Lake Michigan Committee
2007Annual Meeting
Ypsilanti, Michigan
March 2007

Lake Michigan Management Reports

Lake Michigan Fisheries Team
Wisconsin Department of Natural Resources

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INTRODUCTION

These reports summarize some of the major studies and stock assessment activities by the Wisconsin Department of Natural Resources on Lake Michigan during 2006. 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.

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 2,775,737 hours during 2006, .33% above the five-year average of 2,766,596 (Table 1). Both shore and boat anglers had extraordinary action throughout most of the summer. Weather conditions were conducive to fishing nearshore, giving both the shore-bound and small boat anglers ample opportunity to take part in some incredible Lake Michigan fishing. In 2006 ramp and charter effort was above the five year average by 4.21% and 11.61%.

Wisconsin Lake Michigan salmonid fishermen had another exceptional season in 2006. Although salmon overall were on the smaller side, numerous Chinooks exceeding 20lbs were taken. Lake Michigan salmon fishing still remains phenomenal. Both shore and boat anglers continued to have excellent success fishing in 2006. Salmon and trout harvest was 531,885, 2.67% above the five year average. Chinook dominated the majority of the harvest with 398,905 fish taken, a 12.57% increase over the five year mean. Coho salmon harvest decreased to 56,136 fish, 18.7% below the five year mean. The estimated open-water harvest of yellow perch was 825,358 fish, a significant increase over the last few years (Table 2). In past years the perch harvest was supported mainly by the 1998 year class, subsequently, in 2006 a majority of the catch consisted of 2002 year class fish, an encouraging sign for future yellow perch numbers. Overall the primary harvest was made up of Green Bay caught perch, which exceeded those from Lake Michigan. Walleye harvest was estimated at 30,165 a substantial increase from past years. Northern pike harvest was up to 3,308 fish, and smallmouth bass harvest declined slightly to 8,444 fish. This harvest could possibly be influenced by the phenomenal salmon, trout, and walleye fishing as more anglers are targeting these species rather than targeting smallmouth bass.

For more summaries, visit http://dnr.wi.gov/fish/lakemich/managementreports.htm.

Table 1. Fishing effort (angler hours) by various angler groups in Wisconsin waters of Lake Michigan and Green Bay during 2006 and percent change from the 5-year average (2002-2006).

YEAR	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	TOTAL
2006	1,498,043	352,669	290,939	172,275	169,737	292,074	2,775,737
% change	4.21%	-3.26%	11.61%	-3.35%	-17.95%	-4.74%	.33%

Table 2. Sport harvest by fishery type and species for Wisconsin waters of Lake Michigan and Green Bay during 2006.

SPECIES	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	TOTAL
Coho salmon	21,487		15,636	259	518	269	56,136
Chinook	147,010	94,205	119,904	5,709	8,122	23,955	398,905
Rainbow trout	19,106	11,843	11,509	927	1,124	3,911	48,420
Brown trout	6,574	1,480	1,945	1,916	3,692	2,162	17,769
Brook trout	0	0	9	0	8	0	17
Lake trout	3,656	3,171	3,746	24	8	33	10,638
Northern pike	3,082	0	0	0	184	42	3,308
Smallmouth	5,239	2,320	0	313	549	23	8,444
Yellow perch	750,648	50,384	0	13,391	9,848	1,087	825,358
Walleye	24,694	741	0	126	46	4,558	30,165
TOTAL	981,496	182,111	152,749	22,665	24,099	36,040	1,399,160

Table 3. Trout and salmon harvest by species in Wisconsin waters of Lake Michigan, 1987-2006.

Species	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	TOTAL
Brook Trout	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	17	34,307
Brown Trout	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	17,769	857,549
Rainbow Trout	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	48,420	1,497,474
Chinook Salmon	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	398,905	4,173,657
Coho Salmon	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	56,136	1,622,212
Lake Trout	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	10,638	1,087,246
TOTAL	**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**	**531,885**	**9,272,445**
Harvest/Hour	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	0.1916	0.1323

Table 4. Trout and salmon harvest by angler group in Wisconsin waters of Lake Michigan, 1987-2006.

Fisheries Type	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	TOTAL
Ramp	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	197,833	3,608,321
Moored	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	128,666	2,474,793
Charter	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	152,749	2,033,010
Pier	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	8,835	224,068
Shore	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	13,472	320,590
Stream	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	30,330	611,663
TOTAL	**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**	**531,885**	**9,272,445**

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WISCONSIN'S 2006 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.

The salmonid egg harvest quota varies from one year to the next for each species or strain based on the projected needs of WDNR hatcheries and egg requests from other agencies.

Strawberry Creek Weir

Low Stream flow and low Lake Michigan water level was a potential problem for Chinook salmon harvest at SCW in the fall of 2006. However, for the seventh consecutive fall we utilized our 3,500 foot pipeline and pump to deliver approximately 1,500 – 2,000 gallons of water per minute to Strawberry Creek that greatly increased flow and attracted Chinook salmon to the weir. During the fall 2006 run, 4,510 Chinook salmon returned to SCW (Table 1). The 2006 return was the lowest since 1999, but was not unexpected because of stocking reductions that were instituted to reduce the number of fish returning to SCW. Despite the reduced number of returning Chinook salmon, Wisconsin's entire Chinook salmon egg quota was once again collected at SCW in 2006.

Besadny Anadromous Fisheries Facility

Spring Operations

The spring steelhead return to BAFF in 2006 was 582, with the majority (76%) of the returning fish either Chambers Creek or Ganaraska steelhead (Table 2). The 2006 spring run total increased from what was observed during the 2005 spring run and was the second best run since 2000. Improved run number was likely due to the good return of steelhead stocked in 2004 and because of good spring flow. The 2006 spring run was typical of the runs of the past five years, but was far less than those observed in 1994 through 1997. Approximately 0.4 million steelhead eggs were collected at BAFF during the 2006 spring run.

Fall Operations

The summer/fall run of steelhead was poor in 2006 and was similar to those since 2000 (Table 2). Although there was abundant late spring and late fall rain, river flow did not increase enough to trigger steelhead runs into the river, making 2006 a poor year for Skamania steelhead. No steelhead from BAFF were sent to the Kettle Moraine Spring Hatchery for brood production in 2006.

The fall 2006 Chinook salmon capture at BAFF was the 4th largest in 16 years despite the intentional passage of Chinook salmon not needed for egg production (Table 1). Timely rainfall throughout the fall improved water levels and flow to BAFF which contributed to a much higher than anticipated run of Chinook salmon. Because Chinook salmon were intentionally bypassed without handling, it is uncertain how large the run

would have been if the BAFF had been fully operational in fall 2006.

The coho salmon return to BAFF in the fall of 2006 was down slightly in comparison to the fall 2005 run (Table 3). Approximately 0.473 million coho salmon eggs were collected at BAFF in the fall of 2006. Fewer than expected coho salmon returns to the RRSF and VHS concerns contributed to the increase in Coho egg production at BAFF.

Root River Steelhead Facility

Spring Operations

The spring steelhead return at RRSF in 2006 was 845 (Table 2). The majority of steelhead that returned during the spring run were likely either Chambers Creek or Ganaraska strain steelhead. The 2006 spring return was the lowest return noted since 2001 and continues the trend of declining spring returns to the RRSF that began in 2002. Approximately 0.77 million steelhead eggs were collected in spring.

Fall Operations

The Root River Steelhead Facility (RRSF) was in operation for a record 25 processing dates during the fall 2006 fish migration. Stream flows were very consistent, even ideal all season. This produced conditions that resulted in the capture and processing of over 12,000 fish, mostly Chinook salmon during the fall salmon run.

The fall run of 536 steelhead was the fourth best fall run noted at the RRSF since 1994 (Table 2). Most of the steelhead that returned during the fall run were Skamania strain steelhead that were transferred to the Kettle Moraine Springs Hatchery to be used for propagation.

The 10,318 Chinook salmon that returned to RRSF in 2006 represented the second largest run total since the facility opened in 1994 (Table 1).

Coho salmon were not nearly as plentiful. A total of 1,400 coho salmon returned to the RRSF in 2006 (Table 3). We collected 0.8 million coho salmon eggs which left Wisconsin slightly short of our goal of 1.5 million coho salmon eggs.

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Table 1. The total number of Chinook salmon handled during fall migrations at Strawberry Creek (1981-2006), Besadny (1990-2006) and Root River (1994-2006) weirs.

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

1 From 2000 through 2006 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.
2 All fish were allowed t5o bypass BAFF until October 1.

Table 2. The total number of steelhead examined during spring and fall runs at BAFF (1992-2006) and RRSF (1994-2006).

Year	BAFF	RRSF
1992 – Spring	3,338	
1992 – Fall	474	
1993 – Spring	2,273	
1993 – Fall	205	
1994 – Spring	2,804	
1994 – Fall	321	848
1995 – Spring	1,696	2,720
1995 – Fall	457	538
1996 – Spring	1,964	3,169
1996 – Fall	24	353
1997 – Spring	1,955	3,045
1997 – Fall	85	638
1998 – Spring	746	382
1998 – Fall	41	151
1999 – Spring	608	2,263
1999 – Fall	61	70
2000 – Spring	220	2,171
2000 – Fall	2	219
2001 – Spring	324	859
2001 – Fall	6	490
2002 – Spring	307	1,303
2002 – Fall	3	301
2003 – Spring	307	1,060
2003 – Fall	0	236
2004-Spring	720	1,028
2004-Fall	16	398
2005 – Spring	407	887
2005 – Fall	6	116
2006- Spring	552	845
2006- Fall	15	536

Table 3. The total number of coho salmon examined at BAFF (1990-2006) and the RRSF (1994-2006).

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

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).

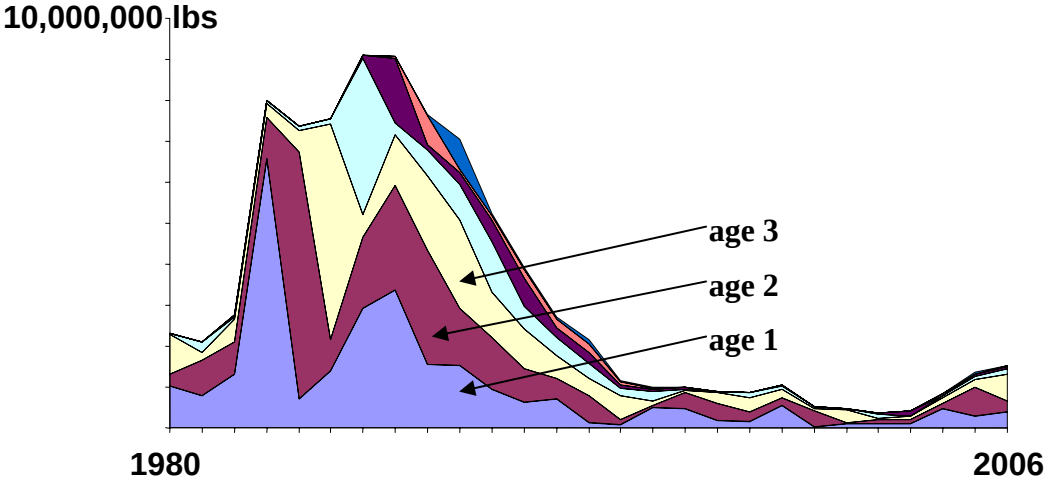

Figure 1. Estimated biomass of yellow perch aged 1 and older in Green Bay at the start of each summer from 1980 to 2006.

Population assessments

The spring spawning assessment continued for the 29th year on Green Bay at Little Tail Point. Double-ended fyke nets were set at three standard locations from April 8 to April 25, 2006. A total of 589 females and 562 males were sampled. A majority of the mature females sampled were age-2 (2004 year class) and age-3 (2003 year class). Age-2 and age-3 comprised 49% of the total and 34% of the females sampled, respectively. Age-2 males were abundant, comprising 81% of the total males sampled.

In 2006, larval sampling continued for the 9th 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 six days from May 2nd through June 7th. Samples were sent to University of Wisconsin-Milwaukee's Great Lakes Water Institute for identification

and analysis.

Index station seining continued for the 25th consecutive year at 15 sites spread over 130 miles of Green Bay shoreline. Seining was implemented on the weeks of June 19-20, June 26-29, and July 5-7, 2006. The average number of young-of-year yellow perch per site was 139, 93, and 103 respectively over the three week sampling period, compared to 59, 55, and 27 in 2005. The percent of sites with young-of-year perch present were 80%, 93%, and 93% respectively.

Annual late summer trawl surveys continued for the 29th 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 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 that standard and deep sites represent, creating a weighted area average value. In 2006, the relative abundance of young-of-year yellow perch (848) ranked as the 6th highest since the deep water-sites were added in 1988 (Figure 2). Yearling and older yellow perch abundance decreased at index sites from 242 in 2005 to 149 in 2006 (Figure 3). This was the 6th lowest since 1988 and below the 19-year combined average of 645.

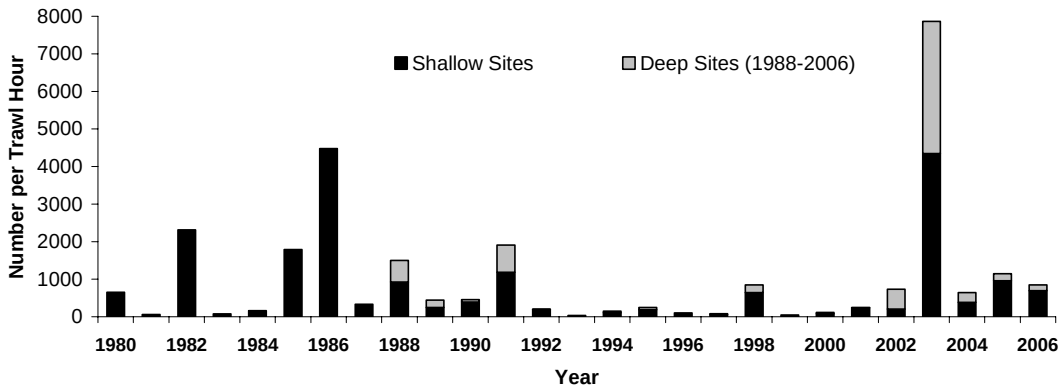

Figure 2. Relative abundance (weighted area average) of young-of-year yellow perch collected during fall index trawling surveys in Green Bay from 1980 to 2006.

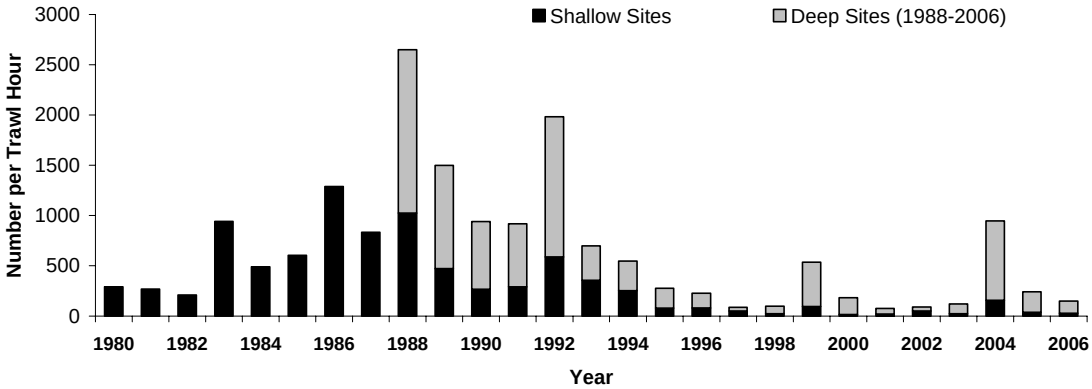

Figure 3. Relative abundance (weighted area average) of yearling and older yellow perch collected during fall index trawling surveys in Green Bay from 1980 to 2006.

Harvests

Sport fishing harvest is estimated from an annual creel survey. Fish obtained through that survey are used to describe the age and size composition of the catch. Sport fishing harvest has fluctuated with changes in yellow perch abundance. In 2004, it reached the lowest level in the 20 years of the survey (Figure 4). Open water harvest numbers of yellow perch increased from 260,128 in 2005 to 692,385 in 2006 (Figure 4). The 2006 harvest rate (0.79/hour) and catch rate (1.12/hour) of yellow perch also increased from 0.32/hour and 0.66/hour in 2005, respectively. A total of 244 sport fish harvested yellow perch were aged in 2006 based on established WDNR protocols. A majority (75%) of the harvest was age-3 (2003 year class). Age-4 perch comprised 13% of the catch. The mean length of harvested yellow perch was 8.5 inches (SD = 1.2).

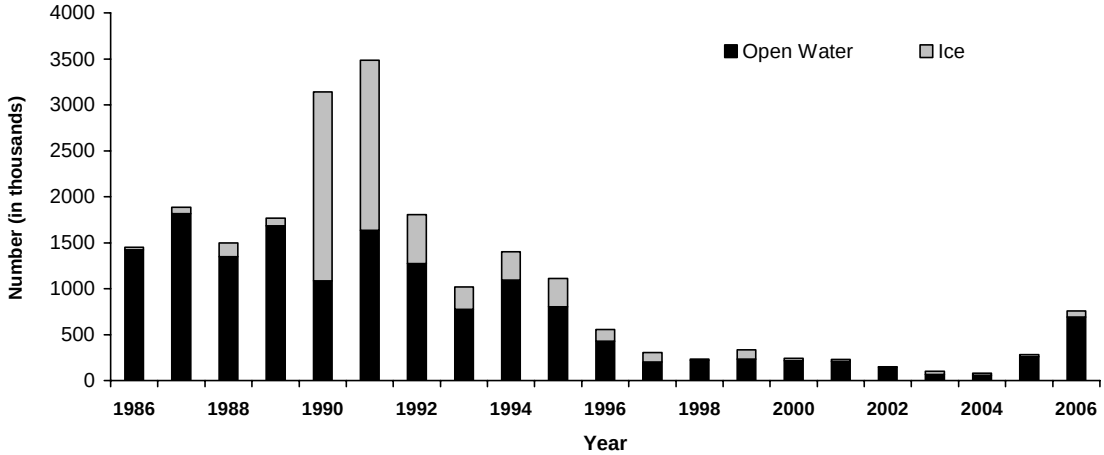

Figure 4. Estimated sport harvest of yellow perch in Green Bay from 1986 to 2006.

The annual commercial harvest is reported by commercial fishermen. Fish sampled by WDNR 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 20,000 pounds to a high of 475,000 pounds (Figure 5).

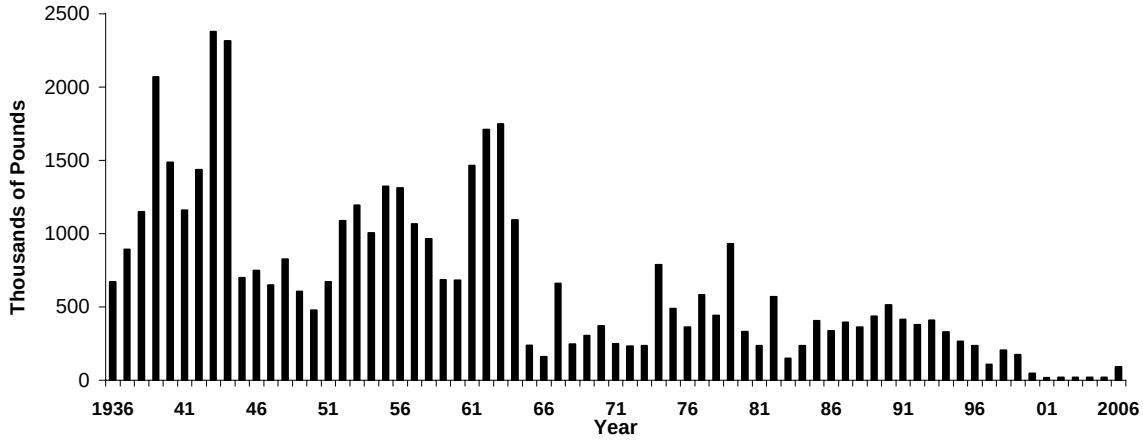

Figure 5. Commercial harvest of yellow perch in Green Bay from 1936 to 2006.

In 2006, commercial fishers harvested a total of 89,973 pounds using both gill nets and drop nets, compared to 19,221 pounds in 2005 (Figure 5). The harvest rate (catch/effort) for gill nets increased from 33.55 in the 2004/2005 quota year to 37.0 in 2005/2006, while drop nets increased from 33.86 in 2004/2005 to 45.81 in 2005/2006. A majority (91%) of the commercial harvest during 2006 were age-3 (2003 year class) yellow perch. Age-4 perch comprised an additional 7% of the catch.

Management Plans

In 2006, Wisconsin DNR increased the bag limit to 15 perch and the commercial quota to 60,000 pounds in Green Bay. Wisconsin DNR is evaluating a computer regarding further changes to the regulations. The decision to increase the daily bag limit and commercial quota was based on improved production observed in fall trawling surveys from 2002 to 2006 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.

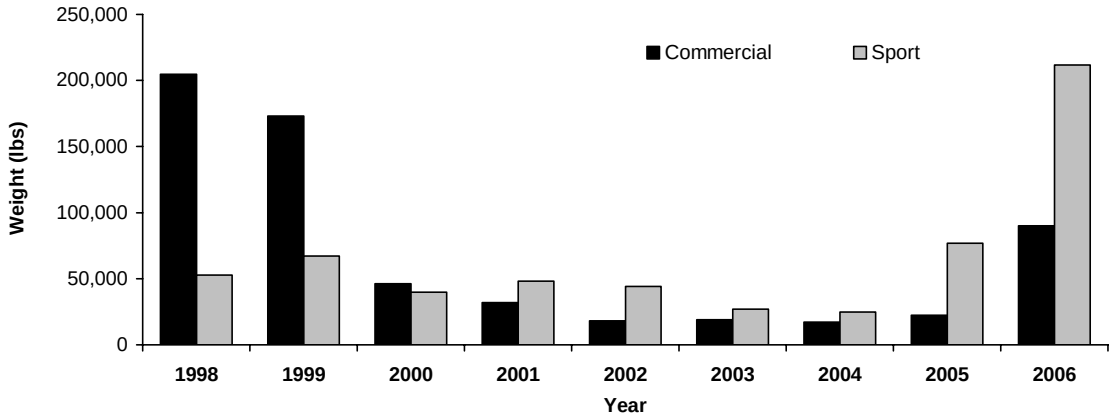

Figure 6. Commercial harvest and estimated sport harvest in Green Bay from 1998 to 2006.

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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 2006-07.

Beach seining

In southeastern Wisconsin, beach seining was done to assess young of the year (YOY) yellow perch. In 2006 we sampled at fifteen sites between Kenosha and Sheboygan from August 29, 2006 to September 19, 2006 using a 25' bag seine with ¼" delta mesh. Surface water temperature remained in the 70s ^{0}F during the early part of September, and then cooled down to 60s ^{0}F. For the most part water clarity was very high. Dense algal growth at some of the sampling sites 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 2006 survey produced one YOY yellow perch captured at Sheboygan North Pier. We sampled at 14 locations, totaling 4,450 ft of seining, and captured only one YOY yellow perch (CPE= 0.02). By and large, YOY alewife dominated the catch followed by round goby, spottail shiner, longnose dace and smelt. A total of twenty-three species of fish were encountered during the survey.

In addition to using a standard bag seine, a 200-foot Swedish monofilament gill net (100 ft of 6 mm and 100 ft of 8 mm bar length mesh) was used to capture YOY yellow perch in the nearshore waters. The majority of YOY yellow perch that were captured in this net ranged between 60mm and 80mm in total length (averaged 70.7mm). 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 (lifted on 09/08/2006), about 17miles south of Milwaukee, and Doctor's Park (lifted on 09/06/2006), about 9 miles north of Milwaukee. We caught a total of 243 YOY yellow perch (242 at Wind Point set, and 1 at Doctor's Park set). Catch per 100 ft of gill net effort worked out to be 61 YOY yellow perch (Figure 1).

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. In 2006, first sampling was done on 5/17/2006 at two different depths ranging from 45-55 ft (Gang 1), and 35-45 ft. (Gang 2), for a total effort of 800 ft net. A total of 534 yellow perch were captured, of which 40 were females. The majority of females were green at this time. The bottom water temperature was 47 ^{0}F. The second lift was taken on 5/23/2006. A total of 808 (27 females) yellow perch were captured in 900 ft of gill net. At this time, 16 females out of the 27 perch were ripe and six of them were spent. The third lift was taken on 6/7/2006 by which time the spawning activity had already peaked out. We captured 400 yellow perch in 800ft of net, of which 94 were females. The majority of female perch had already spawned (73 spent female). We also collected anal spines from 75 perch for age determination. 61% of yellow perch belonged to 1998 year-class, and 29% belonged to 2002 year-class. Although the 1998 year-class still dominated the spawning population, 2002 year-classes also contributed a sizable proportion. This observation is similar to what we found in the sport harvested yellow perch in 2006.

Yellow perch egg deposition survey was conducted by the WDNR dive team. The survey documented successful egg deposition, recording 399 egg masses resulting in 11.27 egg mass per 1000 square meters (Figure 2). This data was similar to the 2005 observation (11.74 per 1000 m^2). 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 winter months, 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 (Figure 3). A total of five lifts, each with 2800' effort were taken from 12/05/2006 to 01/03/2007 at depths ranging from 60' to 90'.

Table 2 shows the relative abundance as catch per effort of perch, by age, for this assessment from 1990 through 2007. 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 in the early 1990s, and the proportions skewed towards older perch (dominated by male perch) in mid to late 1990s until 1998. 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. In our 2006 graded mesh assessment, we found 2002 year-class (age 4) yellow perch forming the second largest year-class contributing about 33% of the total catch, following right behind 1998 year-class (55%). Whereas, the 2007 assessment indicated that the 1998 year-class is no more the dominant player (23%), which is now replaced by the 2002 year-class (41%). In addition, the 2003 year-class yellow perch contributed 12% of the yellow perch in the assessment. It appears that there is a potential of 2005 year-class developing as a sizeable year-class in the future. It was interesting to note that the oldest yellow perch we recorded were the 9 year old 1998 year-class yellow perch in our 2007 assessment. The proportion of 1998 year-class fish dropped from 55% in 2006 assessment to 23% in 2007 assessment.

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. However, the 2007 data indicated more females (52%) in the catch than males (48%), which is a combination effect of 1998, 2002 and 2003 year-classes. An absence of commercial harvest in Lake Michigan certainly has helped decrease the impact on fast growing larger perch in the fishery, allowing them to spawn multiple years.

Harvest

In September 1996, the commercial yellow perch fishery was closed in the Wisconsin waters of Lake Michigan. Hence, the information on commercial harvest is limited up to 1995 catches. Sport harvest is monitored by a contact creel survey. The sport bag limit has been reduced to five fish per day since September 1996, which is reflected in the total harvest (Table 3). Our creel survey data on the sport caught yellow perch in 2006 indicated that the majority of catch consisted of 2002 (57%) and 1998 (26%) year-classes. The 1998 year-class dominated the sport harvest in 2001 representing as high as 86.5% of the catch. However, recent data from sport harvest as well as winter graded mesh assessment indicate that the 1998 year-class perch are depleting in the catch, which is replaced by 2002 year-class. A significant increase in sport harvest from 33,000 yellow perch in 2005 to 68,000 yellow perch in 2006 is probably a reflection of strong 2002 and 2003 year-classes reaching harvestable size. Previously such high harvest was documented in 2001 (121,000) when the 1998 year-class made up the majority of the catch. 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.

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 year-class in

recent years supporting the fishery. Although 1998 year-class continue to support the fishery, the proportion of these fish is gradually decreasing while the 2002 and 2003 year-classes starting to appear in substantial numbers. 57% of the sport caught yellow perch yellow perch in 2006 belonged to 2002 year-class, and 1998 year-class comprised only 26%, a pattern similar to the 2007 winter graded mesh assessment data. 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, and allowing mature adults to spawn multiple years in their life time. While the dominant 1998 year-class is gradually depleting, 2002 and 2003 year-classes are showing promise.

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
2006	1,741	1,580	161	0	9	2,500

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

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

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	724	159	49	60	0	0	0	0	0	42	323	1	0	2	3	0	3	40
3	1037	865	276	98	25	0	0	4	2	57	65	243	4	0	1	61	29	24
4	938	323	715	402	58	28	0	14	6	215	9	20	118	0	0	12	249	60
5	394	327	281	757	218	65	0	11	29	93	27	2	4	33	1	0	37	204
6	381	83	181	165	141	120	19	18	35	57	2	2	3	0	27	11	0	31
7	90	82	126	49	48	76	51	77	20	45	0	1	1	0	1	226	23	4
8	0	32	73	16	11	65	71	251	43	63	8	2	0	0	0	6	417	20
9	0	0	14	0	0	24	31	109	110	44	9	1	0	0	0	0	7	113
10	0	0	0	0	0	2	12	15	60	33	11	1	0	0	0	0	0	0
11	0	0	0	0	0	0	3	0	15	9	1	1	1	0	0	0	0	0
12	0	0	0	0	0	0	0	0	4	7	0	0	1	1	1	2	0	0
%M	61	72	82	86	89	90	95	89	80	58	36	36	38	52	60	64	53	48
%F	39	28	18	14	11	10	5	11	20	42	64	64	62	48	40	36	47	52

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

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

Year	Commercial harvest (lb. x 1000)	Sport harvest (number x 1000)
1986	373	388
1987	550	600
1988	431	869
1989	267	703
1990	256	616
1991	326	844
1992	282	886
1993	267	516
1994	254	255
1995	128	214
1996	15[a]	41[b]
1997	Closed	27[b]
1998	Closed	36[b]
1999	Closed	23[b]
2000	Closed	16[b]
2001	Closed	121[b]
2002	Closed	88[b]
2003	Closed	66[b]
2004	Closed	42[b]
2005	Closed	33[b]
2006	Closed	68[b]

[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)

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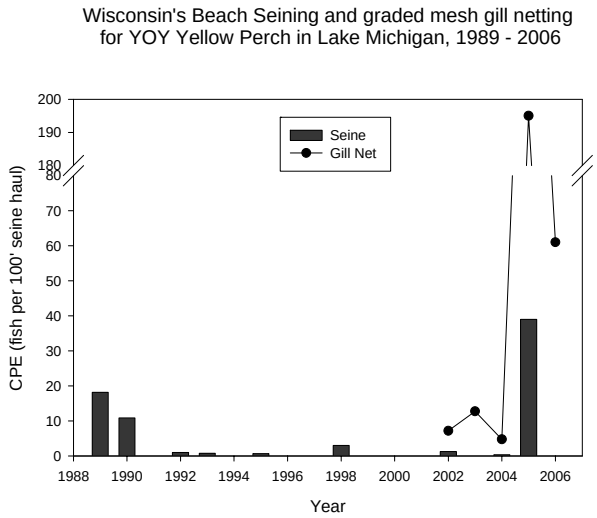


Figure 1. CPE (fish/100') of YOY yellow perch in summer beach seining and graded mesh gillnetting.

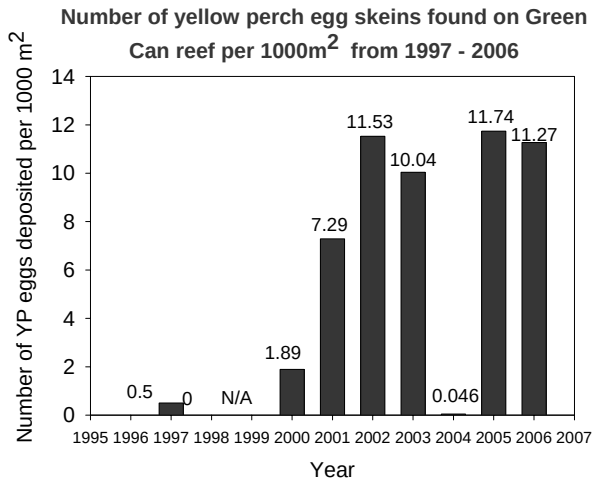


Figure 2. Yellow perch egg deposition survey in Lake Michigan.

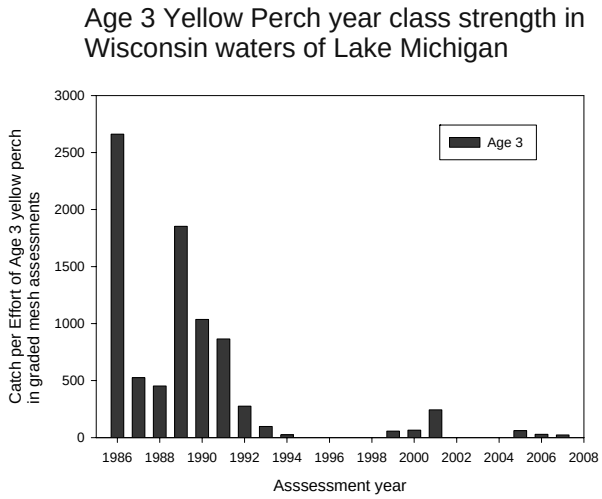


Figure 3. Age 3 yellow perch in the winter graded mesh gillnetting assessment in Lake Michigan.

THE COMMERCIAL CHUB FISHERY AND CHUB STOCKS

The total chub harvest from commercial gill nets was 843,316 pounds for calendar year 2006, a decrease of 33% from 2005 (Tables 1 and 2). Commercial smelt trawlers harvested 4,465 pounds of unmarketable chubs incidental to the targeted smelt harvest which represents a 94% decrease from 2005, when 74,780 pounds of unsorted fish were harvested. There were no reported chubs reported in the marketable catch from trawlers.

By zone, the harvest in the south was 807,031 pounds, which was a decrease of 33% from 2005, while in the north 36,285 pounds were reported caught, a decrease of 29% from 2005. Harvests in both the north and south were the lowest since chub fishing re-opened. The south showed a 16% decrease in CPE from the year before while the CPE in the north was very similar to the previous year. Gill net effort in the south decreased by about 21% or 5,009,400 feet while effort in the north decreased by 27% or 365,700 feet. In the south, 20 of the 40 permit holders reported harvesting chubs while in the north 6 of 19 reported harvesting chubs.

Table 1. Harvest, quota, number of fishers and effort (feet) for the Wisconsin Southern Zone gillnet chub fishery 1979-2006. The actual quota is broken down into three separate periods and runs from July 1 of the previous year to June 30 of the current.

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

Table 2. Harvest, quota, number of fishers and effort (feet) for the Wisconsin Northern Zone gill net chub fishery 1981-2006.

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

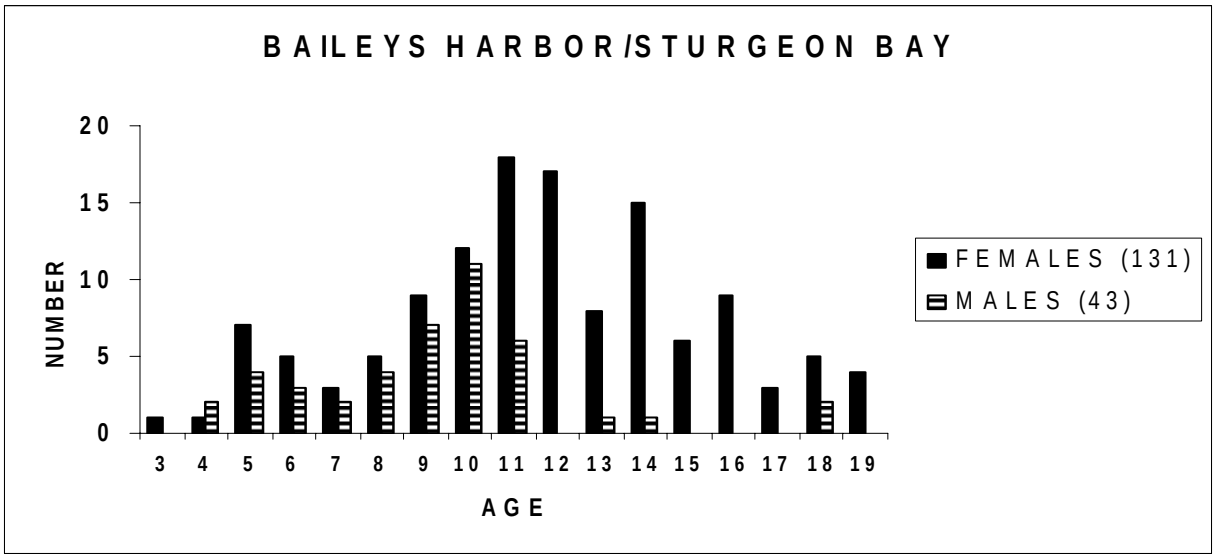
[a] For the years 81-85, 90 & 91, 98-06 totals were by calendar year.
[b] For the years 86-89 & 92-97 the totals were through Jan. 15 of the following year.

Chub assessment in 2006 marked the fifth 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 off Algoma and Baileys Harbor in September of 2006 and off Sheboygan in January of 2007. Two lifts were made off Algoma and Sheboygan and one off Baileys Harbor. Samples of chubs were also collected form standard mesh gear and aged, but because of poor catches off Algoma and Baileys Harbor, only Sheboygan was used. The use of otoliths for aging chubs indicates that scale reading may have under-aged fish in the 1990's as chub growth slowed.

Catches from graded-mesh gill nets were very poor off Algoma and Baileys Harbor, thus data was pooled for these two sites. Chubs up to 21 years of age were collected off Sheboygan and up to 19 years of age off Sturgeon Bay (Algoma)/Baileys Harbor (Figure 1). Chubs aged from 5 to 21 were caught off Sheboygan and 3 to 19 of Algoma/Baileys Harbor. On a positive note, this appears to be the second in a row that younger aged chubs are showing up, particularly off Sheboygan, where a significant number of male chubs showed up from 5 to 12 years of age. This was the first year in many that males actually out numbered females in an assessment, as shown off Sheboygan. In all graded mesh lifts combined this

year, the sex ratio was 50:50. When compared to the past three years, sex ratios in graded mesh gill nets were 71% females in 2005, 73% in 2004 and 82% in 2003. This may be an indication of younger chubs in the system as it is believed that female chubs outlive males.



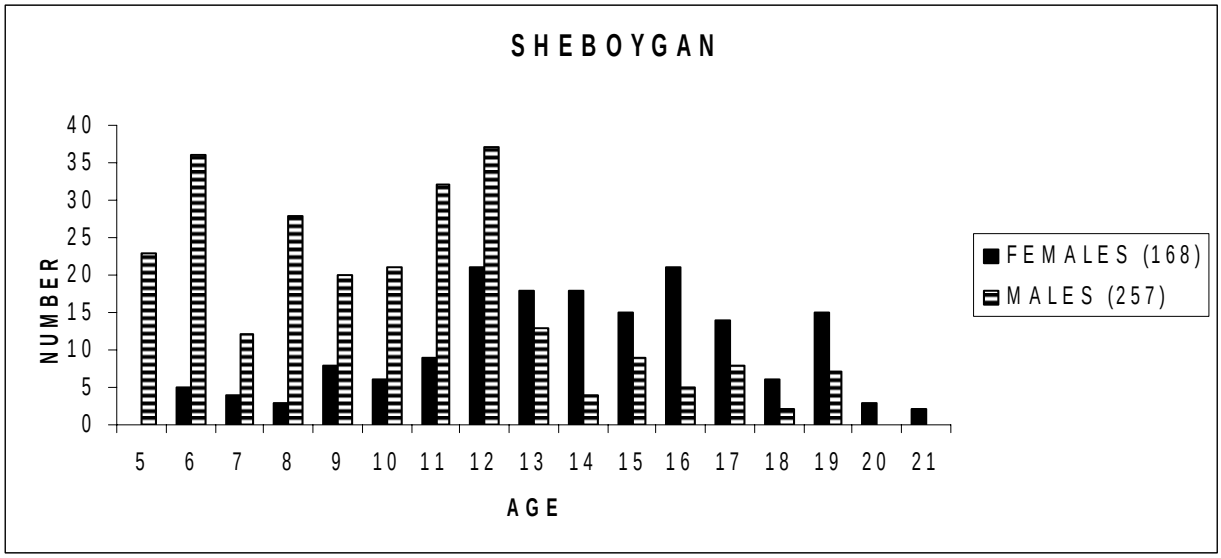


Figure 1. Age composition by number and sex of chubs captured during graded mesh assessments at two locations along the Wisconsin Lake Michigan shoreline, 2006-07.

The chubs sampled from standard mesh nets off Sheboygan showed fish ages from 8 to 20 (Figure 2). Catches from standard gear off Algoma and Baileys Harbor were very poor. Sex ratios in standard mesh continue to be high on the female side with the catch showing 80% females compared to 90% in 2005 and 80% in 2004. An advantage of the female dominated population in the commercial fishery is an added profit in the sale of chub roe to the caviar market during the late fall and winter months.

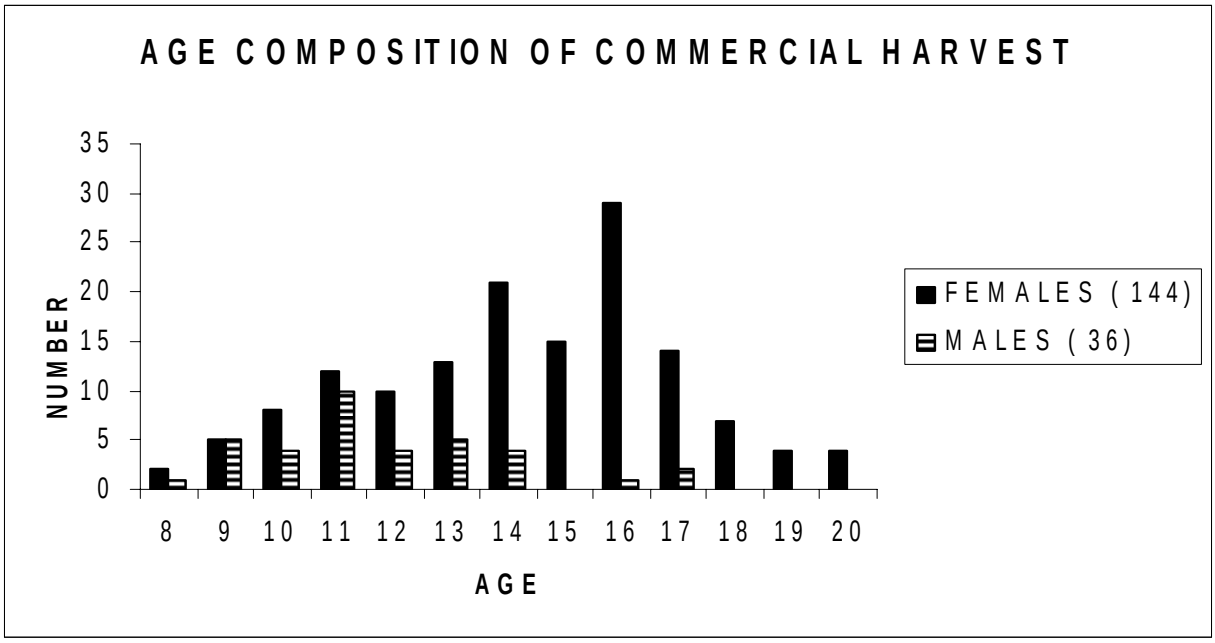


Figure 2. Age composition of chubs by number and sex sampled from commercial nets (2 ½" mesh) off Sheboygan in January, 2007.

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 entry and summary. Also, Mark Nelson, a commercial fisherman out of Sheboygan, was of great help in completing this assessment.

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LAKE STURGEON

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 of Green Bay. The Menominee River contains the largest population in Lake Michigan waters 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, although recent regulation restrictions reduced the harvest to 1 in 2006. 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 Population Assessment

Surveys were conducted from May 2, 2005 through November 14, 2006 (Table 1). In general, surveys were not conducted if water temperatures exceeded 24 C. Past experience indicated that elevated temperatures appeared too stressful for lake sturgeon and lead to lethargic movements after release and occasional death. For these sampling dates, the river surface water temperatures ranged from 4.4 C in the late autumn to 28.3 C in the summer. The average temperature during 10 sampling days in May was 13.1 C. The average fall temperatures were 7 C. Water temperature only exceeded 24 C on one occasion. Immediate mortality was less than 4% for that day, however latent mortality was unknown.

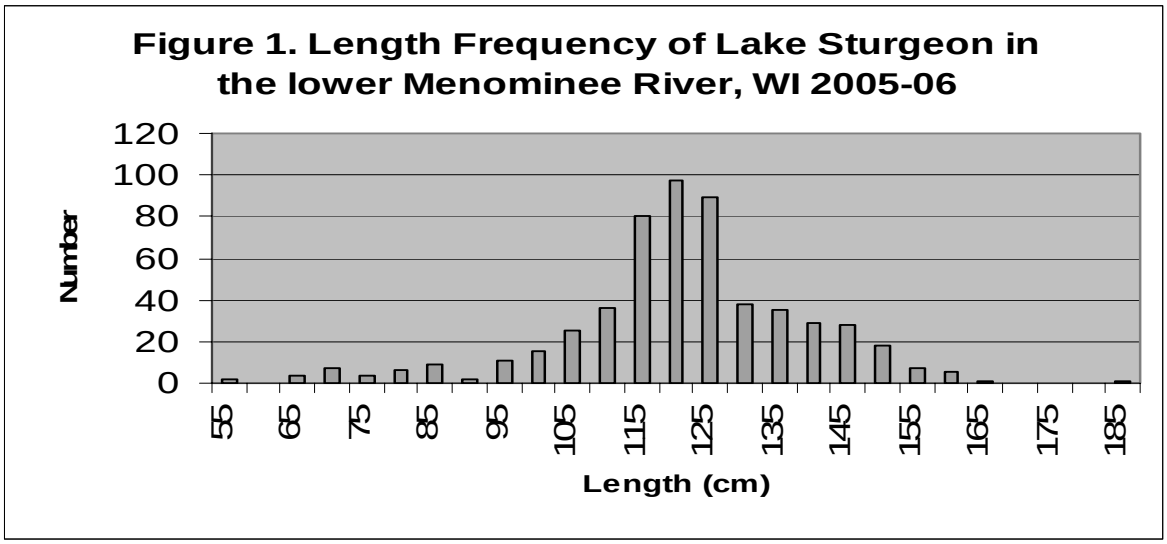
Field sampling in 2005 and 2006 produced 554 lake sturgeon from the lower Menominee River. The sample size was 278 lake sturgeon in 2005 and 276 in 2006. The number of fish caught per day ranged 1 to 95 fish. The largest samples were obtained on October 25, 2006 (95) and June 21, 2006 (89). However, in general, less fish were observed in the spring and fall. Most of the fish (92%) were subjectively labeled as adults (>102 cm in total length), but several sub-adults sturgeon were observed during the surveys. Larger average sturgeon lengths were recorded in the spring (May) compared to the summer and fall. The overall average total length during these sampling events was 124 cm. The smallest sturgeon was 58 cm and several fish were over 152 cm in length.

The length frequency was consistent with sampling methods and adequately described an exploited fishery with a 127 cm minimum size limit (Figure 1). Electrofishing and large mesh gill nets did not over-represent juveniles in the population. The percentage of sturgeon larger than 125 cm was only 29% of the total sample. The size range from 115 to 130 cm described 48% of the population.

Table 1. Sampling dates, effort, water temperature, sample size, total length size range and average length (cm) of lake sturgeon surveyed in the Menominee River in 2005-06.

Date	Effort	Water (C)	Sample size	Size range	Average
May 2, 2005	183 m	8.3	1	141.0	141.0
May 3, 2005	244 m	8.3	1	136.0	136.0
May 5, 2005	152 m	11.7	8	114.3-144.8	130.6
May 9, 2005	213 m	16.1	6	111.8-165.1	134.4
May 10, 2005	213 m	17.2	12	101.6-160.0	133.9
May 11, 2005	91 m	16.7	18	124.5-188.0	143.0
July 19, 2005	3 boats*4 hr	28.3	55	66.0-160.0	115.6
August 22, 2005	2 boats*4.75 hr	22.2	71	68.6-162.6	124.7
August 31, 2005	2 boats*4 hr	22.2	28	106.7-152.4	127.3
October 3, 2005	1 boat*4 hr	*	26	88.9-149.9	124.0
October 14, 2005	1 boat*4 hr	13.3	22	76.2-144.8	119.9
October 21, 2005	1 boat*3 hr	*	14	106.7-154.9	125.2
October 25, 2005	1 boat*3 hr	8.9	16	91.4-139.7	119.4
May 10, 2006	1 boat*2 hr	14.4	19	110.5-152.4	130.8
May 15, 2006	1 boat*3 hr	10.6	7	115.1-151.1	132.6
May 22, 2006	1 boat*3 hr	13.9	19	109.2-146.1	127.8
May 24, 2006	1 boat*2 hr	16.1	24	96.0-154.9	128.8
June 21, 2006	2 boat*3.5 hr	22.8	89	57.9-160.8	117.1
October 25, 2006	2 boat*5 hr	5.6	95	70.6-167.6	124.2
November 7, 2006	1 boat*3 hr	5.0	12	113.0-139.2	125.2
November 14, 2006	1 boat*3 hr	4.4	11	106.7-130.3	121.7

Note: No temperature recorded on this sample date.



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. Those regulation changes reduced the harvest to one lake sturgeon in 2007.

Milwaukee and Manitowoc River Streamside Rearing Facilities

Two sites were selected for the location of the streamside rearing facilities (SRF) in Wisconsin, one on the Milwaukee River in Ozaukee County and one on the Manitowoc River in Manitowoc County. Northern Environmental designed, constructed and delivered both the Milwaukee and Manitowoc streamside rearing facilities. The Little River Band of Ottawa Indians assisted with the design. Both units were ready to be used by the start of the 2006 rearing season.

Prior to the Milwaukee SRF trailer delivery, Wisconsin DNR and Riveredge employees installed the supply and drain lines and the electrical hook-up for the trailer. In addition, the site for the trailer was prepared by laying down an extra layer of crushed gravel.

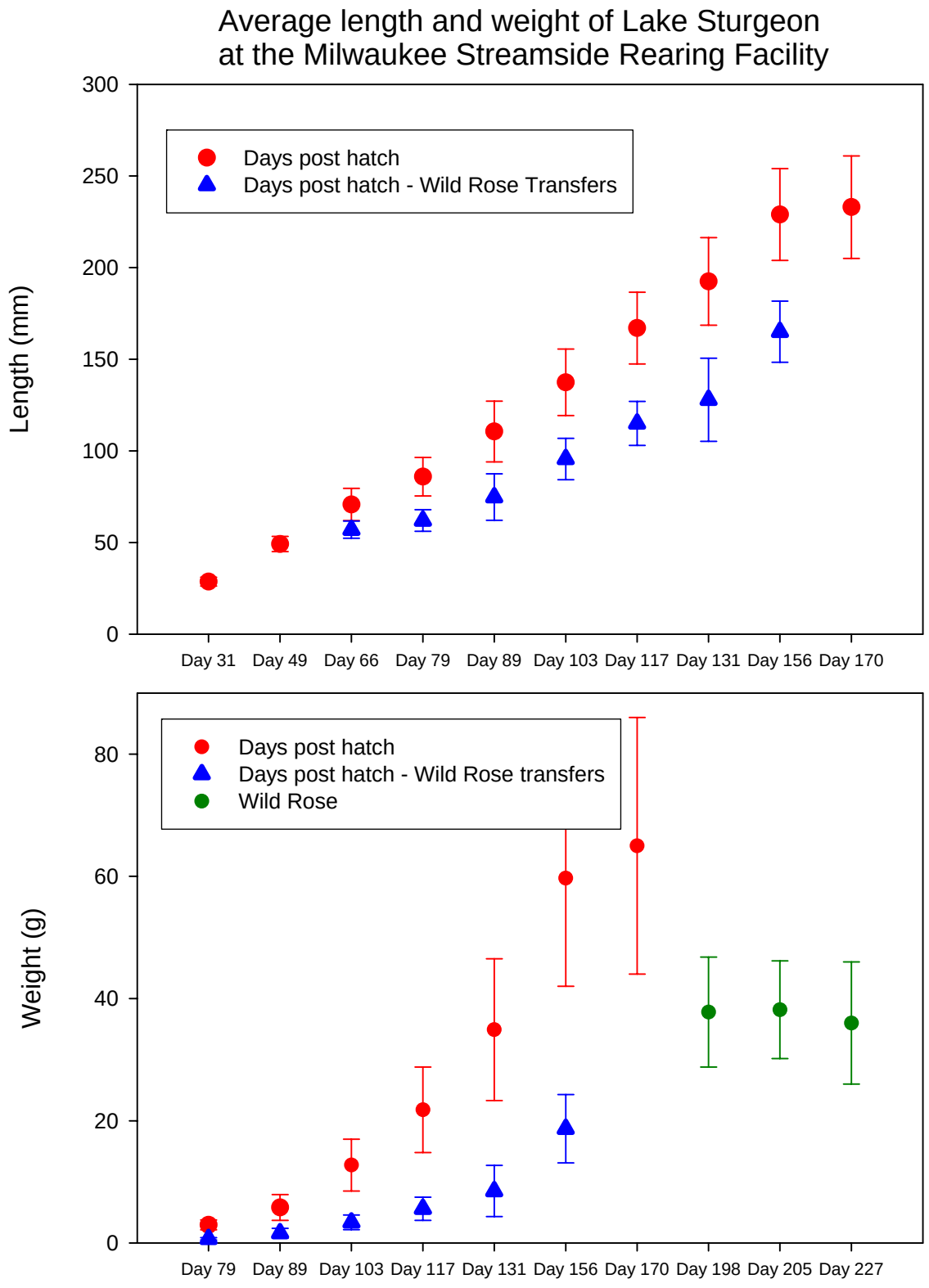
The Milwaukee SRF was deployed on April 10, 2006 and put into service on April 14 and April 15, 2006. Wisconsin DNR personnel artificially spawned 8 females from the Wolf River and transferred those fertilized eggs to the trailer on April 14 and 15, 2006. Sturgeon were raised throughout the season and eventually stocked on October 9, 2006. We were able to stock 27 lake sturgeon with 10 having radio

telemetry tags. Early problems with silt and inadequate filtration resulted in poor survival of hatched fish. In addition, to test densities in the facility, 759 lake sturgeon were transferred from our Wild Rose Fish Hatchery on June, 17 2006 into the facility. These fish had high mortalities the first several weeks due to inadequate food supply. However, once that problem was corrected we were able to achieve very high survival rates and had 420 fingerlings survive until they were removed from the facility on September 27, 2006.

The Manitowoc SRF was deployed to Wisconsin on May 15, 2006. It was delayed because the site preparation on the Manitowoc River was not complete. Efforts to work on the site continued through May and early June. However, it became apparent that the site would not be ready to use in 2006. Most of the technical problems included getting the necessary permits for the operation of the facility and providing electrical power to this remote site. Therefore, the trailer was stored at our DNR facility in Mishicot, Wisconsin. The site on the Manitowoc River will be ready for the 2007 rearing season.

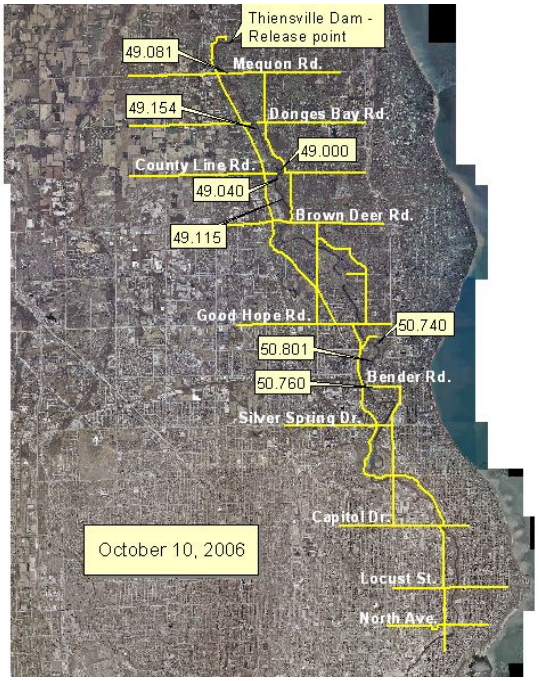
- Trailer built and delivered to Mishicot.
- Permits (WPDES, County Zoning, Town Zoning) received for operation of facility
- Site was prepared for the hatchery with a small area cleared and gravel placed for the trailer to sit on
- Electrical hookup completed (state money)
- Ongoing water quality monitoring and permits completed (state money)

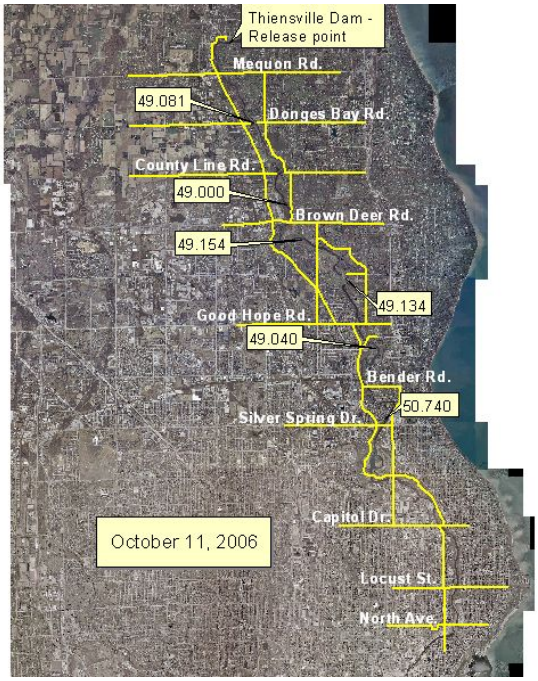
Total length and weight has been measured biweekly for the fish in the Milwaukee River SRF and are summarized below. The Lake Sturgeon that had been in the trailer since the egg stage were noticeably longer and heavier than the transferred fish from Wild Rose. It appears that the daily food ration for the transferred lake sturgeon was not large enough to sustain good growth on these fish. As of July 10, the daily food ration was increased for both groups of fish. Since that time, the transferred lake sturgeon increased noticeably in both length and weight. At the time of removal from the facility either by stocking or for educational display purposes, the original fish were both longer and heavier that the transfer fish. It appears that the lower density in the fingerling tank had a positive effect on their size. In addition, I compared these fish to hatchery stocked fish. The original fish were larger than those stocked by our Wild Rose Fish Hatchery but the transfer fish were smaller. However, with adequate food supply the transfer fish may have been able to reach the size at stocking that Wisconsin would normally achieve at our Wild Rose Fish Hatchery. This will be fully evaluated in 2007 but it appears we may be able to reach this size in 2007.

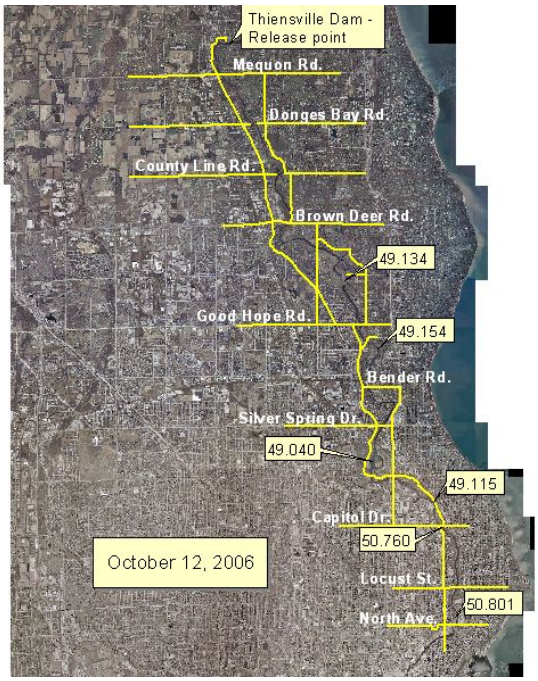

Average length and weight of Lake Sturgeon
at the Milwaukee Streamside Rearing Facility
Length (mm)
300
250
200
150
100
50
0
Days post hatch
Days post hatch - Wild Rose Transfers
Day 31
Day 49
Day 66
Day 79
Day 89
Day 103
Day 117
Day 131
Day 156
Day 170
Weight (g)
80
60
40
20
0
Days post hatch
Days post hatch - Wild Rose transfers
Wild Rose
Day 79
Day 89
Day 103
Day 117
Day 131
Day 156
Day 170
Day 198
Day 205
Day 227

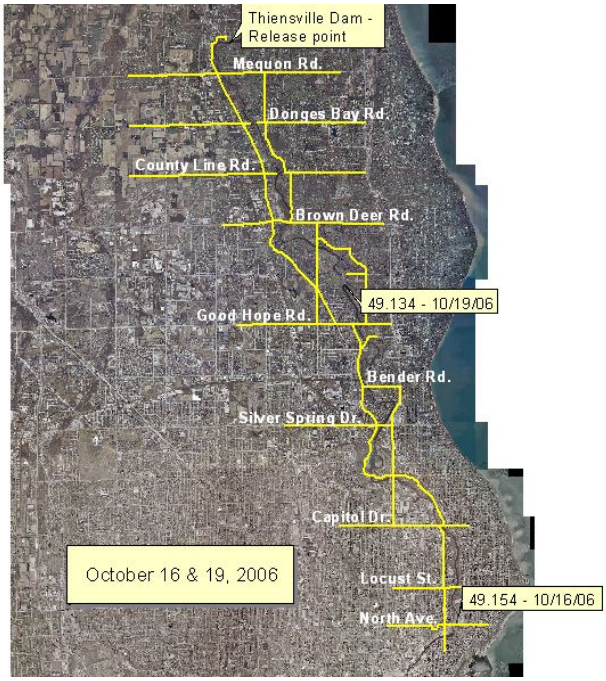
Assess short-term movement patterns and river retention of stocked lake sturgeon.

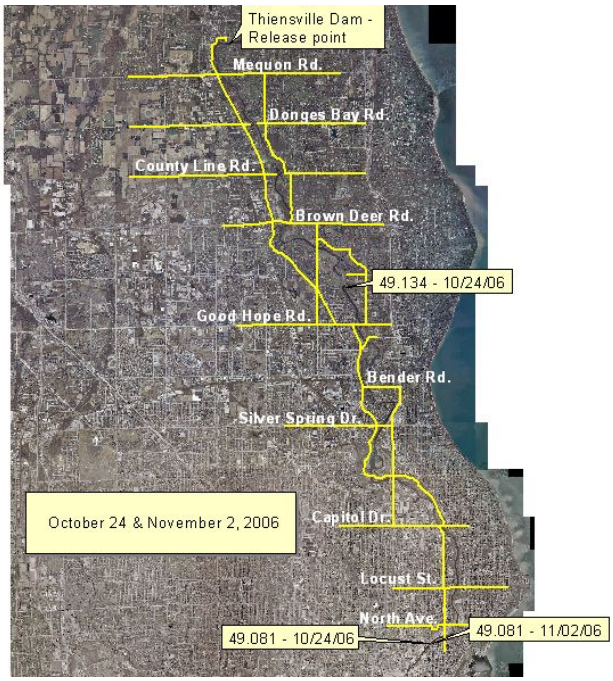
On October 2 and 9, we implanted or attached 10 radio telemetry tags to these lake sturgeon. On October 9 these fish were stocked along with the other non-tagged sturgeon into the Milwaukee River just below the Thiensville Dam in the City of Thiensville. Immediate checks of the radio tags were good and all fish stayed below the dam throughout the first day. We then conducted a full census of the river by foot and car on October 10, 14, 16, 19 by kayak on October 11, 12 and 24 and by boat on November 2. In general, the stocked lake sturgeon moved quickly down the river moving at times 10 miles per night. After 3 days in the river, most of the fish had moved into the lower estuary of the Milwaukee River. These figures show the downstream movement 1, 2, 3, 7 and 15 days post stocking.




Thiensville Dam - Release point
Mequon Rd.
49.081
Donges Bay Rd.
County Line Rd.
49.000
Brown Deer Rd.
49.154
49.134
Good Hope Rd.
49.040
Bender Rd.
50.740
Silver Spring Dr.
Capitol Dr.
October 11, 2006
Locust St.
North Ave.


Thiensville Dam - Release point
Mequon Rd.
Donges Bay Rd.
County Line Rd.
Brown Deer Rd.
49.134
Good Hope Rd.
49.154
Bender Rd.
Silver Spring Dr.
49.040
49.115
Capitol Dr.
50.760
October 12, 2006
Locust St.
50.801
North Ave.





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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 starting in 2001. Following the initial stocking of Arlee, a second strain, Kamloops rainbow trout was identified to be part of this study in 2003. 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 five years to aid in the direct comparison of the two strains.

Arlee Rainbow Trout

In 2006, each port stocked received 10,000 Arlee rainbow trout that were marked with a Left Pectoral fin clip (Table 1). Size at stocking and the time of stocking in 2006 was similar to previous years.

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

Strain	Year Stocked	Number per Port	Number of Ports	Fin Clip	Average Length	Average Weight	Stocking Dates
Arlee	2001	12,000	6	ALP	174 mm	55.1 g	April 16 through May 1
	2002	7,500	2	LP	170 mm	54.5 g	April 9
	2003	10,150	6	ALP	182 mm	74 g	April 27 through May 9
	2004	5,000	6	LP	199 mm	108 g	April 12 through April 19
	2005	10,590	6	ALP	178 mm	72 g	March 30 through April 19
	2006	10,000	6	LP	178 mm	59 g	April 4 through April 20
Kamloops	2003	10,300	6	ARP	148 mm	32 g	April 17 through April 19
	2004	10,066	6	RV	147 mm	36 g	April 20 through April 27
	2005	8,500	6	LV	152 mm	29 g	April 21 through April 27
	2006	9,762	6	RV	145 mm	28 g	March 23 through April 7

It was estimated that anglers harvested 2,130 Arlee rainbow trout in 2006 (Table 2). The estimated harvest in 2006 was 52% higher than the 2005 harvest and was the highest Arlee rainbow harvest since the inception of the project. Most of the harvested Arlee rainbow were taken by pier and shore anglers with fewer caught in the ramp and stream fisheries.

Table 2. Estimated angler harvest of nearshore rainbow trout by strain and fishery type from 2001 through 2006.

Strain	Harvest Year	Harvest Location Boat	Pier and Shore	Stream	Total Harvest
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
	2006	426 (20%)	1,193 (52%)	511 (24%)	2130
Kamloops	2003	0	267 (100%)	0	267
	2004	73 (11%)	513 (78%)	73 (11%)	659
	2005	875 (50%)	525 (30%)	350 (20%)	1750
	2006	1111 (43%)	855 (33%)	600 (247%)	2566

Analysis of fish clips indicated that Arlee rainbow harvested in 2006 came from fish stocked in 2002-2004 and 2006. Fin clips can also help to determine how fish are growing in the lake. For example, Arlee rainbow that were stocked in 2002 have grown to average 711 mm in length and 4.0 kg in weight after 5 summers in the lake (Table 3). 2006 stocked fish averaged 368 mm in length and 0.9 kg in weight after 1 summer in the lake. The average lengths and weights from other stocking years are listed in Table 3.

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

	Length					Weight				
Year Stocked	1 summer in lake	2 summers in lake	3 summers in lake	4 summers in lake	5 summers in lake	1 summer in lake	2 summers in lake	3 summers in lake	4 summers in lake	5 summers in lake
2001	330 mm	547 mm	658 mm	688 mm	681 mm	--	2.3 kg	3.1 kg	4.5 kg	3.1 kg
2002	566 mm	610 mm	655 mm	709 mm	711 mm	1.7 kg	2.4 kg	2.6 kg	3.5 kg	4.0 kg
2003	414 mm	521 mm	559 mm	612 mm		1.1 kg	1.5 kg	2.2 kg	2.5 kg	
2004	323 mm	592 mm	556mm			0.5 kg	2.1 kg	1.8 kg		
2005	305 mm					0.4 kg				
2006	368 mm					0.9 kg				

Kamloops Rainbow Trout

In 2006, each port stocked received 9,762 Kamloops rainbow trout that were marked with a Right Ventral fin clip (Table 1). In 2006, the time of stocking was earlier than in previous years which resulted in Kamloops rainbow being stocked at the smallest size noted during the study.

It was estimated that anglers harvested 2,566 Kamloops rainbow in 2006 (Table 2). Harvest in 2006 increased 46.6% over the 2005 harvest and continued the trend of increasing harvest noted during each year since 2003. Most of the harvested Arlee rainbow were taken by boat anglers with fewer caught in the shore, pier and stream fisheries.

Analysis of fish clips indicated that Kamloops rainbow harvested in 2006 came from each year of Kamloops rainbow stocking. Fin clips can also help to determine how fish are growing in the lake. Kamloops rainbow that were stocked in 2003 have grown to average 699 mm in length and 3.5 kg in weight after 4 summers in the lake (Table 4). 2006 stocked fish averaged 376 mm in length and 0.8 kg in weight after 1 summer in the lake. The average lengths and weights from other stocking years are listed in Table 4.

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

	Length					Weight				
Year Stocked	1 summer in lake	2 summers in lake	3 summers in lake	4 summers in lake	5 summers in lake	1 summer in lake	2 summers in lake	3 summers in lake	4 summers in lake	5 summers in lake
2003	358 mm	424 mm	625 mm	699 mm		0.7 kg	0.9 kg	2.6 kg	3.5 kg	
2004	553 mm	531 mm	663 mm			1.5 kg	1.4 kg	3.0 kg		
2005	546 mm	647 mm				0.8 kg	2.7 kg			
2006	376 mm					0.8 kg				

Summary

The first six years of creel survey data is encouraging and indicates that the Arlee rainbow and Kamloops rainbow may be benefiting nearshore anglers although the results are not clear cut. Since the inception of this project, 48.1% of the nearshore rainbow that have been harvested have been caught by anglers fishing from piers or from the shore. However, the percent harvested by pier and shore anglers has varied greatly from a high of near 100% in 2003 to a low of 23% in 2005 which may indicate that this experiment has not consistently improved nearshore fishing.

In years that Arlee rainbow and Kamloops rainbow were both stocked, anglers have harvested more Arlee rainbow than Kamloops rainbow (Table 1). If return rates are standardized to reflect the return per thousand fish stocked, Kamloops rainbow have returned better than Arlee rainbow since 2003 (Tables 2 and 3). It appears that for both strains, fish stocked in 2005 have returned poorly while fish stocked in 2003 and 2004 have returned well. We do not know at this time if Arlee rainbow, which are larger in size when stocked or Kamloops rainbow, which are longer lived will ultimately provide the greater return to anglers.

Table 5. Return rates (number per thousand stocked) to creel for Arlee Rainbow Trout stocking into Lake Michigan 2001 through 2006.

	Year Stocked					
Year Harvested	2001	2002	2003	2004	2005	2006
2001	18.3	--	--	--	--	--
2002	6.8	74.4	--	--	--	--
2003	3.7	17.7	9.8	--	--	--
2004	6.1	9.7	4.8	2.5	--	--
2005	2.4	23.3	2.9	17.5	2.8	--
2006	0.0	28.4	9.8	11.4	0.0	12.8
Total	37.3	153.5	27.3	31.4	2.8	12.8

Table 6. Return rates (number per thousand stocked) to creel for Kamloops Rainbow Trout stocking into Lake Michigan 2003 through 2006.

	Year Stocked					
Year Harvested	2001	2002	2003	2004	2005	2006
2001	--	--	--	--	--	--
2002	--	--	--	--	--	--
2003	--	--	4.3	--	--	--
2004	--	--	8.3	2.4	--	--
2005	--	--	19.8	5.6	3.4	--
2006	--	--	12.5	20.0	5.0	5.7
Total	--	--	44.9	28.0	8.4	5.7

It also appears that the fish are growing well as anglers have caught fish over 6.0 kg in weight. Based on comparable age at harvest it appears that Arlee rainbow are larger in size than Kamloops rainbow. Stocking in the spring of 2007 will be the last year of paired stocking and until the final evaluation is completed, Arlee strain rainbow will be stocked to provide anglers a variety of fishing opportunities.

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WALLEYE IN SOUTHERN GREEN BAY AND THE LOWER FOX RIVER

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 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 DePere 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 1990-2006) and the lower Fox River (during late October or early November 1991-2006). 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. In fall of 2006, stations near the mouth of the Peshtigo and Oconto rivers were shocked.

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 2006 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 20 fish species were sampled during our 2006 fall index surveys on the lower Fox and Green Bay compared to 22 in 2005 (Table 1). Elecrtofishing sample effort totaled 10.55 hours (28.7 miles) of near shore area. This catch composition suggests that a diverse fish community was vulnerable to our electrofishing efforts, however, emerald shiners were too numerous to sampled in 2006 while gizzard shad were too numerous in 2005. Walleye dominated the total catch. Common carp, freshwater drum, and quillback were relatively common, and muskellunge were the second most abundant predatory species sampled follow closely by northern pike. Lake whitefish, shortnose gar and emerald shiner were new species in 2006.

Table 1. Species, number captured (Number), and catch per hour (C/hour) of fish captured while conducting our electrofishing index surveys on southern Green Bay and the lower Fox River during 2006. The average catch for both areas is included for 2006 and 2005. Muskellunge and walleye sampled were separated by young-of-year (Y) and non-young-of-year (N). * Emerald shiner were too numerous to sample in 2006 as were Gizzard shad in 2005.

	S. Green Bay		Lower Fox River		2006 Average		2005 Average	
Species	Number	C/hour	Number	C/hour	Number	C/hour	Number	C/hour
Black crappie	0	0	0	0.00	0	0.00	1	0.08
Bluegill	2	0.53	16	2.37	18	12.26	2	0.16
Brown bullhead	2	0.53	0	0	2	0.19	1	0.08
Channel catfish	1	0.26	0	0	1	0.10	2	0.16
Common carp	72	19.05	28	4.14	100	9.48	52	4.08
Emerald shiner	0	0.00	*	*	*	*	0	0.00
Flathead catfish	0	0.00	0	0	0	0.00	1	0.08
Freshwater drum	34	8.99	1	0.15	35	33.18	28	2.20
Gizzard shad (N)	0	0	20	2.96	20	1.90	*	*
Lake Whitefish	0	0.00	8	1.48	8	0.76	0	0.00
Largemouth bass	4	1.06	0	0	4	0.38	3	0.24
Musky (N)	0	0	20	2.96	20	1.90	21	1.65
Musky (Y)	0	0	9	1.33	9	0.85	5	0.39
Northern pike	0	0	11	1.63	11	1.04	3	0.24
Quillback	0	0.00	25	3.69	25	2.37	62	4.87
Redhorse spp.	1	0.26	3	0.44	4	0.38	5	0.39
Rockbass	1	0.26	0	0.00	1	0.10	0	0.00
Sauger	0	0	0	0.00	0	0.00	1	0.08
Shortnose gar	2	0.53	0	0	2	0.19	0	0.00
Smallmouth bass	0	0.00	7	1.03	7	0.66	15	1.18
Trout perch	0	0.00	0	0	0	0.00	6	0.47
Walleye (N)	118	31.22	663	97.98	781	74.03	866	67.96
Walleye (Y)	29	7.67	52	7.69	81	7.68	9	0.71
White bass	0	0.00	0	0.00	0	0.00	10	0.78
White perch	6	1.59	2	0.3	8	0.76	19	1.49
White sucker	0	0.00	0	0.00	0	0.00	2	0.16
Yellow bullhead	0	0.00	0	0	0	0.00	1	0.08
Yellow perch	9	2.38	0	0	9	0.85	21	1.65

Oconto and Peshtigo Index Sites

During 2006, fall index stations were added at the mouth of the Oconto and Peshtigo rivers. In the Oconto estuary area (1.89 hours of effort) young yellow perch were too numerous to sample as were common shiners and white sucker were common (Table 2). Recently stocked brown trout were present in good amounts. Sample results appear to be low in the Peshtigo River (1.81 hours of effort). Both day and night shocking were tried with night shocking results deemed the best and reported in Table 3. At the Peshtigo estuary, northern pike, walleye and yellow perch were sampled at relatively low levels.

Table 2. Species, number captured (number), and catch per hour (C/hour) of fish captured while conducting our electrofishing index surveys on Green Bay off Oconto and the lower Oconto River during 2006. Muskellunge sampled were separated by young-of-year (Y) and non-young-of-year (N). * YOY yellow perch and common shiner were to numerous to effectively sample.

	GB off Oconto		Lower Oconto R.		2006 Average	
Species	Number	C/hour	Number	C/hour	Number	C/hour
Black crappie			2	2.20	2	1.06
Bluegill			1	1.1	1	0.53
Brown trout			14	15.38	14	7.41
Common Carp						
Coho salmon			1	1.1	1	1.06
Common shiner			82	90.11	82	43.39
Emerald shiner	1	1.02	13	14.29	14	7.41
Freshwater drum						
Lake Whitefish			1	1.10	1	0.53
Musky (N)			1	1.1	1	0.53
Musky (Y)						
Northern pike			4	4.40	4	2.12
Quillback						
Redhorse spp.			1	1.10	1	0.53
Smallmouth bass			2	2.20	2	1.06
Walleye (N)						
Walleye (Y)						
White bass						
White perch						
White sucker	50	51.02	37	40.66	87	46.03
Yellow bullhead						
Yellow perch (N)	31	31.63			31	16.40
Yellow perch (Y)	13	13.27	*	*	*	*

Table 3. Species, number captured (number), and catch per hour (C/hour), of fish captured while conducting our electrofishing index surveys on Green Bay off Peshtigo and the lower Peshtigo River during 2006. This is a night time catch which was higher than the daytime effort.

	GB off Peshtigo		Lower Peshtigo R		2006 Average	
Species	Number	C/hour	Number	C/hour	Number	C/hour
Common shiner			5	5.49	5	2.76
Northern pike			6	6.59	6	3.32
Redhorse spp.	1	1.11	7	7.69	8	4.42
Rockbass			1	1.10	1	0.55
Smallmouth bass						
Walleye (N)	2	2.22			2	1.10
Walleye (Y)						
White perch						
White sucker			18	19.78	18	9.95
Yellow perch (N)	1	1.11	9	9.89	10	5.53

Recruitment of YOY walleye lower Fox River

Result of our 2006 electrofishing index survey show that relative abundance of YOY walleye at the fall fingerling stage were present in equal amounts in the Fox and southern Green Bay (Figure 1). The "good" 2006 year-class strength was likely caused by consistent 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. The 2006 year class is strong and continues a trend of good year classes every 2 to 3 years that adequately support the fishery.

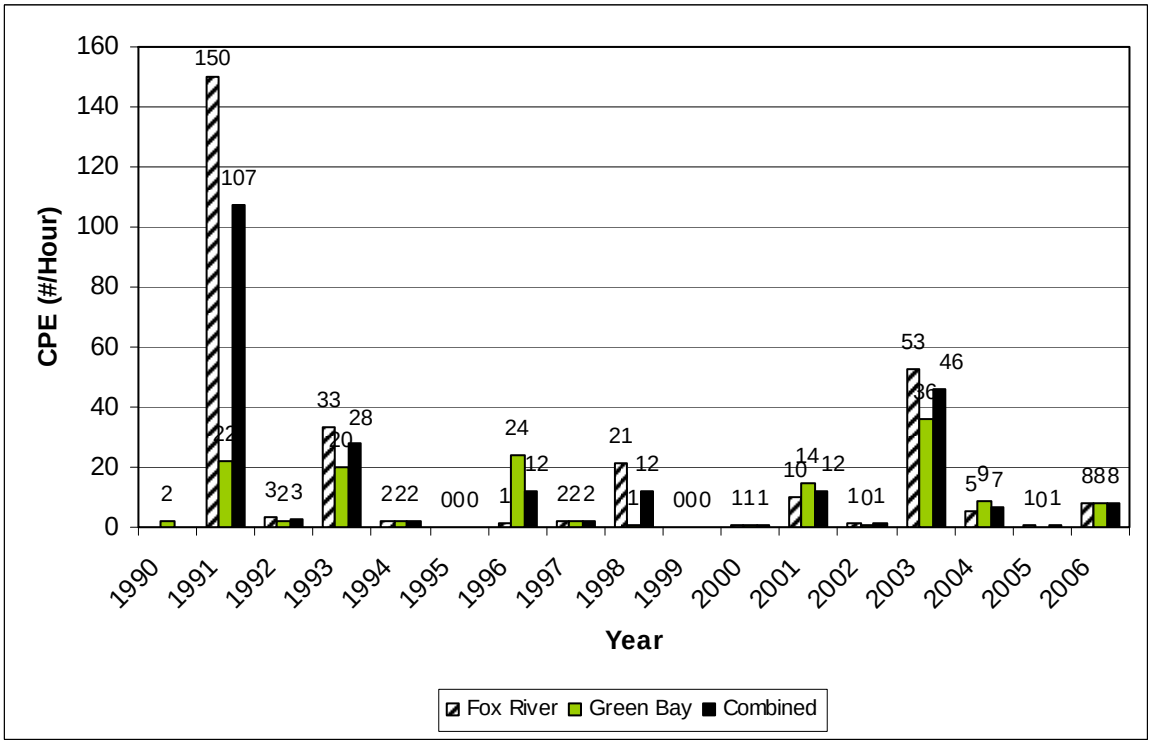


Figure 1. Relative abundance of young-of-year walleye in the lower Fox River (DePere Dam to mouth) and Green Bay (south of a line drawn from Longtail Point to Point Sable) as measured by catch per unit effort (CPUE; number per hour) from data collected in electrofishing index surveys during 1990-2006.

Walleye stock size structure

Walleye captured during our fall electrofishing index surveys averaged 422 mm total length (range 200-695) compared to 417 (range 204-651mm) in 2005. 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:

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

The *PSD* score was 87 in 2006 compared to 73 in 2005. We used the walleye specific *quality* (380 mm) and *stock* (250 mm) length minimums proposed by Gabelhouse (1984). 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 (Kapuscinski and Lange, 2006). The high PSD is typical for this water and 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 1990-2006 (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), and 5) growth rates are above average (Schneider et al. 1991).

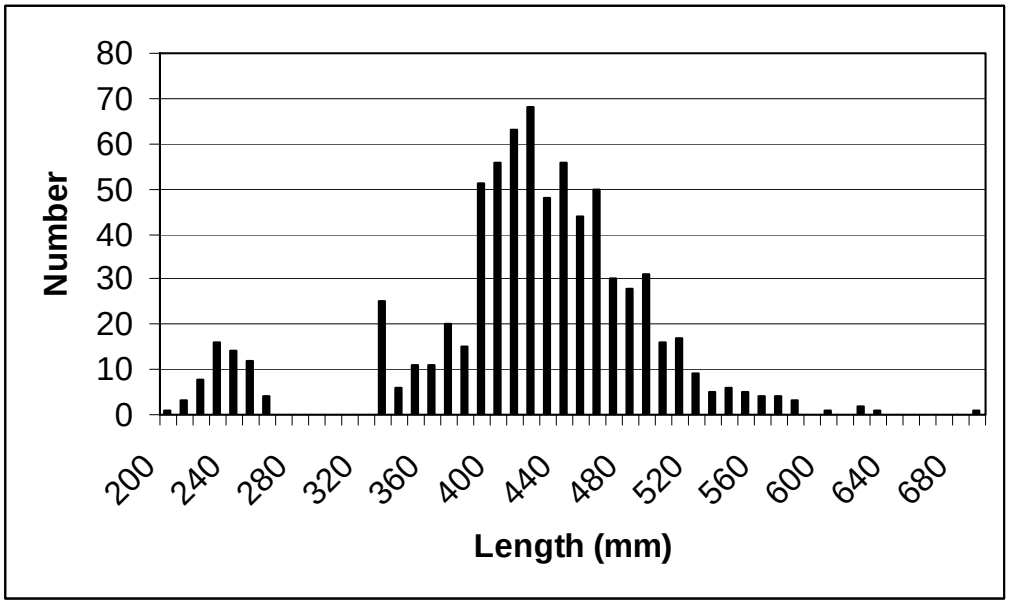
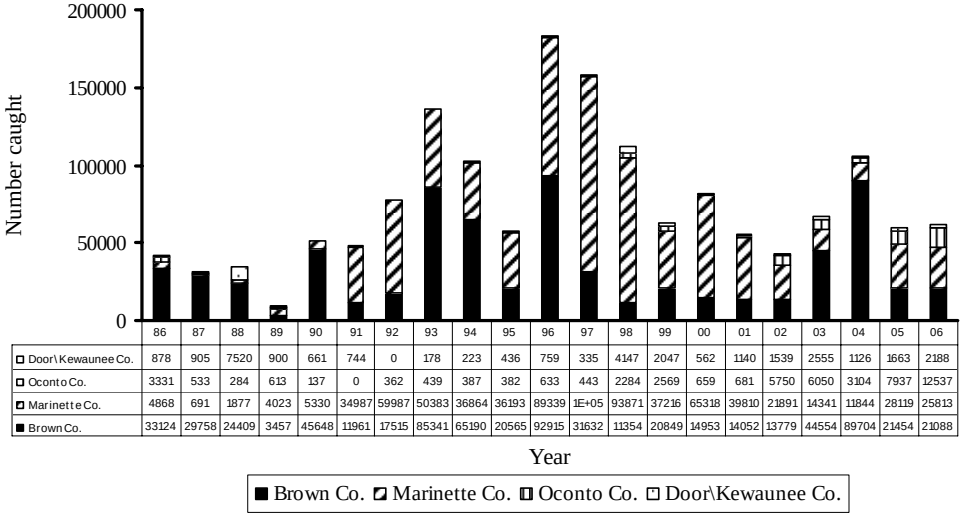


Figure 2. Length-frequency distribution of walleye sampled in fall by electrofishing southern Green Bay and the lower Fox River during 2006.

Catch and Harvest

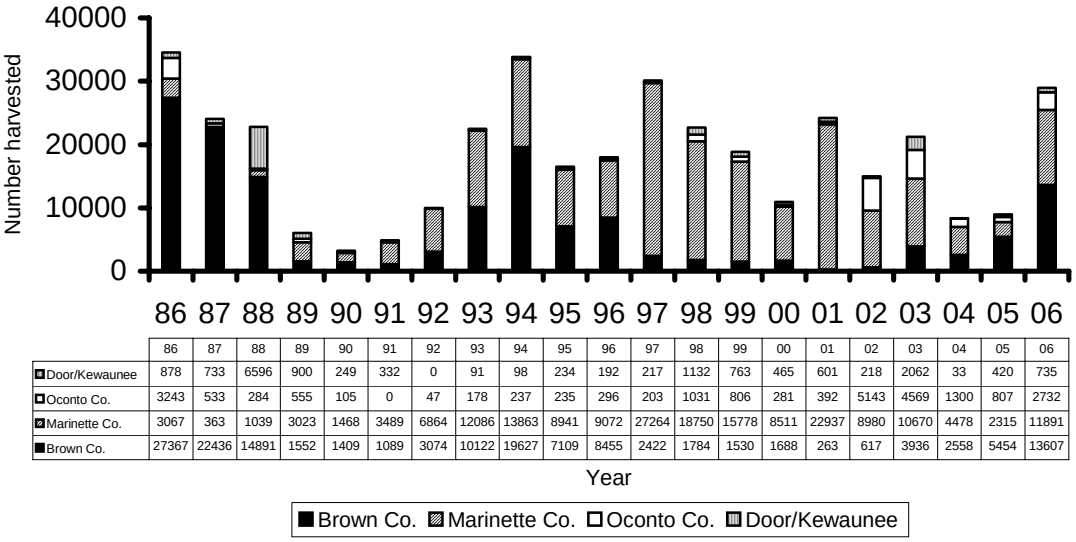
Total catch of walleye from Wisconsin waters of Green Bay was estimated at 61,626 during the 2006 open water season, a slight increase from 2005 but still below the estimated 105,778 caught during 2004 (Figure 3). There were 21,088 walleye caught in Green Bay waters of Brown County a slight decrease from 2005. There was also an estimated walleye catch of 115,955 in the lower Fox River of Brown County (not reported on Figure 3). During 2006, the walleye catch increased in Door / Kewanee, and Oconto County waters, and had a slight decrease in Marinette County.

Total harvest of walleye from Wisconsin waters of Green Bay increased from 8,996 in 2005 to 28,965 during 2006 (Figure 4). Harvest increased in all counties, but in particular Brown and Marinette counties. There was also 29,959 walleye harvested form the lower Fox River in Brown County during 2006 (not reported in Figure 4). Trends in catch and harvest of walleye from Green Bay are not obvious. However in 2006 anglers kept about 20,000 more than in 2005. 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.



	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06
Door\Kewaunee Co.	878	905	7520	900	661	744	0	178	223	436	759	335	4147	2047	562	1140	1539	2555	1126	1663	2188
Oconto Co.	3331	533	284	613	137	0	362	439	387	382	633	443	2284	2569	659	681	5750	6050	3104	7937	12537
Marinette Co.	4868	691	1877	4023	5330	34987	59987	50383	36864	36193	89339	1E+05	93871	37216	65318	39810	21891	14341	11844	28119	25813
Brown Co.	33124	29758	24409	3457	45648	11961	17515	85341	65190	20565	92915	31632	11354	20849	14953	14052	13779	44554	89704	21454	21088

Figure 3. Estimated total walleye catch from Wisconsin waters of southern Green Bay and the lower Fox River by county during 1986-2006.



	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06
Door/Kewaunee	878	733	6596	900	249	332	0	91	98	234	192	217	1132	763	465	601	218	2062	33	420	735
Oconto Co.	3243	533	284	555	105	0	47	178	237	235	296	203	1031	806	281	392	5143	4569	1300	807	2732
Marinette Co.	3067	363	1039	3023	1468	3489	6864	12086	13863	8941	9072	27264	18750	15778	8511	22937	8980	10670	4478	2315	11891
Brown Co.	27367	22436	14891	1552	1409	1089	3074	10122	19627	7109	8455	2422	1784	1530	1688	263	617	3936	2558	5454	13607

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

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. The excellent 2003 year class will support the present fishery and the good 2006 year class should contribute to the fishery in a few years. The size structure of the fall population indicates that the majority of the stock is at or above quality size, and mortality is not excessive at any size. Year-class failures have not been observed in more than two consecutive years during 1990-2006, 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 was set at 1,000,000 pounds, of which no more than 25,000 pounds can be harvested from Green Bay.

During 2006, commercial smelt trawlers reported catching 472,557 pounds of rainbow smelt during the calendar year (Figure 1). The 2006 reported harvest was nearly 20% greater than the 394,944 pounds reported in 2005 and was the highest yearly harvest since 1999. This harvest was 2.2 and 2 times greater then the previous three and five year average harvests respectively.

In 2006 the harvest of rainbow smelt from Lake Michigan was 472,557 pounds (Figure 1), with a CPE of 616 pounds per hour trawled (Figure 2). The 2006 Lake Michigan rainbow smelt harvest was the highest since 1999 when trawlers harvested 794,151 pounds of rainbow smelt. CPE on Lake Michigan in 2006 increased substantially from the 281 pounds per hour reported in 2005 and was the highest CPE since 1992 when trawlers harvested 988 pounds of rainbow smelt per hour trawled.

Commercial trawlers did not fish on Green Bay in 2006. The lack of fishing effort on Green Bay in 2006 continued the trend of declining harvest, CPE and effort noted since 1991 and was the second consecutive summer when rainbow smelt trawlers did not fish the Wisconsin waters of Green Bay (Figures 1 and 2).

Commercial rainbow smelt trawlers experienced a good Lake Michigan season in 2006. Harvest poundage and CPE increased indicating that fishermen were able to catch more rainbow smelt in less time in 2006 than in recent years. 2006 was the third consecutive year in which harvest and CPE increased on Lake Michigan. The lack of effort and harvest of rainbow smelt from Green Bay seems to indicate that in Green Bay the rainbow smelt population is below what is needed to make commercial harvest feasible.

The increased rainbow smelt harvest by trawlers in 2006 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. Surveys conducted by the U.S.G.S. in 2004 and 2005 indicated that the biomass of adult rainbow smelt had increased each year over what was observed in the previous fall survey. Increased adult rainbow smelt biomass in the falls of 2004 and 2005 have translated into increased rainbow smelt harvest at higher CPE's in 2005 and 2006 for commercial trawlers.

The commercial rainbow smelt harvest on Lake Michigan and Green Bay has declined dramatically since peaking in the early 1990's. However, over the past three years this trend has been reversed on Lake Michigan. Although the status of the rainbow smelt population in Lake Michigan and Green Bay remains uncertain, it appears that in Lake Michigan, the rainbow smelt population may be increasing in number as indicted by improved biomass and age-0 densities noted by the U.S.G.S. and improving commercial harvests.

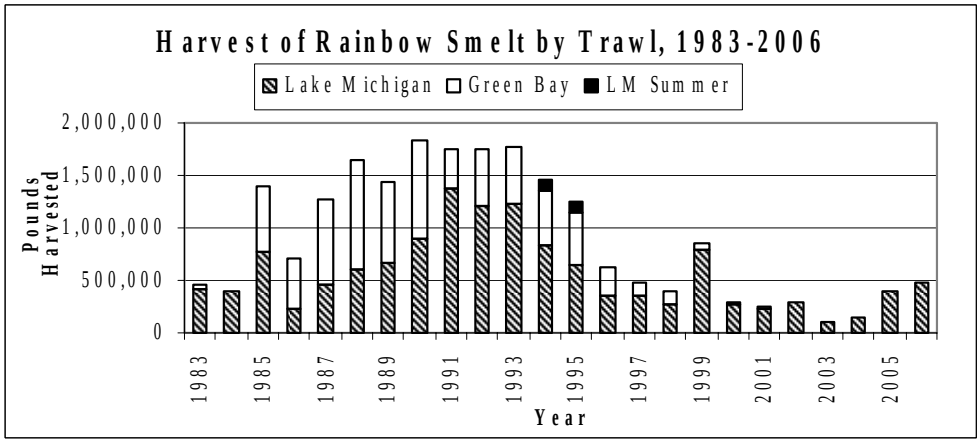

Figure 1. Reported rainbow smelt harvest by trawl from the Wisconsin waters of Lake Michigan for the years 1983 through 2006.

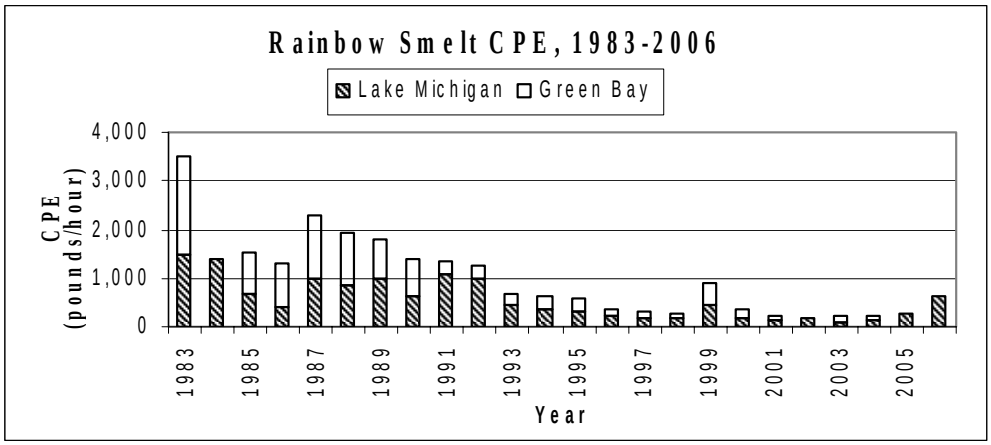

Figure 2. Rainbow smelt CPE in pounds per hour trawled on Lake Michigan and Green Bay during the years 1983 through 2006.

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GREEN BAY FORAGE TRAWLING

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

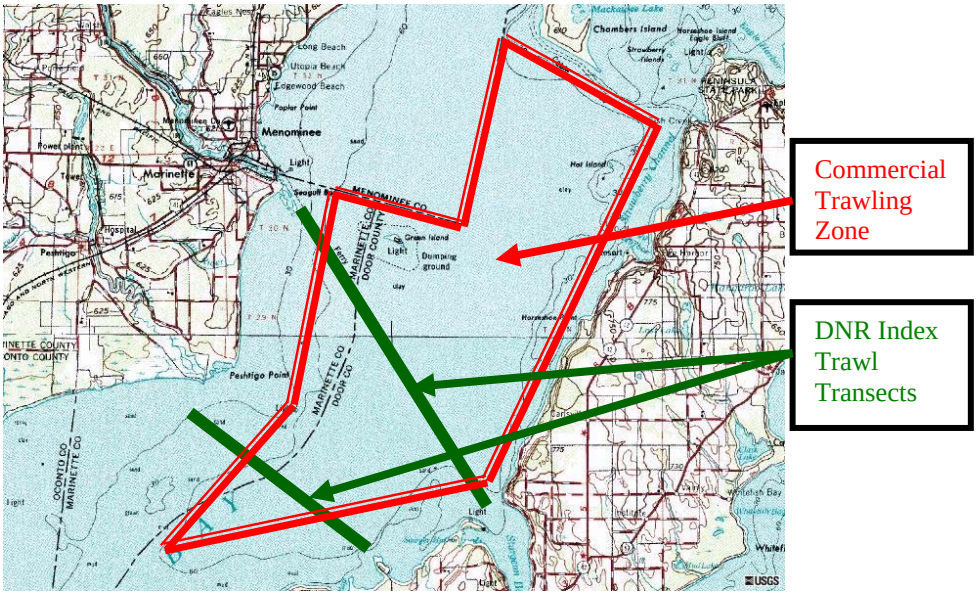

Figure 1. The location of the index trawling transects in relation to the Green Bay commercial trawling zone.

In 2006, both transects were sampled starting at 50 feet and continued across Green Bay in ten foot increments. For each trawl drag, an aggregate fish weight was taken and a subsample of the catch retained for laboratory analysis. Dreissenid mussels were sorted from the fish catch and had an aggregate weight measured. Within each subsample, individual fish were sorted by species, measured and weighed in aggregate. Depth strata (east and west) were combined to determine the catch by depth.

The weight of the catch and CPE (kg/hour trawled) increased with increasing depth along the north transect (Figure 2). CPE at 90 feet was nearly five times greater than the CPE at 50 feet. At 50 feet the catch was dominated by yellow perch, alewife and round goby. By 70 feet the catch was dominated by round goby, sucker sp. and freshwater drum. At the two deepest drags, whitefish dominated the catch with substantially fewer sucker sp. and freshwater drum captured. Fish captured along the north transect and reported in the category listed as other included northern pike, trout perch, smallmouth bass, white bass, white perch and spottail shiner. Dreissenid mussels were only encountered in the 50 and 60 foot drags.

Unlike the north transect, CPE (kg/ hour trawled) across the south transect was similar at all depths, although the CPE at 80 feet was somewhat less than at the other depths trawled (Figure 3). Sucker sp., primarily white sucker, dominated the catch at each depth. At 50 feet other fish that contributed substantially to the catch

included alewife and trout perch. Freshwater drum, trout perch, lake sturgeon and white perch contributed to the catch at other depths. Dreissenid mussels were rarely caught along the south transect and only encountered at 50 feet.

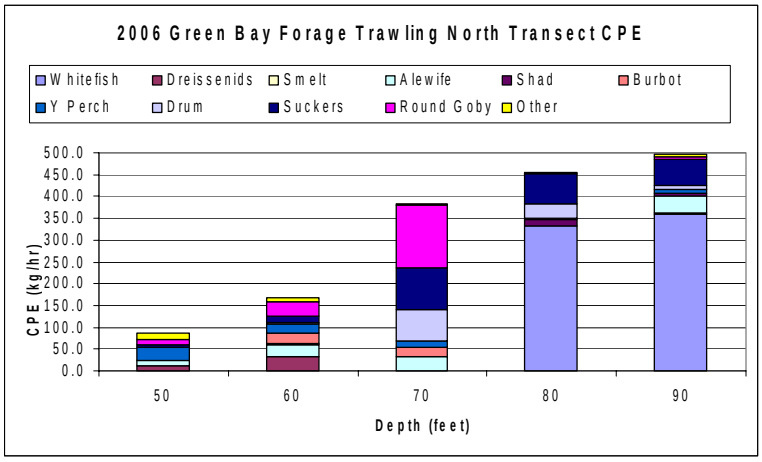

Figure 2. The 2006 CPE (kg/hr) of fish captured by species and depth strata on the north transect on Green Bay.

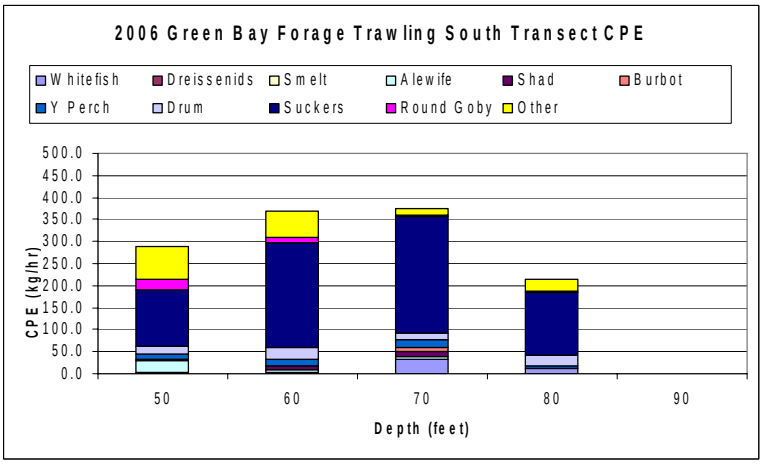

Figure 3. The 2006 CPE (kg/hr) of fish captured by species and depth strata on the south transect on Green Bay.

Four years of data does not allow for detailed analysis of trends, but does allow for general statements about the results to be made. First, there appears to be a difference in the catch between the north and south transects (Figures 4 and 5). Whitefish appear to be the most common fish captured during drags along the north transect, while sucker sp. are the most common fish captured along the southern transect. It is likely that differences in water temperature may be responsible for the differences in catch. Second, round goby CPE has increased in waters less than 80 feet along the north transect since 2004 (Figure 4). At 60 and 70 feet they were the most abundant fish captured (Figure 2). Although round goby were captured at all depths along the south transect, CPE was much lower than those found along the north transect (Figure 3). Round goby CPE has remained low since 2003 along the south transect (Figure 5). Third, dreissenid mussels appear to be declining in abundance along the south transect while the trend along the north transect is not as clear (Figure 4 and 5). Most dreissenids were encountered in waters less than 70 feet (Figure 2 and 3). Finally, on Green Bay, the rainbow smelt population trend remains unclear. Catches along both transects in 2003 and 2004 showed low CPE and likely indicated a low population of smelt in Green Bay (Figures 4 and 5). Rainbow smelt CPE improved in

2005, especially along the north transect with many of the captured rainbow smelt being young of year. However, in 2006 rainbow smelt CPE was the lowest since forage trawling began in 2003. It is unknown if the survival of young rainbow smelt was poor or if as age 1+ fish they moved out of the area that we surveyed.

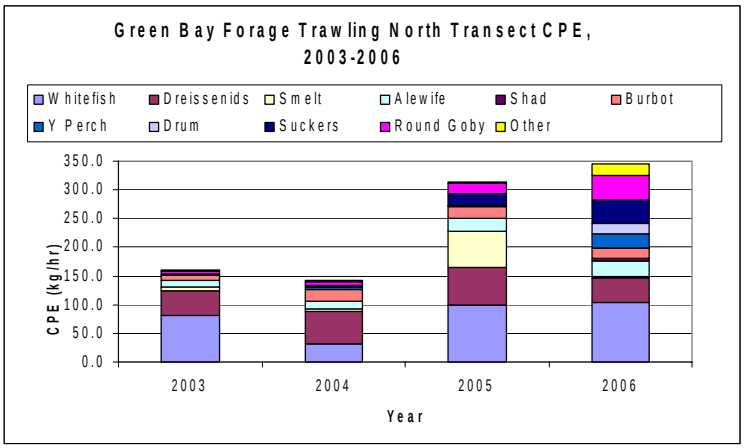

Figure 4. CPE by species for fish and mussels captured during trawling on Green Bay along the north transect, 2003-2006.

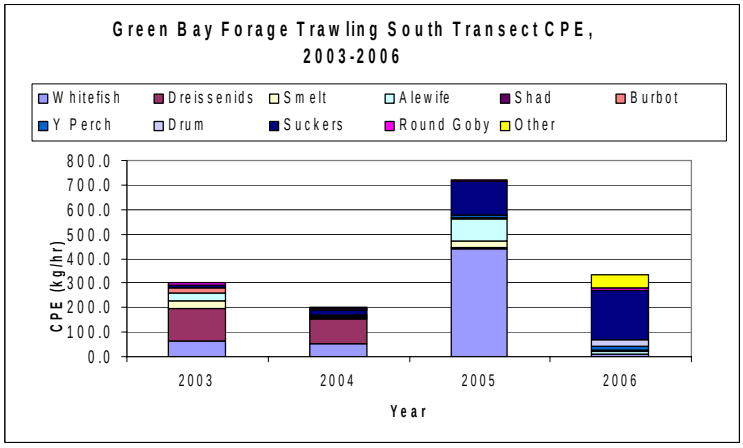

Figure 5. CPE by species for fish and mussels captured during trawling on Green Bay along the south transect, 2003-2006.

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ASSESSMENT OF PREDATION ON STOCKED SALMONINES

In recent years, the Milwaukee River water and habitat quality started to improve dramatically. Therefore, the Wisconsin DNR started a walleye (*Sander vitreus*) stocking program in 1995 to rehabilitate walleye, take advantage of the water and habitat improvements and provide some fishing opportunities for the nearshore angler. Milwaukee River Walleye Restoration Plans (WDNR 1998, and WDNR 2005), were developed to guide restoration efforts. 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 salmonine. Although the initial results from these surveys showed very low to no impact on stocked Chinook salmon (WDNR 2004), the WDNR has proposed to continue to monitor the predatory impact of all fish species on stocked salmon and trout.

Methods

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. This report summarizes the investigation of short-term impact of predators on stocked salmon and trout including fall fingerling brown trout and coho salmon, yearling coho and rainbow and brown trout and fingerling Chinook salmon.

Stomach contents were collected using a non-lethal stomach pump (SOLO Pressure Sprayer with ¼ inch diameter tube). All fish were identified to species level, checked for fin clips, measured (total length in mm), weighed (g) and released. The fish that were processed received an upper caudal clip to avoid multiple sampling on the same night. Stomach contents were transferred into small whirl pack bags and stored on ice, and they were analyzed in the laboratory the following morning. In the laboratory, the contents were identified to the nearest taxonomic level. Many times the contents were in advanced state of digestion, making positive identification difficult. Since there were many samples with only fish vertebral columns remaining, we examined some of the samples which had somewhat complete vertebral columns using the key given by Auer (1982).

Spring 2006 survey

In Spring 2006, there were four different events of stocking and predation surveys. WDNR stocked 25,624 yearling seeforellen strain brown trout (152mm average total length, from Wild Rose Fish Hatchery) at McKinley Marina on April 3, 2006. Following stocking, the LMWU fisheries staff conducted predator sampling to examine the predation impact on stocked salmonids. The survey was conducted on April 4, 2006, one day after fish stocking, using a boomshocker. Predatory fish species, large enough to consume salmonid fingerlings (254 mm or more), were captured in McKinley Marina, the shoreline along Veterans Park, the Art Museum, Pieces of Eight, inside the Summerfest Lagoon, and also in the inner harbor around the swing bridge (Figure 1). The results of this event are summarized in Tables 1. The second stocking occurred on April 10th and 11th, when three strains of steelhead rainbow trout from Kettle Maraine State Fish Hatchery were stocked at the confluence of the Milwaukee River and Menomonee River. On April 10th WDNR stocked 15,750 yearling Chambers Creek steelhead (178mm), and on April 11th 18,198 yearling Ganaraska strain (127mm), and 9,215 yearling Skamania strain (127mm) at the same location. Following that, boomshocking was conducted on April 12, 2006 to survey predatory fish. Results are summarized in Tables 2. The third stocking occurred on April 24th, 2006 when 17,000 coho salmon yearlings (127mm) from Thunder River Hatchery were stocked at the McKinley Marina. Sampling for predatory fish occurred on April 26th, 2006 in McKinley Marina, the

shoreline along Veterans Park, the Art Museum, Pieces of Eight, and also in the inner harbor around the swing bridge. We were not able to sample the Summerfest Lagoon due the construction of Lakeshore State Park. Results are summarized in Tables 3. The final round of sampling was conducted on May 10th in McKinley Marina following the release of 113,946 Chinook salmon smolts (76mm, from Wild Rose Fish Hatchery) from the net pens on May 9th. The smolts were held in the net pens over night for acclimation. Results are summarized in Table 4.

Results and Discussion

A diverse group of predatory fish species were captured, brown trout dominated the catch (61%) followed by rainbow trout (18%) (Table 1). Very few bass and walleye were taken in the sample. A total of 25 out of 51 fish captured had some food items in their stomach. Of the twenty brown trout stomachs examined, all of them had one or more round gobies in them. The number of round goby, at various degree of digestion, varied from 1 to 18 per stomach. Rainbow trout and northern pike also had round gobies in their stomach. None of the stomachs examined had any recently stocked salmonid smolts in their stomachs.

Predator survey on April 12th covering the areas of the lower Menomonee River and canals, the areas downstream of the former North Avenue Dam to Pleasant Street bridge, and in the inner harbor around the swing bridge (Figure 1) yielded six species of predatory fish, of which walleye contributed 58%, smallmouth bass and northern pike together contributed 30% of the catch (Table 2). Brown trout, rainbow trout and largemouth bass made up the rest. Thirty six stomach samples were collected for examination. The majority of walleye and smallmouth bass were taken near the North Avenue Dam area. Of the 36 stomachs examined only one (northern pike) contained an identifiable semi-digested salmonid smolt. Gizzard shad move upriver in schools during this time of the year. As a coincidence, the opportunistic predatory fish appear to feed on the highly available gizzard shad. Several samples contained one or more of semi-digested gizzard shad. Since there were many samples with only fish vertebral columns remaining, we examined some of the samples which had somewhat complete vertebral columns. We counted the number of vertebrae and compared that to the vertebrae counts in the published literature (Auer 1982). Based on the literature, our findings matched most closely with the vertebrae counts of gizzard shad and alewife (47 to 49). According to Auer (1982), the vertebrae counts of rainbow trout, brown trout, coho salmon and Chinook salmon are 60-66, 56-60, 61-69 and 67-75, respectively.

We collected thirty-eight stomach samples from 65 predators captured on April 26th (Table 3). We covered McKinley Marina, where the Coho smolts were stocked, shorelines of Veterans Park all the way to Pieces of Eight, outside the Summerfest Lagoon all the way to the Swing Bridge in the inner harbor. Brown trout dominated the catch (40%) followed by smallmouth bass (25%) and northern pike (20%). The other two predatory species in the catch were largemouth bass and walleye. Seventeen of the nineteen brown trout stomachs examined contained freshly eaten or semi-digested round goby in their stomachs. The other two had fish eggs and alewife. Except one, all of the remaining smallmouth bass stomachs contained round goby. Northern pike and largemouth bass were no exception to this trend. The number of gobies in the stomachs varied from fish to fish, depending on the size of the predator as well as the size of the prey. One walleye stomach contained a gizzard shad. It is obvious that there is abundant supply of round goby in the area and the predatory fish are utilizing them, which follows the natural opportunistic behavioral pattern of predatory species. None of the thirty-eight stomachs belonging to five predatory species examined contained any recently stocked salmonid smolts.

About 114,000 Chinook salmon smolts were put in the net pens on May 7th and released into the lake on May 8th. We sampled the area on May 10th using a boomshocker and captured nineteen predatory fish and collected fifteen stomach samples (Table 4). Four species of predatory fish were captured including smallmouth bass, largemouth bass, brown trout and northern pike. All seven smallmouth bass stomachs

contained round goby, two of the four brown trout stomachs also contained round goby, one northern pike and one largemouth bass had round goby in their stomachs. The remaining food items included semi-digested alewife, gizzard shad, and some unidentifiable fish bones.

We did notice many recently stocked salmonid smolts in the vicinity of stocking. However, all the predatory fish species examined predominantly contained round gobies in their stomachs suggesting abundant supply of gobies in the harbor. The majority of walleye captured came from Menomonee canals and area on the Milwaukee River from the former North Avenue Dam to Pleasant Street. Brown trout were captured in McKinley Marina and the outer harbor.

Table 1. Predator sampling in McKinley Marina, Veterans Park, Summerfest Lagoon, and around the swing bridge on April 04, 2006.

Species captured	Number of fish captured	Size range (mm)	Number of stomachs with food items
Brown trout	31	340-840	20
Rainbow trout	9	445-690	3
Chinook salmon	2	670-760	0
Smallmouth bass	1	380	1
Largemouth bass	2	300-391	0
Northern pike	5	530-880	1
Walleye	1	483	0

Table 2. Predator sampling around the swing bridge in the inner harbor, Menomonee River and canals, and Milwaukee River downstream from former North Avenue Dam to Pleasant Street on April 12, 2006.

Species captured	Number of fish captured	Size range (mm)	Number of stomachs with food items
Brown trout	9	495-604	7
Rainbow trout	3	515-760	0
Smallmouth bass	17	269-459	8
Largemouth bass	2	265-296	1
Northern pike	17	498-774	4
Walleye	66	156-623	16

Table 3. Predator sampling at McKinley Marina, Veterans Park, Pieces of Eight, and around the swing bridge in the inner harbor on April 26, 2006.

Species captured	Number of fish captured	Size range (mm)	Number of stomachs with food items
Brown trout	26	440-824	19
Smallmouth bass	16	320-428	10
Largemouth bass	8	363-436	3
Northern Pike	13	556-759	5
Walleye	2	533-573	1

Table 4. Predator sampling in McKinley Marina, and Vetarans Park to Summerfest Lagoon area on May 10, 2006.

Species captured	Number of fish captured	Size range (mm)	Number of stomachs with food items
Brown trout	4	481-671	4
Smallmouth bass	8	331-425	7
Largemouth bass	5	320-430	2
Northern Pike	2	675-781	2

Summary of spring sampling

A diverse group of predatory fish was found in the Milwaukee Harbor. By and large, brown trout out numbered all other predatory species. Four sampling events following salmonid smolt stocking indicated very minimal short-term predatory impact on the stocked smolts. Very few predators sampled had recently stocked salmonid smolts in their stomach. Low impact on stocked Chinook salmon smolts was documented in a previous study (Hirethota and Burzynski 2004). Higher abundance of round goby in the area is undoubtedly the reason for the increased consumption of these opportunistic predatory fish on round goby. 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. WDNR accounts for these different levels of mortality when determining stocking numbers of salmon and trout.

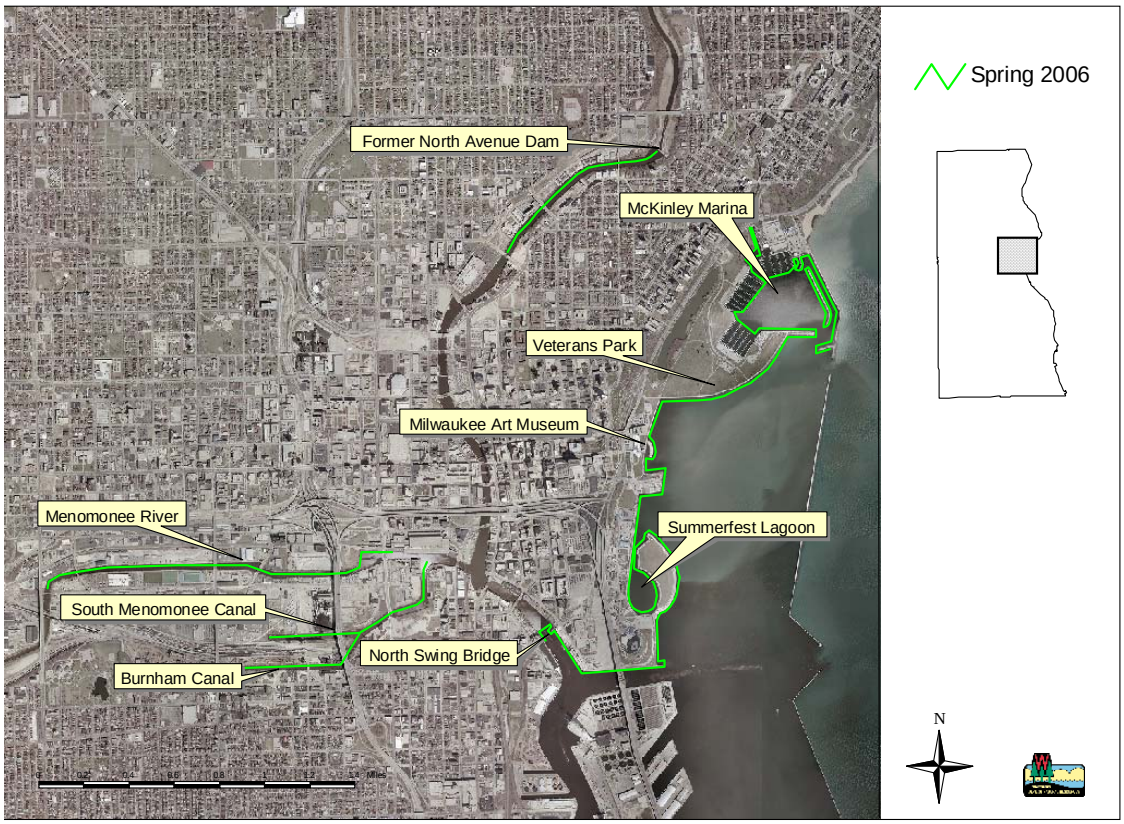

Figure 1. Predatory fish sampling sites (marked green line) in Spring 2006 in the Milwaukee River and harbor.

Fall 2006 survey

In October 2006, there were three separate stocking events in the Milwaukee Harbor. On October 16, WDNR stocked 15,605 brown trout fingerlings (185 mm average total length, from Wild Rose Fish

Hatchery) at McKinley Marina. About half of them were held overnight in one of the net pens before releasing them into the lake. On October 17, 2006, 12,658 coho fingerlings (137 mm average total length, from Bayfield Hatchery) were stocked into the other net pen and released the following day. Finally, on October 23, 2006, 17,600 brown trout fingerlings (152 mm average total length, from Langlade Hatchery) were stocked into the net pens and released the following day.

Following stocking, the LMWU fisheries staff conducted predator sampling to examine the short term predation impact on stocked salmonids. The survey was conducted with two boomshockers on the night of October 25, 2006. Predatory fish species large enough (254 mm or more) to consume salmonid fingerlings were captured in McKinley Marina, the shoreline along Veterans Park, the Art Museum, Pieces of Eight, inside the Summerfest Lagoon, and also in the inner harbor around the north swing bridge, Menomonee River and canals (Figure 2). The results of this event are summarized in Tables 5, and 6. Stomach samples were collected, and analyzed using the standard procedure.

Results and Discussions

A variety of predatory fish species were collected in the harbor area as well as in the Menomonee River and canals. Tables 5 summarize the fish captured in McKinley Marina, off Veterans Park, and in the lagoon. Forty-five predators were captured, of which adult brown trout comprised 76% of the catch followed by rainbow trout (16%). A few largemouth bass and one northern pike were also in the catch. Only eight fish (18%) had some food items in their stomach, and the remaining stomachs were empty. Stomach contents included round goby, gizzard shad, salmonids eggs, an unknown centrarchid and unidentifiable fish vertebral column. Round goby were found in 3 of the 8 stomachs examined. Although we noticed a few smolts in the vicinity of the stocking location they seem to have dispersed. Gizzard shad were distributed sparsely in the harbor. There was no dominant food item in the stomachs of the predators captured in the harbor.

Predatory species collected in the inner harbor and Menomonee River and canals included walleye, smallmouth bass, largemouth bass, and northern pike. Walleye dominated the catch, comprising 81%, followed by largemouth bass, smallmouth bass and northern pike (Table 6). Of the 85 fish captured, 41 had some food items in their stomach. Gizzard shad were the most common food item. Seventeen of the 41 stomachs examined contained one or more gizzard shad. Most of the walleye examined (50%) had one or more gizzard shad in identifiable condition, and others were in a state of advanced digestion with only a few vertebrae remaining. Four of the 33 walleye also had round goby in their stomachs. Gizzard shad were found in the canals and inner harbor in large schools. No salmonids smolts were observed in the canal area at the time of sampling. Walleye seem to congregate in the canals either due to the abundant supply of gizzard shad, greater water temperature, or both.

Both largemouth bass and smallmouth bass preferred round goby. Three northern pike stomach contents were examined; one had a salmonid smolt, the other had a redhorse sucker, and the third one was partially digested fish. This was the only occasion when a single smolt was found in the stomach during the survey. Other food items included one centrarchid fish, and partially digested fish parts.

Table 5. Predator sampling at McKinley Marina, along Veterans Park, Discovery World and in the Summerfest Lagoon on October 25, 2006.

Species captured	Number of fish captured	Size range (mm)	Number of stomachs with food items
Brown trout	34	342-829	3
Rainbow trout	7	409-658	2
Largemouth bass	3	317-418	2
Northern pike	1	571	1

Table 6. Predator sampling at Swing Bridge in the inner harbor, and in Menomonee River and canals on October 25, 2006.

Species captured	Number of fish captured	Size range (mm)	Number of stomachs with food items
Walleye	69	324-636	33
Smallmouth bass	4	289-376	2
Largemouth bass	9	268-372	3
Northern pike	3	510-680	3

Summary of fall sampling

A variety of predatory fish species were captured in our survey. While adult brown trout dominated the catch in the outer harbor area, walleye comprised the majority of the catch in the inner harbor and Menomonee River and canals. Gizzard shad and round goby were the main food items. Gizzard shad occurred in large schools in the canals, which were reflected in the stomach contents of the predators in the canals, especially walleye. Most of the predators captured in the outer harbor (including McKinley Marina and Summerfest Lagoon) did not have anything in the stomach. Only one predatory fish stomach (northern pike) had a single smolt in the entire survey, indicating a negligible short term impact on the stocked salmonids following their release in the harbor.

Our observations of the current survey are similar to the findings from previous surveys where the dominant food item in the stomach consisted of gizzard shad and round goby which were abundant in the area. The occurrence of stocked salmonids smolts in the stomachs was insignificant (Eggold 2005, Hirethota 2005 and 2006). Brown trout dominated the catch in the harbor waters both in spring and fall. While the majority of the brown trout stomachs in the fall were empty, round gobies dominated the diet of brown trout sampled during spring. Largemouth bass comprised significant proportion of the predators captured in the fall 2005 samples, whereas the spring 2006 and fall 2006 samples had very few largemouth bass. Round gobies were the preferred food items of both smallmouth and largemouth bass.

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Figure 2. Predatory fish sampling sites (marked green line) in Fall 2006 in the Milwaukee River and harbor.

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REINTRODUCTION OF GREAT LAKES MUSKELLUNGE INTO GREEN BAY

Background

The reintroduction of great lakes strain muskellunge to southern Green Bay started in 1989 with the stocking of muskellunge obtained from the state of Michigan's Indian Spread Chain drainage to Lake Huron. Muskellunge in southern Green Bay were decimated during the early to mid 1900s by habitat destruction, pollution, and over-exploitation (Kapuscinski 2006). The need to reestablish a native predator fish species has been identified in several planning efforts including the Lake Michigan Integrated Fisheries Management Plan (1995 and 2004).
From 1989 to 1994, production by the DNR Wild Rose Hatchery was 2,200 fingerling and yearling per year stocked in the lower Fox and Menominee rivers. A brood lake population was established and these fish supplemented the program from 1995 to 2001 with an annual production of 2,875. Starting in 2002, musky rearing pond management of the nitrogen\phosphorous ratio resulted in improved fingerling survival. From 2002 to 2006, the annual production has averaged 20,324 and resulted in other Green Bay stocking locations at Peshtigo, Sturgeon Bay, Little Sturgeon Bay and southern Green Bay. The present production goal is 30,000 fingerling and yearling per year. The lower Fox River estuary and southern Green Bay has been the priority restoration area.

2005 and 2006 Spring Population Survey- Fox River

In 2005, 7 five-foot fyke nets were fished periodically from April 25 to May 25 in the lower Fox River, for a total effort of 70 net days, capturing 81 muskies (1.2 per net day). The water temperatures rose fairly rapidly from the middle 40 degree to the middle 60 Fahrenheit the first week of May (Figure 1).

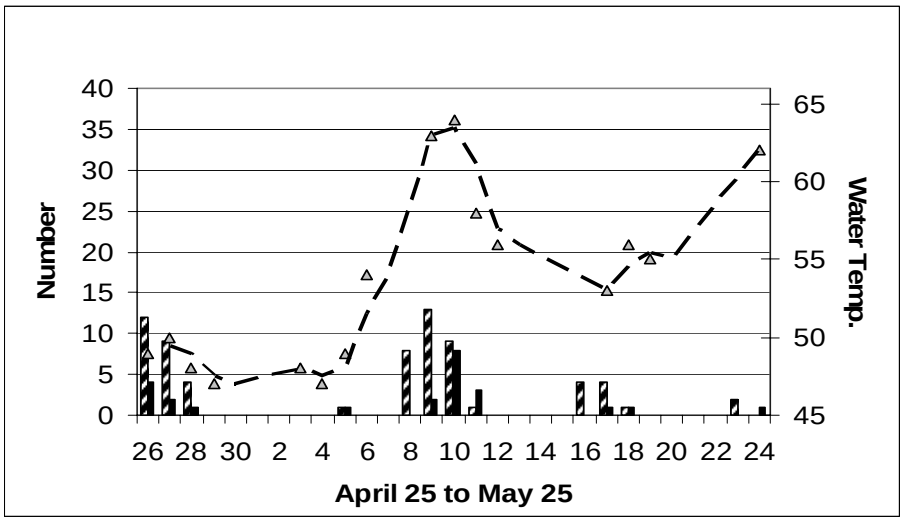

Figure 1. Total daily catch of all muskellunge (striped bar), ripe female musky (black bar) and recorded water temperature (triangles and dashed trend line in degrees Fahrenheit, right Y axis) lower Fox River, 2005

Of the identifiable mature adults, there were 29 females that averaged 44.1 inches (range 40.3 to 49.8) in total length. These 29 females averaged 24.4 pounds (range 16.9 to 40.0). There were 32 mature males that averaged 40.5 inches (range 35.0 to 46.5). These males had an average weight of 18.5 pounds (range 9.0 to 27.9). There were 20 muskies either immature or undetermined sex (Figure 2). Kapuscinski (2006) used a Chapman modification of Schnabel multiple recapture estimate for a population of 425 adults (95% CI 173- 1,061).

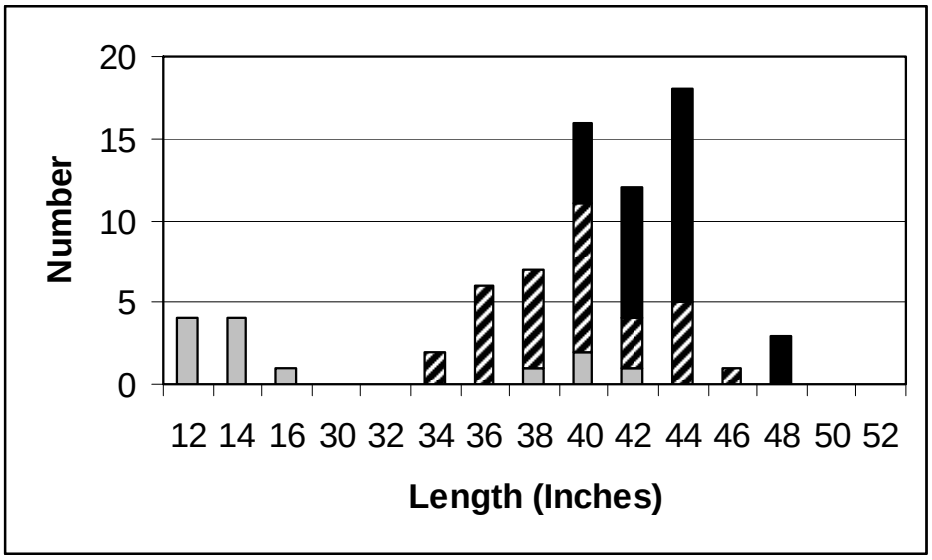

Figure 2. Length frequency of 81 muskellunge captured in fyke nets lower Fox River , April 27- May 25, 2005, with mature male (striped bar) and female (black bar), unknown (gray bar).

During the spring of 2006 (April 18 to May 18), seven 5-foot fyke nets (effort of 92 net days) were fished in locations similar to 2005 with a total catch of 296 muskies (3.2 musky per net day). Water temperatures were more consistent than 2005, ranging between 56 and 61 degrees Fahrenheit during the period (Figure 3). The 249 mature adults were double marked by Flog and PIT tag, measured in total length and weighed. The catch included 24 previously tagged musky, 14 adults were captured but not marked and 8 immature (unknown sex). A Schnabel multiple recapture estimate during spring 2006 equaled 2,975 adults (95% CL 1,642 – 5,199).

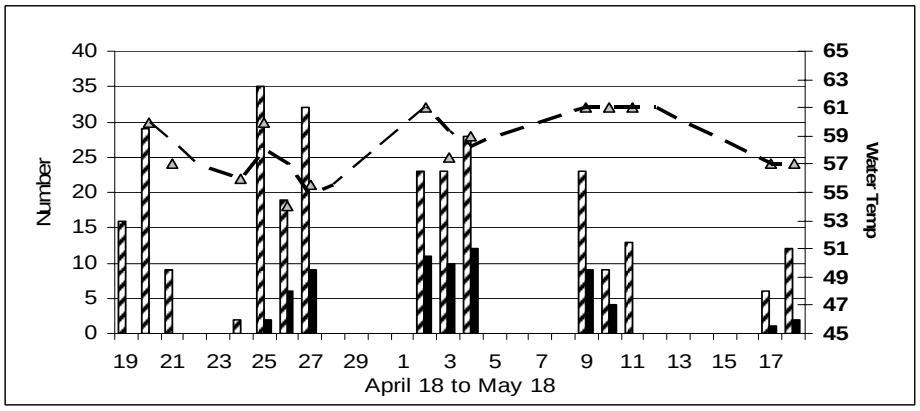

Figure 3. Total daily catch of all muskellunge (striped bar), ripe female musky(black bar) and recorded water temperature (triangles and dashed trend line in degrees Fahrenheit) lower Fox River, 2006

During 2006, eight-nine mature females averaged 44.8 inches total length (range 35.4 -51.9, Figure 4). Of these, weights were collected from 63 females that averaged 26.3 pounds (range 13.0 to 39.9). There were 143 mature males measured that averaged 40.9 inches (range 32.6- 48.3). Of these males, 109 weighed an average of 18.6 pounds (range 8.7 to 25.2).

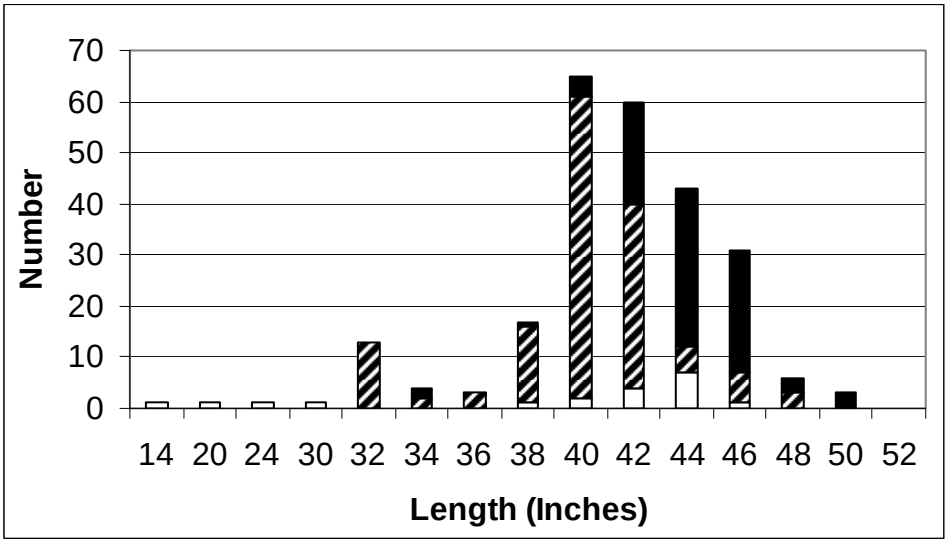

Figure 4. Length frequency of 249 muskellunge captured in fyke nets, lower Fox River, April 18 to May 18, 2006, including mature males (striped bar), female (black bar), unknown (white bar).

Fall Electrofishing effort Fox River

Fall electrofishing surveys are conducted as part of the general walleye/fish community index (Meyers, 2007) and an additional effort is given to muskellunge sampling. During the fall 2006, 15.6 hours of effort in the lower Fox River captured 53 muskies from 10.2 to 42.2 inches in length (Figure 3). These are mainly juvenile fish and all were fin clipped; 7 were stocked as yearlings and 46 were fingerling stocks. Essentially all muskies handled in the fall and spring surveys had fin clips (some fins regenerate but are usually deformed). To date, there has been no definite indication of successful natural reproduction.

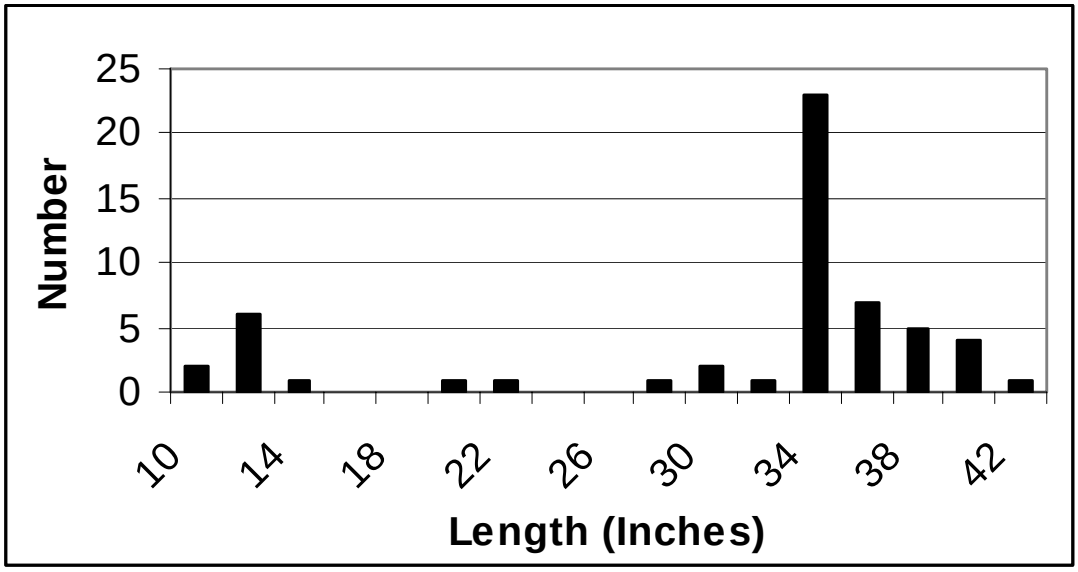

Figure 3. Length frequency of 53 muskellunge captured in the Fox River during the fall of 2006.

Egg Collection

The first six years of the program (1989-94), hatchery production averaged 2,200 fingerling and yearling muskies and was based upon spawn collected directly from the Indian Spread Chain in the State of Michigan. From 1995 to 2001 hatchery production averaged 2,875 muskies and was supplemented by spawn collection from an inland Wisconsin lake with brood fish near Wild Rose Hatchery. From 2002 to 2006, the annual production has averaged 20,324 muskies mainly due to rearing pond management of the nitrogen\phosphorous (N\P) ratio (Randy Larson, personal comm.). In 2005, the lower Fox River became the sole location for spawn collection for the reintroduction program. During 2006, spawn was collected from 18 individual females paired with18 separate males. All spawned Fox River muskies tested negative for Viral Hemorrhagic Septicemia (VHS) (Sue Marcquenski, personal communication).

Stocking

During 2006, spotted musky production totaled 22,024 (98% fall fingerling, 2% spring yearling). Approximately,12,972 muskies were stocked in the lower Fox River estuary, 5,065 in Menominee and Peshtigo estuaries, 1,169 in Sturgeon Bay area and 694 in Fox River above DePere. Since 2000, spotted muskies have been stocked in the Winnebago system upstream of dams on the lower Fox River (2,124 stocked in 2006) as a possible backup brood source in the future.

Fishery

The reintroduction program has resulted in an artificial (all hatchery production) population that are a relatively small but important component of the Green Bay nearshore fish community (Meyers, 2007). The “first ever” musky tournament was held on lower Fox River of Green Bay in the fall of 2006, and the 15, 2-person teams boated 47 muskies (average of 3 musky per team) during the 1.5 day tournament. The 2006 Lake Michigan creel survey, estimated a muskellunge catch and release of 455 muskellunge from Green Bay. There was no harvest recorded in the creel, however antidotal information suggests about 6 legal size (over 50 inches) musky were harvested in 2006.

Future

Efforts will continue to add genetic diversity to the present Green Bay muskellunge stock by obtaining either eggs or fingerling musky from the Ontario waters of the Great Lakes. Finding additional backup brood water for future spawn collection is desired. We will continue to monitor the Green Bay population for indication of natural reproduction and collect data on the stocking returns in order to help guide the production system. If the present growth and survival rates continue, a higher harvest length limit would be desirable (54 inches such as Canadian great lake waters)

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