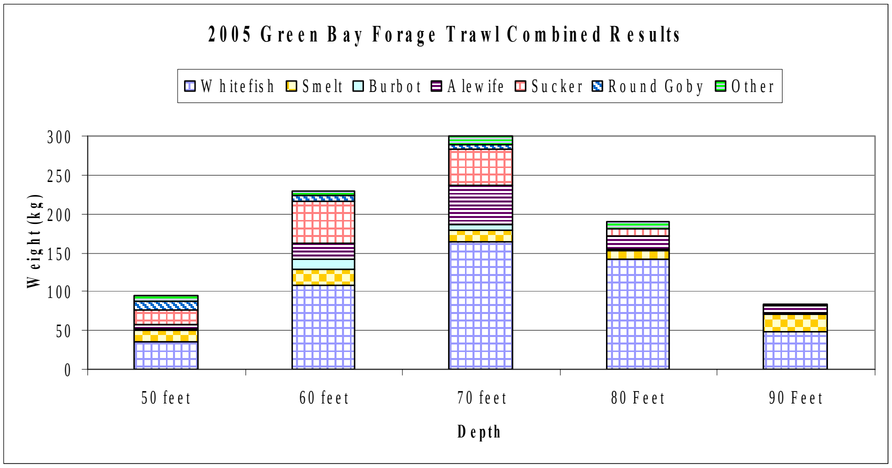

Figure 5. The 2005 weight composition of the fish catch by species and depth strata on Green Bay.

Three years of data does not allow for in depth analysis of trends, but does allow for general statements about the results to be made. First, there appears to be a difference in shallow water (50-60 feet) and deeper water (>69 feet) composition of catch with a greater diversity of fish species in the shallow samples. Second, lake whitefish appear to be abundant in this area of Green Bay with the greatest abundance found between 60 and 80 feet of depth. At 60 and 70 feet many sub-adult lake whitefish were captured. Third, round goby appear to be well established in Green Bay as they were captured in most samples since 2003. Fourth, dreissenid mussels appear to be abundant out to 60 feet in Green Bay and may be found in deeper water as was the case in 2004. Finally, we were able to capture rainbow smelt at all depths in 2005, which may indicate an increase in their abundance in Green Bay.

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ASSESSMENT OF PREDATION ON STOCKED SALMONINES

The walleye (*Sander vitreus*), one of the native species of the Lower Milwaukee River and harbor, has almost disappeared due to poor water and habitat quality. Until the early 1990s, near shore anglers targeted primarily the Lake Michigan yellow perch (*Perca flavescens*), which declined in the 1990s. In recent years, the Milwaukee River water and habitat quality started to improve dramatically. Therefore, the Wisconsin DNR started a walleye stocking program in 1995 to rehabilitate walleye, take advantage of the water and habitat improvements and provide some fishing opportunities for the near shore angler. These initial stockings led to the formation of a Milwaukee River Walleye Restoration Plan (WDNR 1998), developed with extensive public input. Because of the controversy surrounding the rehabilitation of this native species, an objective was created to evaluate the predatory impact, if any, by stocked walleye on stocked chinook salmon smolts. Results from these surveys showed very low to no impact on stocked chinook salmon (WDNR 2004). However, now that the initial 1998 plan has been concluded, the Department has proposed to continue to monitor the predatory impact of all fish species on stocked salmon and trout. A project to assess these impacts has been approved for the next 2 fiscal years (FY 2006 and 2007) and will investigate the short-term impact of predators on stocked salmon and trout including fall fingerling brown trout and coho salmon, yearling coho salmon and rainbow and brown trout, and fingerling chinook salmon.

The Wisconsin DNR conducted nighttime electrofishing surveys 1 to 2 days after various salmon and trout stockings to determine a) species and number of predators in the stocking areas and b) diet composition. The study area is shown in Figure 1. The following is an update on these surveys.

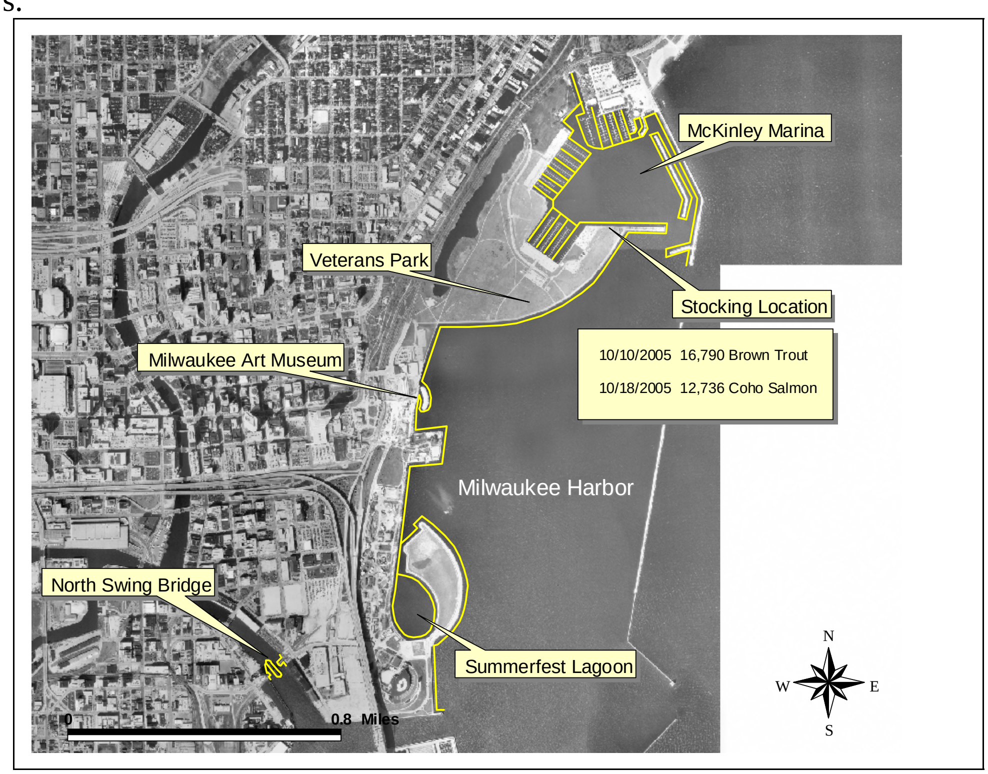

Figure 1. Predatory fish sampling sites (marked yellow line) on October 12, 2005 and October 20, 2005 in the Milwaukee River and harbor.

Spring 2005 survey

We sampled five times in the spring of 2005 to determine a) species and number of predators in the stocking areas and b) diet composition. Fish samples were collected 1 to 2 days following the stocking of various salmon and trout in the Milwaukee River and harbor. Sampling was conducted using a pulsed DC electroshocker (boom-shocker) at night to capture all predators in the area of recently stocked salmon and trout. All fish were identified to species, checked for fin-clips, measured (mm), weighed (g) and clipped to prevent multiple sampling. Stomach contents were expelled from the stomach by using a non-lethal stomach pump (SOLO Pressure Sprayer, 1 gallon with ¼ inch diameter tube). Water under pressure was pumped into the stomach of the fish through a tube. Gut contents were forced out and collected into an enamel tray, stored on ice in a whirl pack bag and analyzed the following day at the laboratory. Fish were then safely released. Stomach contents were identified to species in the laboratory. Many times the contents were in an advanced state of digestion, making positive identification difficult.

Results

Predator sampling began on March 9, 2005; two days after yearling brown trout were stocked near Pieces of Eight. We sampled from McKinley Marina to the Summerfest lagoon. A total of 37 brown trout were captured but most of them had to be measured and released (18) because of extremely cold weather affecting the stomach pumping gear. Nineteen brown trout were sacrificed and their stomach contents extracted in the lab. Of the 19, 12 had empty stomachs and one small fish was not checked. Stomach contents ranged from amphipods to fish included gobies, rock bass and brown trout smolts. Most of the fish captured on this survey were caught very close to the stocking site in a protected area in front of the Art Museum. It appears that this area holds adult brown trout at this time of year and stocking of brown trout this close to that protected area may not be the best location for these yearling brown trout.

The second predator sampling survey occurred on March 15, 2005, one day after stocking yearling brown trout in McKinley Marina near the boat ramps. A total of 3 brown and 1 rainbow trout were captured, and only 1 fish had some items in its stomach. Amphipods were found in the rainbow trout stomach. The lower number of predators found during this survey is probably attributable to the extremely cold conditions. Most of McKinley Marina was iced in, as well as the Summerfest lagoon and other parts of the outer harbor. The numerous brown trout caught in survey #1 were either not present or inaccessible due to ice conditions.

The third predator sampling survey was conducted on March 24, 2005, one day after rainbow trout were stocked near the former North Avenue dam. This survey was conducted in the Milwaukee River between the former dam and Pleasant Street. We captured a total of 18 fish including 8 walleyes, 2 northern pike, 5 rainbow trout and 3 brown trout. Only walleye and northern pike were found to have items in their stomachs with a total of 12 empty stomachs. The stomach contents were comprised mostly of fish including 10 identifiable salmonid smolts plus other semi-digested fish parts. While these predators consumed some salmonid smolts, we did not detect a large number of predators in the area. Radio telemetry information on walleyes has shown that walleyes do not start to make their spawning run up the Milwaukee River until April, with most of the walleyes remaining in the lower harbor and canals. If rainbow trout are stocked early and then disperse downstream, they will not encounter large concentrations of predators before they move out of the river and into Lake Michigan. In addition, stocking rainbow trout farther upstream might be a viable option so that they encounter fewer predators that might be present at the time of stocking.

Predator sampling on April 26, 2005, the day of stocking rainbow trout by the McKinley ramps, produced the largest and most diverse group of predators sampled during our spring surveys. We sampled from McKinley Marina to Veterans Park. A total of 75 fish were captured including 28 largemouth and 14 smallmouth bass, 18 northern pike, 7 brown trout, 4 rock bass, 3 walleyes and 1 rainbow trout. Stomach contents ranged from crayfish to fish, with gobies dominating the contents appearing in 14 of the 39 stomachs. Other food items included fish parts, gizzard shad, salmon eggs, salmonid smolts, and rainbow trout smolts. It appears that the McKinley Marina is home to wide variety of predators including large numbers of largemouth and smallmouth bass. These fish are eating what is available in the area including gobies and stocked salmon and trout. While numerous predators were found in the Marina, the area near the old Coast Guard Station and flushing tunnel held the highest number of predators.

Our predator surveys in the spring concluded on May 4, two days after chinook salmon were released from net pens. We sampled our typical route from inside McKinley Marina to the War Memorial. We captured a total of 28 predators including 11 brown trout, 6 largemouth bass, 4 rock bass, 2 northern pike, 2 smallmouth bass, and one each of walleye, rainbow trout and black crappie. This sample was also very diverse, much like the sample collected in survey #4, but we caught a lot fewer fish during this trip. Northern pike and largemouth and smallmouth bass were no longer found in large numbers near the old Coast Guard Station and flushing tunnel. Stomach contents were dominated by fish including a large number of gobies found in brown trout stomachs, 9-spine sticklebacks, salmonid smolts and semi-digested fish parts. We observed numerous salmonid smolts in the area including the recently stocked brown, rainbow trout and chinook salmon. Despite the large numbers of salmonids that were stocked in the past weeks, predator consumption of them was very limited in survey #5. One brown trout stomach contained 2 smolts, a northern pike had eaten a smolt and a walleye consumed 2 salmonid smolts. It appears that the predators examined during this survey preferred to consume gobies now abundant in the outer harbor and McKinley Marina.

Discussion

Results from these five spring predator surveys shows that there is a diverse population of predators throughout the Milwaukee River and estuary that is not limited to only walleye. In fact, walleye comprised only 7% of the predators sampled while brown trout (38%) largemouth and smallmouth bass (32%) comprised 70% of the sample. It seems that the populations of brown trout and bass during spring stockings of salmon and trout are orders of magnitude higher than the walleye population and probably have much more of an effect on the survival of salmon and trout.

Stomach content results showed a wide variety of food items ranging from amphipods to fish. The dominant food item in the predators was gobies with 14% of all predators and 34% of all full stomachs containing at least one goby in their stomachs. In addition, we did find 12% of all predators sampled and 25% of all full stomachs had one of more salmonid smolts in their stomachs. However, in general the number per stomach was generally low. Brown trout and largemouth bass appear to be utilizing the large population of gobies in the harbor and also preyed on the recently stocked salmon and trout. Northern pike as well as smallmouth bass were also found to eat gobies and smolts. Walleye consumed some salmonid smolts plus gizzard shad. In general, predator consumption of salmon and trout was low especially when you consider the large amount of salmon and trout in the system from the spring stockings. While predation on salmon and trout smolts does exist, the information suggests that it is not a major factor in the overall mortality of these species.

A numerous and diverse population of predators exists in the McKinley Marina and outer harbor. While these populations may be growing, similar conditions have probably existed for the last 10 years. Despite these populations, information from the creel survey suggests that it has not significantly altered the mortality rates of the stocked salmon and trout. In addition, mortality on stocked fish is a known factor and quotas for Lake Michigan have been adjusted to account for this mortality.

Fall 2005 survey

WDNR stocked yearling brown trout (16,790, 180mm average total length, from Wild Rose Fish Hatchery) at McKinley Marina on October 11, 2005, and fall fingerling coho salmon (12,736, 150mm average total length, from Bayfield Fish hatchery) on October 19, 2005. These fish were held in net pens overnight to acclimate them to the environment prior to release. Following stocking, the LMWU fisheries staff conducted predator sampling in order to examine predation impact on the stocked salmonids. The survey was conducted one day after stocking fish using a boom-shocker. Predatory fish species, large enough to consume salmonid fingerlings, were captured in McKinley Marina, the shoreline along Veterans Park, the Art Museum, Pieces of Eight, the Summerfest Lagoon, outside of the Summerfest Lagoon, and also in the inner harbor near the swing bridge (Figure 1). The procedure for collection and analysis of stomach contents were consistent with the spring sampling protocol.

<u>Results</u>

Two sampling events occurred in the fall of 2005, one on October 12th following the stocking of yearling brown trout and the other on October 20th following the stocking of fall fingerling coho salmon. A diverse group of predatory fish species were captured on both occasions. A total of 138 fish were captured on October 12th using two boom-shockers. Of the eight species captured, largemouth bass comprised 49% of the sample, followed by brown trout (23%), walleye (12%) and smallmouth bass (7%). The remaining species occurred in very small proportions. A total of 40 stomach samples (largemouth bass - 22, smallmouth bass - 4, walleye - 9, northern pike - 4, and rainbow trout - 1) were collected out of 138 predators captured. The remaining stomachs were empty. Eighteen of the 40 stomachs examined had one or more goby in their stomach, which formed the most common food item. Gobies were the preferred diet of largemouth bass. The other food items included rainbow smelt, alewife, stickleback, crustaceans and brown trout smolt. Some of the items were in advanced process of digestion, and were beyond positive identification. There were fifteen stomach samples with partially digested fish or fish flesh which could not be identified. Although brown trout comprised 23% of the predators captured, none of them had any food items in the stomach. Our technique of forcing the food out of the stomach using a stomach pump appeared to function well for all other species. It could be that brown trout may not be actively feeding while they are staging in the harbor at this time of the year. While we were electro-shocking, we did notice many recently stocked salmonid smolts in McKinley Marina. However, both smallmouth and largemouth bass appear to prefer gobies which are quite abundant in the harbor. The majority of walleye captured came from the inner harbor, around the swing bridge in the Milwaukee River, which is quite far from the brown trout stocking location in the Marina. None of these walleye had anything their stomach that resembled recently stocked salmonid smolts. We did not notice any recently stocked salmonid smolts in the lagoon or in the River.

The second predator sampling event occurred on October 20th following the stocking of fall fingerling coho salmon. The coho fingerlings were held in net pens overnight at McKinley Marina before they were released on October 19th. During the boom-shocking survey, we captured a total of 62 fish comprising six species. Brown trout was the dominant species comprising 69% of the total catch, followed by largemouth bass (16%) and walleye (6%). Although we surveyed the same area as that of October 12th, the predator species composition was much different on October 20th. Largemouth bass formed a smaller proportion compared to the first round of sampling. Brown trout occurred in large numbers, congregated in certain locations such as off the Art Museum and the Summerfest lagoon. However, only one brown trout had food items in its stomach. Eleven stomach samples were collected out of 62 predators captured. Three (2 largemouth bass, and 1 walleye) of the eleven stomach samples contained recently stocked salmonid smolts, which means 4.8% of the predators captured had identifiable salmonid smolts in their stomach. Gobies were found in both largemouth and smallmouth bass stomachs. We observed large numbers of stocked coho salmon smolts dispersed throughout McKinley Marina and in the Summerfest Lagoon. However, no brown trout smolts were present in the area. We did not see many walleye or largemouth bass in the Lagoon. Most of the walleye captured came from around the old swing bridge on the Milwaukee River.

Discussion

A diverse group of predatory fish was found in the Milwaukee Harbor. On October 12th, we encountered a large number of largemouth bass in McKinley Marina and the Summerfest Lagoon. Brown trout were the second most abundant species found in the harbor, however most had empty stomachs. Although we observed many recently stocked salmonid smolts in the area, only one largemouth bass had a brown trout in the stomach. High abundance of goby in the area seems to be supporting the largemouth bass population. By the time we sampled again after coho salmon were stocked, a lot more adult brown trout had moved into the harbor, dominating the catch. However, except one brown trout that had an alewife in its stomach, all other brown trout stomachs were empty.

Overall, our two nights of sampling efforts following salmonid stocking indicated very minimal short-term predatory impact on the stocked salmonid smolts. Only 1.6% of all predators sampled had recently stocked salmonid smolts in their stomach. Of those predators, each had consumed only one smolt. Low impact on stocked Chinook salmon smolts was documented in a previous study (Hirethota and Burzynski 2004). Historical data on the salmon and trout fishing in the Milwaukee River and harbor have shown higher levels of harvests and harvest rates for last several years. That indicates that despite many predatory species in the harbor, the stocked salmon and trout survive well after stocking, grow, mature and return to the fishery. When a large number of small salmonid smolts are stocked in the river/harbor, it can be expected that some will be lost to predation pressure. WDNR accounts for these different levels of mortality when determining stocking numbers of salmon and trout.

Management implications

The original intent of our predatory sampling survey was to document the impact of walleyes on stocked chinook salmon. This survey was conducted annually since 1996. Our data show that the impact of walleyes on chinook salmon was very low once the stocking site for the chinook salmon was changed to the McKinley marina (WDNR 2004). This sampling survey was conducted through 2004 as part of the original walleye restoration plan. Now that this plan has expired, WDNR has developed a more comprehensive plan to rehabilitate walleyes in the Milwaukee River Estuary (WDNR 2005). Objective D in this plan details the problems and tactics related to maintaining and enhancing the salmon and trout populations in Lake Michigan. As part of this objective, the WDNR believes it is important to assess the impacts of predators on stocked salmon and trout. A project was funded for FY06 and FY07 to assess the short-term predation on stocked salmon and trout. In order to get a head start on this project, a high priority was given in FY05 to sample predators in the spring of 2005. The data contained in this report shows our commitment to this objective.

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SMALLMOUTH BASS IN SOUTHEASTERN WISCONSIN HARBORS

Introduction

In recent years, interest in the smallmouth bass fishery in the nearshore waters of Lake Michigan has increased. The smallmouth bass population has substantially increased because of improvements in the habitat quality of Lake Michigan tributary streams, especially in the lower reaches. The improvements were attributable, in some cases, to dam removals (Hirethota et al. 2005). The stone rip-rap along the shore line, break wall construction in the harbor area, and quiet-water bays have also enhanced habitat availability for smallmouth bass spawning, nursery and forage areas. We conducted a two-year survey with the following objectives:

1. To survey and document the occurrence and abundance of adult smallmouth bass in Kenosha, Racine, Port Washington and Sheboygan harbors.
2. To survey and document their natural reproduction.
3. To describe size and age structure in the population.

Methods

We used both passive and active gear at all the sampling sites. Active gear included a standard WDNR pulsed-DC electroshocking boat with two dippers. The passive gear was the standard double-ended fyke net (4ft X 4ft metal frame mouth), set overnight. The first round of boom-shocking was done in all four harbors in August 2003. At each site we targeted smallmouth bass and largemouth bass. At times we collected other game species and panfish species. We sampled at Kenosha and Racine harbors in May 2004 and at Port Washington and Sheboygan in May 2005, using double-ended fyke nets lifted on multiple days. All species of fish captured in the fyke nets were counted and recorded. Total length (mm) and weight (g) of smallmouth bass were recorded. Scales from a sub-sample of smallmouth bass were taken for age determination. We repeated the boom-shocking effort at the Kenosha and Racine harbors in August-September 2004 and at the Sheboygan and Port Washington harbors in June 2005.

Results and Discussion

Kenosha Harbor

Boom-shocking was conducted from the Kemper Center south of downtown Kenosha along the shoreline into Southport Marina, along the outer breakwall and into the Kenosha Harbor. Fyke netting was done by deploying two double-ended fyke nets in the Southport Marina harbor and fishing overnight. The nets were set at the same location throughout the week and checked on successive days.

During boom-shocking, we focused on collecting only game fish. In 2003, the catch was dominated by largemouth bass, followed by rock bass. Very few smallmouth bass were captured. Although the location, effort and timing were similar, the 2004 boom-shocking survey produced very few fish compared to the 2003 survey (Table 1). We used fyke nets in the 2004 sampling, which also did not catch any bass. The harbor appears to have a diverse fish community with fifteen species recorded in the fyke net sample. Alewife dominated the catch followed by spottail shiner. Panfish such as rock bass, bluegill, and pumpkinseed also were well represented. The fyke net effort was extended over four lifts on consecutive days, while boom-shocking was limited to one night of effort. With the large area of rock walls and rip rap we expected to find a lot more smallmouth bass than we encountered. However, the warmer water temperature and the widespread submerged vegetation are probably more conducive for panfish and largemouth bass to flourish in the area.

Rock bass are widely distributed in the Lake Michigan drainage basin, but are not considered an important sport fish in Wisconsin (Becker 1983). Rock bass occurred in sizeable numbers in the Kenosha Harbor. Although the majority of rock bass were in the 161-200mm size-class, the wide size range (47 mm-270 mm) in the sample indicated the strong presence of multiple year-classes (Table 2). The majority of largemouth bass captured (89%) ranged from 101 mm to 200 mm (Table 2). Becker (1983) reported largemouth bass attain greater growth in length during their first two years of life. Based on the published size at age data (Becker 1983), largemouth bass ranging from 101-200 mm in Kenosha may be 1,2 and 3 year old bass. We captured very few bass over 201 mm total length. It is possible that larger individuals are getting fished out since the largest bass measured 364 mm in total length. Largemouth bass in Kenosha and Walworth county lakes reach an average total length of 101 mm at age 1, 152 mm at age 2 and 203 mm at age 3 (Doug Welch, WDNR, Personal communication).

Table 1. Number of fish captured by species in the Kenosha Harbor during electrofishing and fyke net surveys, 2003-2004.

Species caught	2003	2004	
	Boom-shocker	Boom-shocker	Fyke net[1]
Alewife			3,155
Rainbow trout			1
Northern Pike	1		
Goldfish			5
Golden shiner			3
Spottail shiner			532
Bluntnose minnow			1
White sucker			95
Black bullhead			21
Trout-perch			2
3-spine stickleback			3
Rock bass	38	1	316
Green sunfish			1
Pumpkinseed			77
Bluegill			154
Smallmouth bass	3		
Largemouth bass	94	4	
Yellow perch	1		14

[1] includes four fyke net lifts

Table 2. Size frequency distribution of rock bass and largemouth bass in the Kenosha Harbor captured by electrofishing, 2003.

Rock bass		Largemouth bass	
Size class (mm)	# of rock bass	Size class (mm)	# of largemouth bass
41 – 80	1	51-100	3
81 – 120	6	101-150	26
121 – 160	2	151-200	57
161 – 200	18	201-250	1
201 – 240	8	251-300	4
241 - 280	3	301-350	1
		351-400	1

Racine Harbor

We used a boom-shocker to sample in Meyers Park along the shoreline and breakwall, the shoreline of the Pershing Park small boat harbor, Reef Point marina, Racine Yacht Club and the Root River upstream to Cedar Bend Park. Fyke net sampling was conducted using two double-ended fyke nets fished over night in the Racine Harbor.

Boom-shocking produced similar species composition in 2003 as well as 2004 (Table 3). However, smallmouth bass numbers increased in the 2004 sampling. The majority of them measured 251-300 mm total length, and were probably 3 year old bass (Figure 1). We did not capture any smallmouth bass less than 150 mm. This may not be a factor of capture efficiency of the electroshocking as we were able to collect many bass less than 150 mm at other locations. The largest smallmouth bass captured was 461 mm in total length.

We did not capture any smallmouth bass in the fyke nets. However, fyke netting produced 24 species in five lifts (Table 3). Alewife dominated the catch by number followed by white sucker, black bullhead, spottail shiner and rock bass.

Table 3. Number of fish captured by species in the Racine Harbor during electrofishing and fyke net surveys, 2003-2004.

Species caught	2003	2004	
	Boom-shocker	Boom-shocker	Fyke net[2]
Alewife			9,367
Gizzard shad			1
Coho salmon			1
Rainbow trout			2
Brown trout			4
Northern Pike	1	5	
Goldfish			5
Carp			3
Golden shiner			1
Spottail shiner			99
Bluntnose minnow			3
White sucker			190

Black bullhead			172
Yellow bullhead			7
Channel catfish			1
Trout-perch			35
9-spine stickleback			1
3-spine stickleback			1
White perch			2
Rock bass	1	8	79
Pumpkinseed	1	2	2
Bluegill	2	4	18
Black crappie			20
Smallmouth bass	2	28	
Largemouth bass	4	8	
Yellow perch		1	10
Sculpin			1

[2] includes five fyke net lifts

Port Washington Harbor

Boom-shocking was conducted inside the harbor along all of the breakwalls, and along the rock wall of the power plant water intake channel. Two double-ended fyke nets were set inside the harbor and fished overnight. Fyke netting was done in May 2005, and boom-shocking was done once in August 2003 and again in June 2005. During boom-shocking we focused on collecting only game species. Very few fish were captured. Five lifts of fyke netting produced a variety of fish species, including migratory salmonids. Recently introduced round goby dominated the catch.

Sheboygan Harbor

Boom-shocking was conducted from the Kiwanis Park ramp on the Sheboygan River downstream to the harbor, including the entire inside of the marina break walls. For the first week of the survey, two double-ended fyke nets were set, one inside the break wall, and the other just down stream of the 14th Street Bridge on the Sheboygan River. Both fyke nets were set in the Sheboygan Harbor for the second week of the survey. The nets were lifted each morning to collect data. The Sheboygan River and Harbor sampling produced the greatest number of smallmouth bass compared to the rest of the sites. Although we observed many northern pike during the electrofishing survey we captured only limited numbers and recorded the data, since our focus was mainly to capture smallmouth bass. Using fyke nets and boom-shocking we captured a total of 26 species which included four species of stocked salmonids (Table 4). Bass and northern pike were captured mainly by boom-shocking, while alewife dominated the catch in the fyke net lifts. Most of the smallmouth bass captured were found in the Sheboygan River. Compared to the Kenosha harbor, the Sheboygan Harbor had very limited largemouth bass and rock bass populations.

Age distribution data from the 2003 and 2005 surveys indicate strong year-classes exist in both years. In 2003, age 2 smallmouth bass from the 2001 year-class dominated the catch at 36 fish, or 64% of the aged sample. These fish averaged 198 mm total length and 118 g. We also captured age 3 (10.7%) and age 4 (10.7 %) smallmouth bass during the electrofishing survey. In 2005, age 3 smallmouth bass dominated the catch with 11 fish comprising 44% of the aged sample. These age 3 smallmouth bass averaged 257 mm total length and 258 g. The 2001 year-class of smallmouth bass, represented in 2005 as age 4 fish, only comprised 24 % of the aged sample, indicating a fairly high mortality rate from 2003 to 2005. In both the years smallmouth bass ranging from 151 mm to 250 mm dominated the catch (Figure 2). We did not catch any in the 51 mm to 100 mm size class in 2005 sampling (Figure 2) which is evident by the absence of ages 0-1 bass in 2005. Our sampling technique and timing remained consistent in both the years.

The growth rate of smallmouth bass in the Sheboygan Harbor appears to be greater than the state-wide average for smallmouth bass (Figures 3). Becker (1983) reported that smallmouth bass in Lake Michigan and Green Bay reached an average size (total length in mm) of 79 mm at age 1, 160 mm at age 2, 234 mm at age 3 and 264 mm at age 4. More recently, Kroeff (1996) reported mean back-calculated lengths of smallmouth bass as 120 mm at age 1, 169 mm at age 2, 216 mm at age 3, and 268 mm at age 4 for fish captured in Sturgeon Bay. Average size at age for smallmouth bass from the Sheboygan Harbor captured in this study was much greater compared to the Sturgeon Bay population (Table 5). The average length at age for smallmouth bass from our previous survey in Milwaukee Harbor documented 159 mm at age 2, 243 mm at age 3, and 314 mm at age 4 (Hirethota et al. 2005).

Table 4. Number of fish caught by species in the Sheboygan River/Harbor during electrofishing and fyke net surveys, 2003-2004.

Species caught	2003	2005	
	Boom-shocker	Boom-shocker[4]	Fyke net[5]
Alewife			898
Coho salmon			1
Chinook salmon			4
Rainbow trout			2
Brown trout			2
Rainbow smelt			18
Northern Pike		10	2
Common carp			2
Spottail shiner			54
Bluntnose minnow			1
White sucker			51
Greater redhorse			1
Black bullhead			72
Yellow bullhead			3
Brown bullhead			4
Channel catfish			1
Burbot			1
9-spine stickleback			77
Rock bass			9
Bluegill			9
Smallmouth bass	61	46	2

Largemouth bass		1	
Black crappie			15
Yellow perch			1
Walleye			1
Round goby			14

[4] Targeted capturing game species only; many northern pike were not captured
[5] includes five fyke net lifts

Table 5. Mean length (TL mm) and weight (g) at age of smallmouth bass captured in the Sheboygan Harbor by electrofishing in August 2003.

Age	No. of smallmouth bass	%	Mean length (mm)	Mean weight (g)
1	4	7	140	40
2	36	64	198	118
3	6	10.7	288	376
4	6	10.7	339	556
5	2	3.6	358	680
6	1	1.8	372	795
7	1	1.8	408	920

Summary

In this survey, we encountered a total of 35 species, of which ten species were common to all the harbors. Alewife was the most abundant species at all locations, which were probably moving in schools into the harbor area. Four species of migratory stocked salmonid species were captured in the harbors. Most of them might have entered the harbor as they were staging for feeding or spawning migration. We did not see any pattern in the distribution of species between the harbors north of Milwaukee and harbors south of Milwaukee, except that smallmouth bass were more abundant in Sheboygan harbor, while largemouth bass were more abundant in Kenosha harbor. It appears that the Kenosha harbor, the southern most site, produced more largemouth bass which does better in slightly warmer waters than the smallmouth bass. Both Sheboygan and Kenosha had fair amount of submerged vegetation, and plenty of rock-rubble structures. A recently introduced exotic species, round goby, was more common in the north in Sheboygan and Port Washington harbors than in the south. Other exotic species recorded in the survey included common carp, goldfish, and 3-spine stickleback.

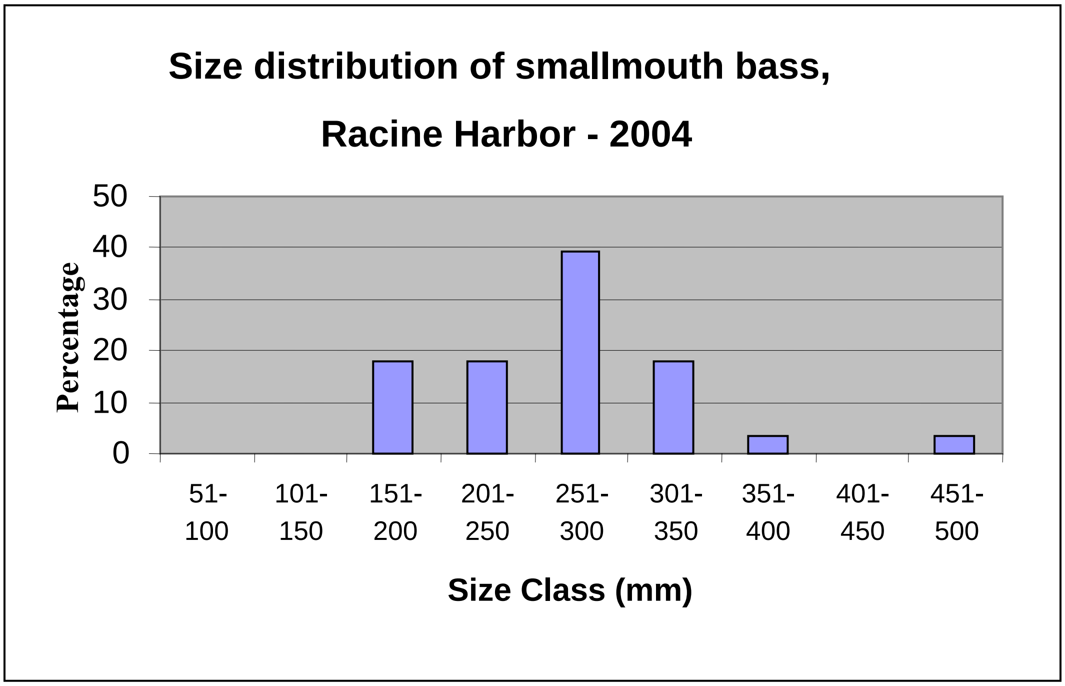

Figure 1. Length frequency distribution of smallmouth bass captured in Racine harbor using electrofishing.

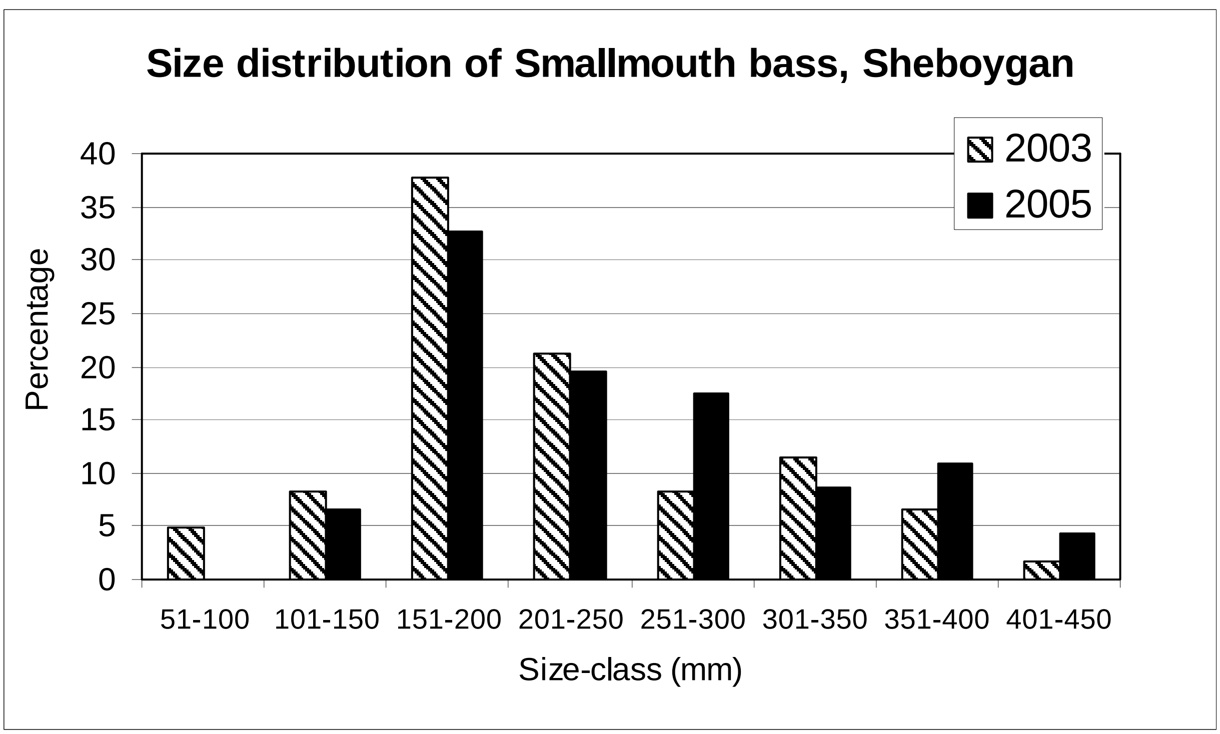

Figure 2. Length frequency distribution of smallmouth bass captured in the Sheboygan harbor using electrofishing in 2003 and 2005.

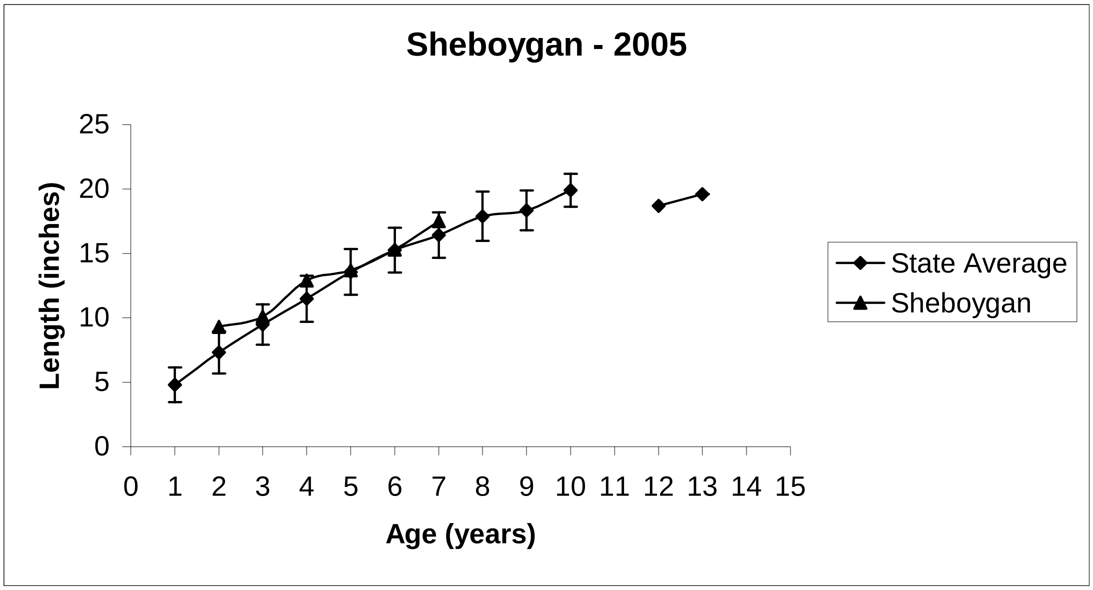

Figure 3. Comparison of mean length at age of smallmouth bass captured in Sheboygan River/harbor plotted against state average - 2005.

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For more details see the Lake Michigan web page:
http://www.dnr.state.wi.us/org/water/fhp/fish/lakemich

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FISH HEALTH

Each year we strive to collect some information regarding the prevalence of *Renibacterium salmoninarum, Aeromonas salmonicida, Echinorhynchus salmonis* (casusative agents of Bacterial Kidney Disease, furunculosis, and an acanthocephalan parasite, respectively) and other pathogens in spawning broodfish from Lake Michigan. Depending on available manpower, 30 to 60 fish are generally sampled on one day, early in the spawning period. Additional fish are sampled for special studies. In addition to screening fish for the pathogens above, ovarian fluids and kidney/spleen homogenates are collected to screen for viruses, and wedges of skull are removed from steelhead to screen for *Myxobolus cerebralis.*

Tables 1 and 2 summarize the prevalence of *R. salmoninarum* (Rs) and *A. salmonicida* (As) from 1996 through 2005. Unless otherwise noted, prevalence of Rs was determined by the direct fluorescent antibody technique (DFAT) of kidney smears. Polyclonal QELISA and ovarian membrane filtration tests are more sensitive tests than DFAT. Kidney was cultured on TSA and bacterial growth was used to determine prevalence of As. Estimates of intensity of infection (number of worms per fish) of the acanthocephalan parasite, *E. salmonis* (Es) were made by visual exam at the weir site.

For the years 1999 through 2005, Chinook salmon from the Root River and from Strawberry Creek were sampled as part of a collaboration between WDNR and the USGS Western Fisheries Research Center in Seattle WA. Fifty to over 100 pairs of Chinook (males and females) were sampled each year to identify parents testing negative for Rs. Gametes from these negative testing pairs were shipped to Seattle and used in laboratory studies related to Bacterial Kidney Disease. This work was funded in part by the Great Lakes Fishery Trust. For purposes of this summary, only data from the polyclonal QELISA test on kidney tissue is presented and is denoted in the table by a Δ**.** The best data we have are the data from 1999 through 2005 from the Root River and Strawberry Creek which resulted from collaborations with the Western Fisheries Research Center. These fish were not randomly collected; we targeted the healthiest looking fish since our goal was to obtain gametes from Rs free parents. In general, Rs prevalence was lower than we expected, knowing the history of this pathogen in Lake Michigan. In 2005, Rs prevalence was very low in 28 pairs of Chinook sampled on October 6 (1/56 fish). However, due to a hatchery problem, we lost the eggs from these fish and sampled Chinook again on October 20 to obtain replacement eggs. Rs prevalence was much higher (36/100) and of the 36 fish that tested positive by polyclonal QELISA of the kidney, 34 were males and 2 were females. This indicates that Chinook that spawn early may have a different Rs prevalence than fish spawning later. This suggests that sampling at the beginning and end of the spawning run may be necessary to obtain the true Rs health status of a population.

Starting in 2004, WDNR uses both the polyclonal QELISA (kidney) test and bacterial culture on SKDM2 agar from the same piece of kidney used in the QELISA test to assess the presence of Rs. Although the data are not presented here, in both 2004 and 2005, Coho returning to BAFF had high prevalences of Rs based on bacterial growth (30/36; 33/60) compared to prevalence based on the QELISA test (7/36; 7/60). This suggests that the QELISA test alone may not be a good indicator of Rs prevalence in Coho. The QELISA test detects a specific protein produced by Rs. Rs may not have produced enough protein to be detected by the QELISA in a newly infected fish. Alternatively, it is known that some isolates of Rs do not produce the specific protein, and thus the QELISA cannot detect it. This situation warrants some investigation and study.

Prevalence of As in Chinook from Strawberry Creek is very low or absent compared to other spawning weirs in Wisconsin. This pattern may arise because only Chinook are stocked in Strawberry Creek; the other weirs receive Chinook, Coho, three strains of steelhead and one strain of brown trout each year, which all return as adults at the appropriate time of their life cycle. This commingling may increaser the chance for As to infect fish as they return to natal streams. Of special concern is the increased prevalence of As in Coho salmon. Our broodstock streams are stocked with Coho from the Lake Mills hatchery and we have never isolated As from fish at Lake Mills. The question is, where and how are these fish acquiring their infections? Fortunately As is not thought to be vertically transferred, and eggs can be surface disinfected with iodophors to kill the bacteria.

Table 3 summarizes the intensity of Es from 1996 through 2005 for male and female Chinook. The Es life cycle begins with adult parasites in the intestine of fish. The worms shed eggs that are passed in the feces of the fish. Amphipods ingest the eggs and larvae develop. When a fish ingests the amphipod, the larvae develop to adults and the cycle begins again. Interestingly, if an infected fish is consumed by another fish, the worms will survive and establish an infection in the new host. Theoretically, by monitoring the intensity of infection of parasites over time, one might learn something about changes in the diets of fish.

The Strawberry Creek and Besadny Anadromous Fisheries Facility (BAFF) weirs are located near Sturgeon Bay and Kewaunee, respectively; the Root River Spawning Facility is located near Racine. Intensity of infection tends to be similar between Chinook returning to Strawberry Creek and BAFF, and is consistently somewhat lower in Chinook from the Root River. Mean intensity of Es in Coho is slightly higher for fish returning to the Root River vs. BAFF.

Although there is fluctuation from year to year, intensity of infection was markedly lower in Chinook sampled in Fall 2005 than in any other year. This pattern also occurred for Coho between 2004 and 2005. This suggests that there could be fewer intermediates hosts (amphipods) in the diet of fish (predators or forage), or that there are fewer forage fish in the diet of predators to act as paratenic hosts (fish to fish transfer of a parasite- no parasite development occurs). The dramatic reduction of Es intensity of infection in the intestine of Chinook and Coho in 2005 is an indicator that they have shifted their previous foraging strategies. Whether this is due to depletion of amphipods or stocks of forage fish needs to be investigated.

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Table 1. Pathogen History for Great Lakes Salmonids -- *Renibacterium salmoniarum*

Broodstock	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Strawberry Creek										
Chinook	1/58	1/60	2/60	NS	4/60	0/60	2/60	2/101Δ	6/84Δ	37/156Δ
BAFF										
Chinook	9/180	8/80	2/60	2/60	0/60	0/60	0/60	0/60	NS	NS
Coho	33/183	4/60	13/60	1/60	1/60	2/58	lab error	NS	7/36Δ	7/60Δ
Chambers STT	4/60	3/60	1/60	1/60	2/50	NS	1/30	0/31	1/30	19/30Δ
Ganaraska STT	2/60	6/59	1/60	2/60	0/48	1/46	0/30	0/30	0/30	NS
Root River										
Chinook	4/60	3/60	2/60	54/211Δ	35/200Δ	22/200Δ	41/120Δ	NS	NS	NS
Coho	1/60	6/60	0/60	2/60	2/60	6/60	2/60	4/60	1/30Δ	7/60Δ
Chambers STT	3/60	USFWS	NS	1/60	NS	NS	1/60	0/30	0/30	16/30Δ
Ganaraska STT	3/60	9/60	NS	1/59	1/60	0/60	0/60	0/30	2/30	21/30Δ
Kettle Moraine Sp										
Skamania STT	4/64	0/60 *	0/30 *	1/23	2/50	NS	2/20**	1/57	0/30	9/30Δ
Wild Rose										
Seeforellen BNT	0/30 *	0/30 *	0/30 *	0/30*	0/25*	NS	0/14**	0/30*	2/25Δ	6/30Δ

* R.s not detected in kidney smears, but was present in ovarian fluids (DFAT filtration method).
** Only ovarian fluids tested with the DFAT centrifugation method (kidney smear results were problematic).
Δ R.s. prevalence based on the polyclonal QELISA test on kidney tissue
NS= not sampled

Table 2. Pathogen History for Great Lakes Salmonids -- ***Aeromonas salmonicida***

Broodstock	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Strawberry Creek										
Chinook	0/60	1/60	0/60	NS	0/60	0/60	0/60	0/60	0/60	0/60
BAFF										
Chinook	0/60	0/60	0/60	0/60	3/60	1/60	1/60	2/60	NS	NS
Coho	3/60	0/60	0/60	6/60	14/60	14/60	lab error	NS	3/43	4/60
Chambers STT	0/60	0/60	0/60	0/60	0/50	1/41	0/30	2/31	0/30	0/30
Ganaraska STT	0/60	0/59	0/60	0/60	2/48	1/46	0/30	2/30	0/30	NS
Root River										
Chinook	0/60	9/60	1/60	1/60	2/60	1/60	1/60	NS	NS	NS
Coho	7/60	7/60	16/60	2/60	13/60	13/60	1/60	6/60	5/30	4/60
Chambers STT	0/60	0/58	NS	0/60	NS	NS	0/60	0/30	0/30	1/30
Ganaraska STT	0/60	0/60	NS	0/59	0/60	0/60	0/60	0/30	0/30	3/30
Kettle Moraine Sp										
Skamania STT	4/76	0/60	2/68	0/23	0/50	NS	1/60	1/36	0/30	0/30
Wild Rose										
Seeforellen BNT	27/60	3/60	19/60	5/60	1/25	12/28	0/23	2/30	4/25	1/30

NS= not sampled

Table 3. Mean intensity of infection (number of worms per fish) of the acathocephalan parasite *Echinorhynchus salmonis* in Chinook salmon from Wisconsin spawning weirs. Chinook were sampled in October each year.

	1996	1996	1996	1997	1997	1997	1998	1998	1998	1999	2000	2000	2000
	Str Cr	**BAFF**	**Root R**	**Str Cr**	**BAFF**	**Root R**	**Str Cr**	**BAFF**	**Root R**	**BAFF**	**Str Cr**	**BAFF**	**Root R**
M	88	130	67	91	103	65	105	143	109	27	39	54	52
F	99	100	47	78	82	52	103	144	60	41	55	51	33

	2001	2001	2001	2002	2003	2003	2004	2005
	Str Cr	**BAFF**	**Root R**	**Str Cr**	**Str Cr**	**BAFF**	**Str Cr**[1]	**Str Cr**[2]
M	125	72	83	73	188	212	113	13
F	128	65	115	111	158	259	86	20

[1] Intensity ranged from 10 to 450 worms per fish
[2] Intensity ranged from 0 to 85 worms per fish

Table 4. Mean and range of intensity of infection (number of worms per fish) of the acathocephalan parasite *Echinorhynchus salmonis* in Coho salmon from Wisconsin spawning weirs. Coho were sampled in October or November each year.

	2004	2004	2005	2005
	BAFF	**Root R**	**BAFF**	**Root R**
Mean	287	386	45	55
Range	20-600	80-800	7-100	4-110