Great Lakes Fishery Commission
Lake Michigan Committee
1999 Annual Meeting
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Lake Michigan Management Reports

Lake Michigan Fisheries Team
Wisconsin Department of Natural Resources

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INTRODUCTION AND SUMMARY

These reports summarize some of the major studies and stock assessment activities of the Department of Natural Resources on Lake Michigan during 1998. They provide specific information about the major sport and commercial fisheries, and they describe trends in some of the major fish populations in Wisconsin waters. 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, made up of representatives of Michigan, Indiana, Illinois, Wisconsin, and COTFMA (the Chippewa/Ottawa Treaty Fishery Management Authority). These reports are presented to the Lake Michigan Committee as part of Wisconsin's contribution to that shared management effort. In addition, the Department and its biologists contribute to a variety of joint information gathering and analysis initiatives that are reported elsewhere. These include a) the development and implementation of lakewide forage assessments methodologies, b) the development and implementation of common creel survey methodologies, c) the development of a lakewide assessment program for chinook salmon, lake trout, and burbot, d) the coordination of yellow perch research and assessment activities, e) the estimation of total predation by stocked salmon and trout, and f) the monitoring of fish health.

Report highlights

This was an *el nino* year, and distributions of fish may have been affected by the unusual weather conditions, but the data reported here continue to reflect generally healthy sport and commercial fisheries. Sport fishing Anglers devoted nearly 3,000,000 hours to sport fishing on Lake Michigan and Green Bay during 1998. The estimated overall harvest of all salmon and trout species in 1998 was somewhat lower than in 1997 because of a 57% decline in the catch of coho salmon, but catches of steelhead, chinook salmon, and lake trout were up 17%, 5%, and 42%, respectively. 26,000 smallmouth bass and 23,000 walleye were harvested. The sport harvest of yellow perch remained low in Green Bay and Lake Michigan. Commercial fishing. Commercial landings of chubs and whitefish were again high, at 1,891,405 pounds and 1,556,941 pounds, respectively, for the quota year ending June 30, 1998. The smelt harvest continued to decline, reflecting a continuing decline in the lakewide smelt population. The commercial harvest of yellow perch was limited by quota to 200,000 pounds from Green Bay and and was closed on Lake Michigan.

Spawning runs of all salmon and trout species were adequate to meet egg collection goals, with the exception of the fall run of the Skamania strain of steelhead, which was poor at both the Besadny Anadromous Fisheries Facility, on the Kewaunee River, and the Root River Steelhead Facility.

Population assessments provided both good and bad news. Our assessments show a very strong whitefish population, justifying the recent increase in the annual harvest limit, from 1,770,000 pounds to 2,470,000 pounds. Yellow perch populations in Green Bay and Lake Michigan remain low, but we believe that a fairly strong year class was produced in Green Bay in 1998 and, although the numbers of young yellow perch produced in our waters of Lake Michigan were low, they were higher than in recent years. The bloater chub population remains enormous in

Lake Michigan, but our data reflect several years of poor recruitment and show an aging population made up increasingly of female fish. The estimated adult walleye spawning population in the lower Fox River reached the highest level in twelve years.

For more information

These reports were written by the fisheries biologists directly involved with the collection and analysis of the data presented. The author's name is listed at the end of each report. If you would like additional information about any topic, please call the author of that report at the phone number listed below:

Brian Belonger – 715-583-5006
Brad Eggold – 920-892-8756
Pradeep Hirethota – 414-382-7929
Steve Hogler – 920-683-4923
Bill Horns – 608-266-8782
Timothy Kroeff – 920-746-2860
Terry Lychwick – 920-448-5140
Paul Peeters – 920-746-2865
Steve Surendonk – 920-683-4923
Mike Toneys – 920-746-2864

Prepared by:

Bill Horns
Lake Michigan Fisheries Team Leader
101 S. Webster St.
Madison, WI 53707-7921

SPORT FISHING EFFORT AND HARVEST

Overall fishing effort by various angler groups is shown in Table 1. Effort increased slightly from 2,868,547 hours in 1997 to 2,870,450 hours in 1998. The largest changes present were in the moored boat fishery which increased by 102,235 hours and the stream fishery which declined by 58,319 hours. Fishing effort has declined by 1.3 million hours since 1986 but has remained relatively constant since 1993.

The salmonid harvest in Wisconsin decreased from 464,522 fish in 1997 to 416,521 in 1998 (Table 3). Coho salmon and brown trout were responsible for the modest decline. Coho salmon harvest decreased by 79,220 fish from 1997 mostly in the ramp fishery (Table 4) while the brown trout harvest declined to 27,371 fish (Table 3). The rainbow trout harvest increased by 16,418 fish in 1998 while the lake trout harvest increased dramatically to 82,247 fish. Fishing was good from late July through August but no real good weather pattern set up in 1998, probably contributing to the lower than average coho salmon harvest.

The yellow perch harvest increased in 1998. The estimated harvest was 257,197 fish an increase of 21,784 fish from 1997. Northern pike harvests were estimated at 2,561 fish while both smallmouth bass and walleye were higher at 26,334 and 23,362 fish respectively.

Table 1. Fishing effort (angler hours) by various angler groups in Wisconsin waters of Lake Michigan and Green Bay, 1998.

YEAR	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	TOTAL
1998	1,385,459	581,672	234,814	137,907	189,522	341,076	2,870,450

Table 2. Sport harvest by fishery type and species for Wisconsin waters of Lake Michigan and Green Bay, 1998.

SPECIES	RAMP	MOORED	CHARTER	PIER	SHORE	STREAM	**TOTAL**
Coho salmon	22,234	22,619	10,593	634	1,166	1,957	**59,203**
Chinook salmon	52,060	38,460	29,935	994	2,992	12,212	**136,653**
Rainbow trout	43,603	43,108	18,352	1,280	621	3,924	**110,888**
Brown trout	13,547	3,921	1,683	1,212	4,173	2,835	**27,371**
Brook trout	0	0	19	57	45	38	**159**
Lake trout	24,509	33,430	24,285	23	0	0	**82,247**
Northern pike	1,995	-	-	289	189	88	**2,561**
Smallmouth bass	8,228	14,483	-	800	1,690	1,133	**26,334**
Yellow perch	155,818	71,354	-	12,538	6,451	11,036	**257,197**
Walleye	16,114	443	-	72	194	6,539	**23,362**
TOTAL	**338,108**	**227,818**	**84,867**	**17,899**	**17,521**	**39,762**	**725,975**

Table 3. Total number of fish harvested by year across all angler groups in Wisconsin waters of Lake Michigan, 1986-1998.

Species	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	TOTAL
Brook Trout	4,587	1,369	5,148	2,192	5,927	1,659	4,431	1,967	7,481	1,914	419	299	159	37,552
Brown Trout	68,806	82,397	59,397	55,036	45,092	59,164	51,554	64,546	52,397	49,654	38,093	43,224	27,371	696,731
Rainbow Trout	26,483	56,055	60,860	87,987	51,711	67,877	79,525	104,769	114,776	117,508	77,099	94,470	110,888	1,050,008
Chinook Salmon	356,900	396,478	176,294	189,251	111,345	139,080	103,564	87,365	99,755	162,888	183,254	130,152	136,653	2,272,979
Coho Salmon	127,919	111,886	136,695	105,224	64,083	44,195	70,876	74,304	110,001	65,647	104,715	138,423	59,203	1,213,171
Lake Trout	96,858	113,930	89,227	94,614	75,177	85,841	52,853	61,123	53,989	69,332	36,849	57,954	82,247	969,994
TOTAL	681,553	762,115	527,621	534,304	353,335	397,816	362,803	394,074	438,399	466,943	440,429	464,522	416,521	6,240,435

Table 4. Total number of fish harvested by year across all species in Wisconsin waters of Lake Michigan, 1986-1998.

Fisheries Type	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	TOTAL
Ramp	255,559	266,036	222,428	173,224	118,439	150,840	111,260	145,689	167,388	193,752	176,085	190,976	155,953	2,327,629
Moored	186,611	225,586	98,908	184,011	97,206	103,633	111,441	110,507	134,315	128,743	125,017	129,332	141,538	1,776,848
Charter	124,282	150,249	133,861	125,969	85,773	88,490	71,113	81,490	81,909	84,898	86,346	94,556	84,867	1,293,803
Pier	47,643	44,280	26,527	7,548	6,946	8,701	10,867	9,144	15,130	14,621	6,218	5,002	4,200	206,827
Shore	27,947	30,043	22,945	13,268	14,538	16,830	16,602	13,645	16,370	17,676	19,676	16,726	8,997	235,263
Stream	39,511	45,921	22,952	30,284	30,433	29,322	41,520	33,599	23,287	27,253	27,087	27,930	20,966	400,065
TOTAL	681,553	762,115	527,621	534,304	353,335	397,816	362,803	394,074	438,399	466,943	440,429	464,522	416,521	6,240,435

Prepared by:

Brad Eggold
Wisconsin Department of Natural Resources
P.O. Box 408
Plymouth, Wisconsin 53073

WEIR HARVEST

The Wisconsin Department of Natural Resources (WDNR) operates three salmonid egg collection stations on Lake Michigan tributaries. The Strawberry Creek Weir (SCW) 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 primary egg collection station for the three strains of steelhead *O. mykiss*, coho salmon *O. kisutch*, and brown trout *Salmon trutta*. 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 primary egg collection station for steelhead, and serves as a backup for coho and chinook salmon egg collection.

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

Salmonid egg harvest quotas vary from one year to the next based on projections to satisfy WDNR hatchery needs and accommodate egg requests from other agencies. In 1998 the projected salmonid egg quotas were: chinook salmon, 5,000,000 million; coho salmon, 1.3 million; steelhead (Skamania / Chambers Creek / Ganaraska) 500,000 per strain; Seeforellen brown trout 650,000 million.

During the fall of 1998, 5,035 chinook salmon weighing an estimated 61,427 pounds were processed at SCW (Table 1). Over the last 18 years the average number of chinook salmon processed at SCW has been 4,319. The higher chinook salmon return at SCW in 1998 was the fifth highest of all time, easily beating the annual return recorded the last 18 years. Approximately 3.4 million eggs of a 5.0 million egg quota were collected at SCW in 1998. As a result of the large return of chinook salmon return, WDNR staff only collected a small amount of chinook salmon eggs from BAFF and RRSF.

The chinook salmon return to BAFF during the fall of 1998 was 4,105 (Table 2). Over the last nine years an average of 2,951 chinook salmon have been processed each fall. Approximately 1.2 million chinook salmon eggs were collected at BAFF in the fall of 1998. The coho salmon return to BAFF in the fall of 1998 was 2,432 (Table 2). The nine year average coho salmon return is 2,121. Approximately 0.6 million coho salmon eggs were collected at BAFF in the fall of 1998. The steelhead return to BAFF in 1998 was 926 (Table 2), with the majority returning in the spring as Chambers Creek and Ganaraska strains. Over the last 7 years an average of 2,528 steelhead have been processed each year. About 400,000 eggs were taken from mature steelhead in spring 1998.

A total of 3,977 chinook salmon were examined at the RRSF in the fall of 1998. The majority of them (3,845 or 97%) were passed upstream (Table 3). A total of 93,000 eggs were obtained from mature chinook salmon at RRSF. A total of 4,000 coho salmon were examined at the RRSF from September 15 through November 15, 1998 (Table 3). The majority of coho salmon were passed upstream (83%). A total of 418 fish were sacrificed for egg or sperm production. The steelhead return at RRSF in 1998 from March 1, 1998 to November 15, 1998 was 533. The majority of all fish (446 or 84%) were passed upstream (Table 3). About 500,000 eggs were obtained from the combined steelhead run in 1998 with the majority coming from Chambers Creek and Ganaraska strain steelhead.

Low water conditions and poor weather contributed to the dramatic decrease in the steelhead runs in both the Kewaunee and Root Rivers in 1998.

Brad Eggold	Steve Hogler	Paul Peeters
Wisconsin DNR	Wisconsin DNR	Wisconsin DNR
P.O. Box 408	1314 Hwy 310	110 S. Neenah Ave.
Plymouth, WI 53073	Manitowoc, WI 54220	Sturgeon Bay, WI 54235
414-892-8756	414-683-4923	414-746-2865

TABLES 1-3 follow . . .

Table 1. Yearly summary of chinook salmon returns at Strawberry Creek, 1981-1998.

Harvest Year	Total number of Live and Dead fish	Number of adipose clipped fish	Total Weight (pounds)	Hatchery Egg Production[1]	
				Number	Pounds
1981	4,314	-	74,209	9,786,000	9,786
1982	3,963	-	60,206	7,728,000	7,728
1983	3,852	48	66,091	6,954,000	6,954
1984	5,208	64	76,905	7,652,000	7,652
1985	5,601	582	90,860	7,085,000	7,058
1986	4,392	322	53,700	5,052,000	5,052
1987	7,624	701	99,100	4,929,000	4,929
1988	3,477	408	43,645	3,997,000	3,997
1989	1,845	301	20,849[2]	1,350,000	1,350
1990	3,016	501	47,091[2]	2,378,000	2,378
1991	3,009	377	43,630[2]	1,649,000	1,649
1992	4,099	382	51,878[2]	1,677,100	1,677
1993	4,377	582	66,094[2]	2,156,666	2,156
1994	4,051	733	63,195[2]	3,426,026	3,426
1995	2,381	408	30,001[2]	2,221,446	2,221
1996	6,653	1,185	97,134[2]	4,720,000	4,720
1997	4,850	969	78,085[2]	4,060,944	4,606
1998	5,035	1,092	61,427[2]	3,489,144	3,489

1 Chinook salmon eggs harvested for hatchery production (does not include eggs sold for bait).
2 Annual average weight per fish used to estimate total weight (1998 average weight was 12.2 pounds).

Table 2. Yearly summary of trout and salmon returns at the Besadny Anadromous Fisheries Facility, 1990-1998.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Hatchery transfer	Total number of fish examined	Adipose clipped	Number of eggs harvested
CHINOOK SALMON							
1990	1,307	1,797			3,104	214	1,081,000
1991	2,390	966			3,356	21	1,880,000
1992	2,254	995	625		3,874	120	2,148,000
1993	2,180	726	354		3,260	241	880,000
1994	813	847	62		1,722	452	471,000
1995	1,182	1,362	77		2,621	737	1,360,000
1996	952	2,029	212		3,193	629	700,000
1997	144	1,139	235		1,518	148	0
1998	695	2,858	452		4,005	72	1,155,080
COHO SALMON							
1990	1,889	1,813		185	3,887		1,374,000
1991	780	287		73	1,140		790,000
1992	307	596			958		163,000
1993	448	130	326	725	1,671		529,000
1994	433	185	97		746		350,000
1995	698	2,744	325		3,767		535,000
1996	632	989	248		3,328[1]	54	688,000
1997	773	337	52		1,162	251	524,000
1998	847	1,518	67		2,432	299	607,898
STEELHEAD							
1992 - Spring		2,892	446		3,338		
1992 - Fall		66		408	474		
1993 - Spring		2,096	177		2,273		
1993 - Fall		30		175	205		
1994 - Spring		2,804	164		2,968		
1994 - Fall		321		200	521		
1995 - Spring		1,696	151		1,847		756,000
1995 - Fall		457	9	121	587		
1996 - Spring		1,964	180		2,144		454,000
1996 - Fall		24	18	151	193		
1997 - Spring		1,955	136		2,091		780,000
1997 - Fall		85	6	40	131		50,600
1998 - Spring		746	130		876		400,000
1998 - Fall		41	2	7	50		15,000

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

Table 3. Yearly summary of trout and salmon returns at the Root River Steelhead Facility, 1994-1998.

Year	Number of fish harvested	Number of fish passed upstream	Dead fish	Hatchery transfer	Total number of fish examined	Adipose clipped	Number of eggs harvested
CHINOOK SALMON							
1994	129	1,726	3		1,858	3	
1995	300	2,663	16		2,979	1	1,020,000
1996	62	5,440	87		5,589		644,000
1997	76	3,974	52		4,102		0
1998	127	3,845	5		3,977	2	93,000
COHO SALMON							
1994	285	513	15		813		
1995	199	2,115	1,040		3,321	3	330,000
1996	161	3,940	305		4,406		2,200,000
1997	65	6,909	16	655	7,645		1,750,000
1998	90	3,336	246	328	4,000	1	760,000
STEELHEAD							
1994 - Fall		583	47	218	848	2	200,000
1995 - Spring	120	2,582	18		2,720	2	1,008,000
1995 - Fall		208		330	538	1	300,000
1996 - Spring	150	2,970	49		3,169		775,000
1996 - Fall		105		248	353		240,000
1997 - Spring	2	2,918	125		3,045		777,000
1997 - Fall		228	2	408	638		500,000
1998 - Spring		382			382		320,000
1998 - Fall		64	1	86	151		184,000

STATUS OF THE COMMERCIAL CHUB FISHERY AND CHUB STOCKS IN WISCONSIN WATERS OF LAKE MICHIGAN

The chub harvest from commercial gill nets was 1,931,405 pounds for calendar year 1998, a decrease of 478,367 pounds or 20% from 1997 (Tables 1 and 2). Commercial smelt trawlers harvested an additional 426,627 pounds incidental to targeted smelt, with 61,640 pounds of these chubs counting against the southern quota. This is a drop of over 50% for the incidental catch but the poundage counting against the quota was almost identical to 1997.

By zone, the South had a decrease of 429,111 pounds (-20%) of chubs harvested in gill nets while the harvest in the North decreased by 49,256 pounds (-16%). Gill net effort decreased in both the South and North. CPE was very similar in the South when compared to 1997 while the North CPE increased to the highest catch rate since chub fishing re-opened in 1981. In the North, thirteen of the twenty-three fishers holding chub permits fished and caught chubs from July 1 of 1998, while in the South, thirty-six of the 49 chub permit holders fished and caught chubs in the same time period.

Table 1. Harvest, quota, number of fishers, effort, and catch per unit of effort (CPE) Wisconsin's southern chub fishing zone, 1979-1998. 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.

YEAR	HARVEST	QUOTA	FISHERS	EFFORT	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

Table 2. Harvest, quota, number of fishers, effort, and catch per unit of effort (CPE) for Wisconsin's northern chub fishing zone, 1981-1998.

YEAR	HARVEST	QUOTA	FISHERS	EFF.(x1000)	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

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

In 1998, graded mesh gill net (GMGN) assessments were conducted off Baileys Harbor (Grid 707) in mid-September, off Algoma (1004) in late September, off Sheboygan (1502) in mid-November and off Milwaukee (1802) in mid-December (Table 3). Assessments with GMGN were not conducted in northern Green Bay due to weather conditions. Over 800 scale samples were collected and aged and over 3800 chubs were measured and sexed. Age classes six through nine appear fairly strong off the assessed ports. The chub population at present appears to contain a larger number of age nine and ten fish than has been observed in the past. Because of slower growth when compared to the early 1980's, chubs, ages one through three (under 175 millmeters) are not fully vulnerable to our smaller meshes. However, this was the first year where no aged two chubs were captured in any of the assessments and the only place where age three showed up was off Algoma in very small numbers. In addition, catch rates of age four chubs was poor at all the sites. There does seem to be an indication that poor year classes were produced from 1993 through 1996. Back-calculated lengths-at-age were similar among the four assessment sites (Figure 1).

The substantial shift in sex ratios that has occurred since 1980 continued in the chub population sampled during 1998 from GMGN. In the early 80's when younger fish (ages 2-5) dominated the chub population, the sex ratio was about 50:50. Now, with a greater range of year classes in the population, which older fish dominate, females predominate. The one advantage of the female dominated sex ratio to the industry is that commercial fishers have profited through the sale of eggs to the caviar market during the late fall and winter months.

Table 3. Catch rate (number of fish/ standard effort **) by age group for chubs from graded mesh gill nets fished in the northern and middle (central) areas * of Wisconsin Lake Michigan from 1980-87, Baileys Harbor (706) and Algoma (1004) from 1988-98, Northern Green Bay (507) from 1994-96, and Milwaukee (2002, 1802) from 1995-98 and Sheboygan (1504) from 1998.

YEAR		Age Group 1	2	3	4	5	6	7	8	9	10	11
1980	Middle	21.1	461.0	452.8	30.2	3.7	3.4	0.2	-	-	-	-
	North	2.1	542.7	683.9	64.9	9.1	7.1	0.3	-	-	-	-
1981	Middle	10.9	280.4	593.6	234.4	9.0	0.6	-	-	-	-	-
	North	10.7	296.8	818.5	246.4	9.3	0.6	-	0.5	-	-	-
1982	Middle	-	547.7	1119.5	720.4	127.8	1.5	-	-	-	0.2	-
	North	-	262.7	282.2	188.2	37.4	0.9	1.2	-	-	-	-
1983	Middle	2.6	192.9	965.7	832.2	262.1	6.9	-	0.5	-	-	-
	North	2.4	120.3	649.4	398.0	117.3	18.6	-	-	-	-	-
1984	Middle	5.0	253.9	650.6	818.3	397.0	45.8	-	-	-	-	-
	North	9.0	145.6	293.3	361.7	88.2	14.2	0.7	-	-	-	-
1985	Middle	4.4	135.1	419.1	457.6	336.2	54.6	1.5	-	-	-	-
	North	2.0	250.1	676.4	565.4	598.5	137.0	2.0	0.2	-	-	-
1986	Middle	1.8	48.5	364.3	685.8	381.0	213.6	18.6	3.6	-	-	-
	North	-	111.0	274.1	576.3	199.7	152.4	9.3	0.3	-	-	-
1987	Middle	-	17.0	100.0	233.3	221.2	110.2	26.2	5.3	-	-	-
	North	-	105.6	197.2	390.1	376.8	115.9	47.7	3.4	-	-	-
1988	Algoma	-	30.8	85.1	292.1	312.6	211.7	39.5	-	-	-	-
	Baileys Harbor	-	6.8	140.1	285.2	471.6	270.1	48.2	7.7	-	-	-
1989	Algoma	-	28.5	164.2	242.9	340.6	449.7	116.5	14.2	-	-	-
	Baileys Harbor	-	65.2	102.6	204.1	270.9	263.2	152.7	5.2	5.2	-	-
1990	Algoma	-	21.5	85.1	169.6	180.8	255.5	68.4	10.4	-	-	-
	Baileys Harbor	-	49.3	69.5	343.3	348.3	250.4	197.5	49.3	-	-	-
1991	Algoma	-	14.6	44.9	138.5	259.9	307.4	107.3	62.0	22.1	-	-
	Baileys Harbor	-	19.2	119.3	194.3	304.1	332.0	221.3	125.8	6.1	-	-
1992	Algoma	-	7.5	90.2	189.0	324.0	339.8	152.9	37.2	0.5	-	-
	Baileys Harbor	-	12.4	84.1	170.9	197.0	146.3	93.0	21.5	-	-	-
1993	Algoma	-	5.6	72.7	277.3	418.4	260.3		258.2	81.8	5.6	-
	Baileys Harbor	-	11.4	115.1	208.1	300.2	306.8	212.0	53.6	-	-	-
1994	Algoma	-	-	10.4	53.3	125.9	226.8	209.5	146.4	30.0	-	-
	Baileys Harbor	-	-	48.4	129.8	374.5	341.5	313.4	185.9	21.0	-	-
	N. Green Bay	-	6.9	37.3	124.0	75.5	65.9	43.7	13.5	1.9	1.6	-
1995	Milwaukee	-	-	57.6	755.2	440.8	679.2	364.1	201.0	68.0	17.8	
	Algoma	-	4.2	2 9.2	66.7	166.4	217.6	158.1	44.9	14.7	-	-
	Baileys Harbor	-	18.9	20.6	154.9	339.9	448.1	209.0	159.4	65.8	18.2	-
	N. Green Bay	-	7.2	19.9	65.3	159.6	52.2	94.6	25.6	5.8	2.9	2.9
1996	Milwaukee	-	-	14.5	78.7	331.0	275.1	355.8	220.6	36.6	5.2	-
	Algoma	-	2.5	5.0	38.3	70.3	130.2	97.6	39.4	7.9	10.1	-
	Baileys Harbor	-	-	8.4	84.6	165.9	356.3	274.3	239.9	39.0	14.3	-
	N. Green Bay	-	1.5	-	4.4	19.6	24.1	9.1	2.6	1.8	-	0.9
1997	Milwaukee	-	-	14.9	104.5	433.6	557.8	579.2	481.3	298.5	35.0	-
	Sheboygan	-	-	14.4	32.6	76.8	211.1	149.5	223.9	70.9	30.2	11.8
	Algoma	-	4.1	3.8	49.4	105.0	216.3	130.1	120.6	14.6	13.5	-
	Baileys Harbor	-	-	-	84.4	103.6	260.5	225.3	261.4	59.2	18.5	3.5
1998	Milwaukee	-	-	-	24.4	50.5	180.8	238.7	307.5	195.8	83.7	24.0
	Sheboygan	-	-	-	7.5	78.1	183.4	256.9	257.6	124.5	60.2	15.6
	Algoma	-	-	3.5	18.0	102.4	231.1	191.3	180.0	109.2	40.0	3.5
	Baileys Harbor	-	-	-	21.3	39.96	104.8	171.3	146.0	56.9	31.4	-

* northern area = Baileys Harbor (707) & Washington Island (609) combined.
middle (central) area = Algoma (1004-05) & Two Rivers (1304) combined.

** standard effort = 1000 feet each of 1.5, 1.75, 2.0, 2.25, 2.5, 2.75 and 3.0 stretch measure fished for one night.

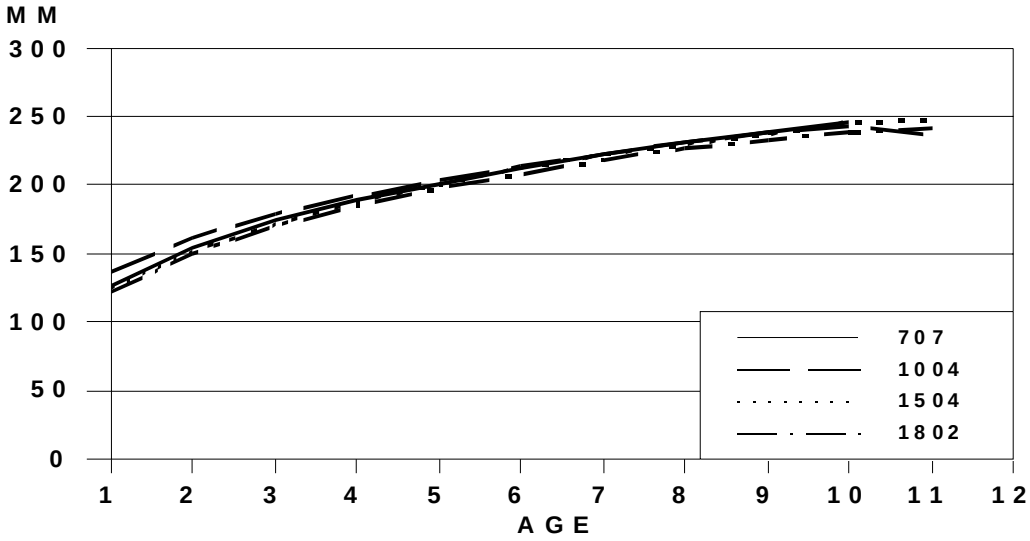


Figure 1. Back calculated mean length-at-age of chubs caught in GMGN from assessment surveys in 1998.

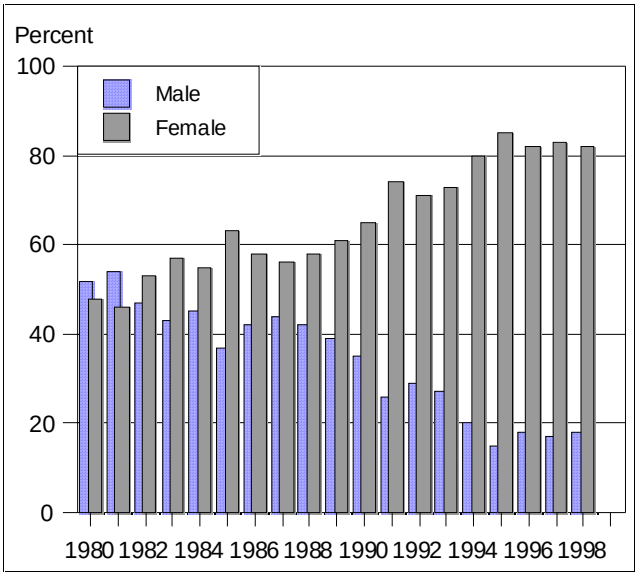


Figure 2.-Sex ratio trends of chubs caught in GMGN from Algoma and Baileys Harbor during 1980-1998 and combined chubs from southern Lake Michigan surveys in 1996-1998.

Prepared by:

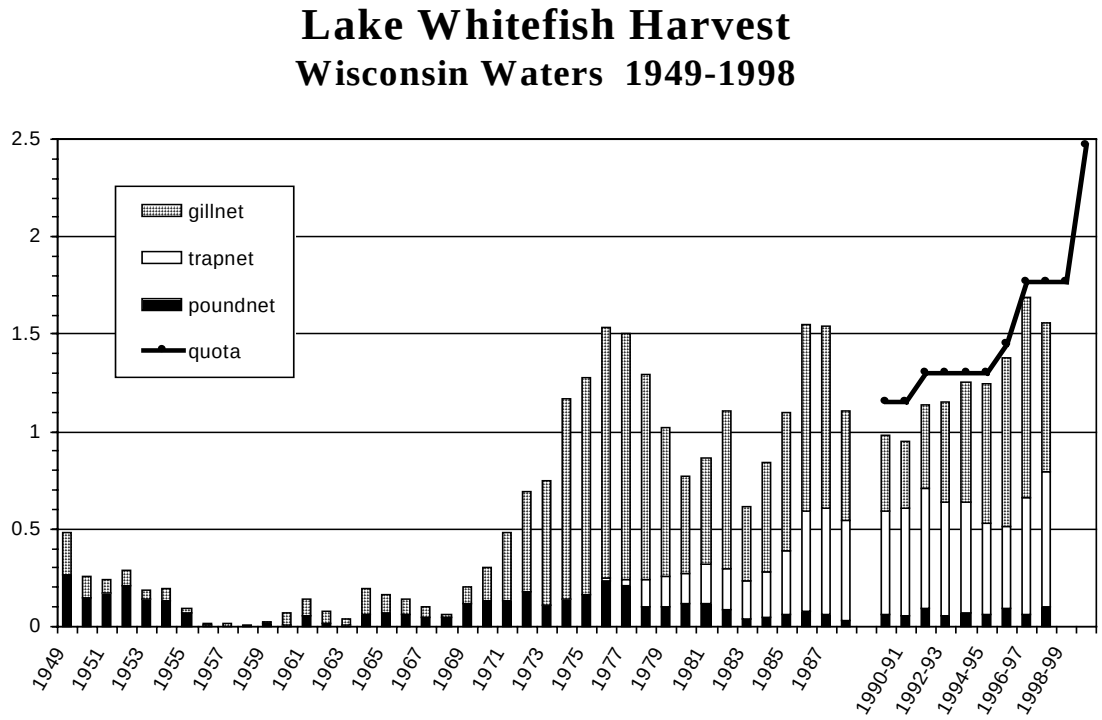
Timothy Kroeff
Wisconsin Department of Natural Resources
110 S. Neenah Avenue
Sturgeon Bay, Wisconsin 54235

STATUS OF THE LAKE WHITEFISH STOCK AND COMMERCIAL FISHERY IN THE WISCONSIN WATERS OF LAKE MICHIGAN

Lake whitefish *Coregonus clupeaformis* (whitefish) continues to rank economically as one of the most important species in Wisconsin's Great Lakes commercial fishery. Most of the whitefish harvested from Lake Michigan by Wisconsin commercial fisherman belong to the North/Moonlight Bay (NMB) stock, whose major spawning grounds are concentrated along the eastern shore of Door County. Since July 1989 the commercial harvest of whitefish in Wisconsin waters has been under enforced quota control. This stock is also heavily exploited by state of Michigan commercial fisherman in the waters of Green Bay, but their harvest is not currently under enforced quota control.

In order to maintain current data on this whitefish stock and quota fishery in Wisconsin waters of Lake Michigan including Green Bay, catch statistics are summarized and lifts of commercial fishing gear are sampled by Wisconsin Department of Natural Resources (WDNR) personnel. The WDNR also conducts whitefish sampling from the research vessel (R/V) Barney Devine with graded mesh gill nets (GMGN) in the spring for juvenile whitefish and in the fall near the spawning grounds for mature whitefish. Similar data has been collected and reported annually by WDNR since the late 1970's.

The total annual quota of whitefish for Wisconsin commercial fisherman has been increased three times since it was first established at 1.15 million pounds for quota year 1989-90. It was increased to 1.3 million pounds in quota year 1991-92, up to 1.45 million pounds for quota year 1995-96 and up to 1.77 million pounds in quota year 1996-97. There is currently a fourth quota increase working it=s way through the legislative procedure. In quota year 1999-2000, the whitefish quota for Wisconsin commercial fisherman is likely to be 2.47 million pounds.

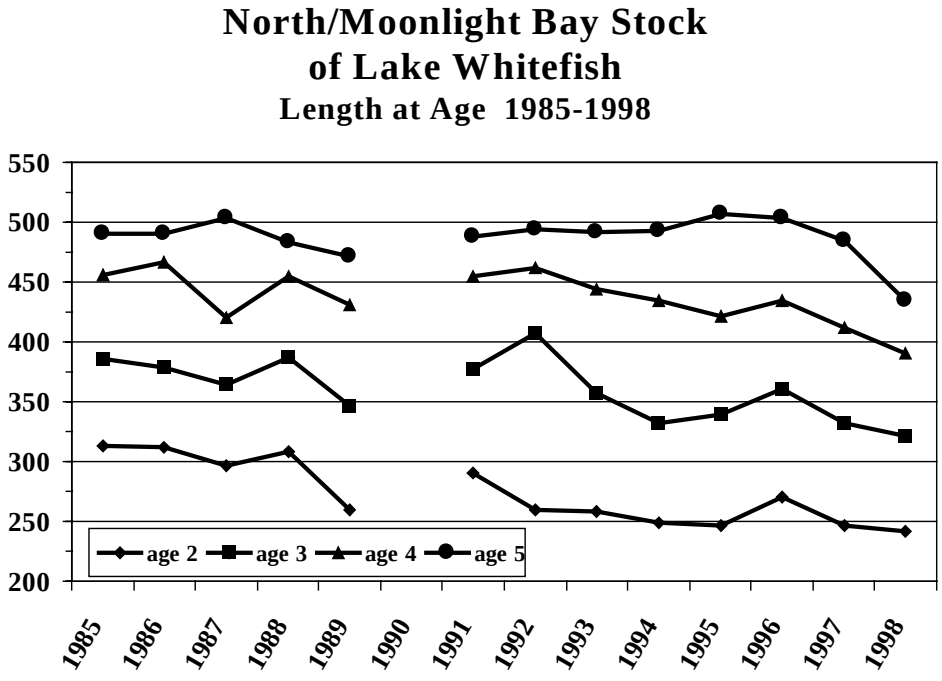


Lake whitefish reported commercial harvest by gear in pounds (dressed weight) from Wisconsin waters of Lake Michigan, including Green Bay, from 1949 through 1997-98 and the Wisconsin allocated quota for lake whitefish including the projected quota for license year 1999-00.

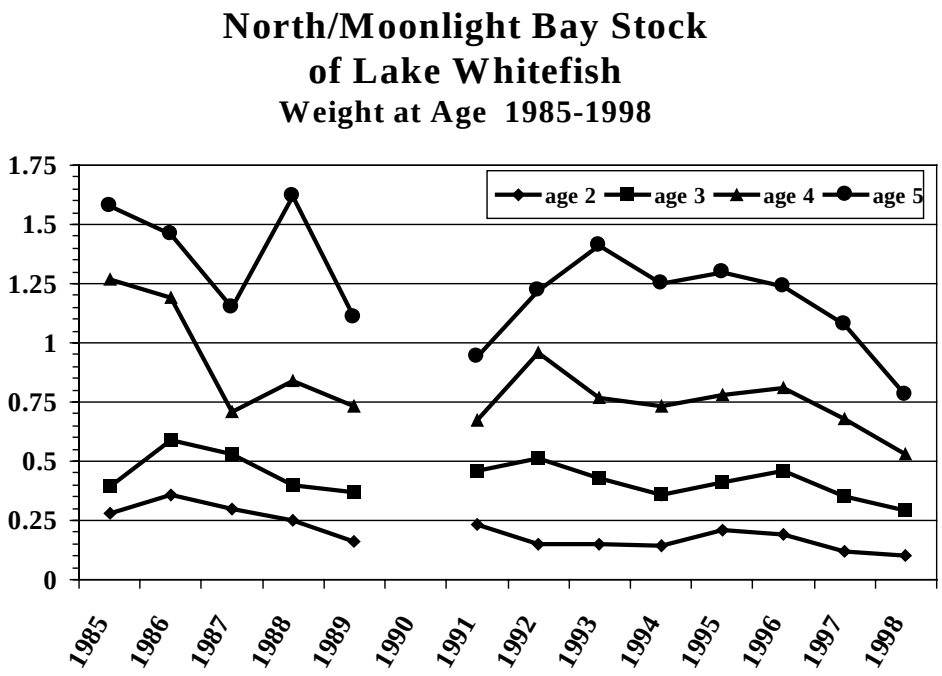
Over the last three quota years the Wisconsin commercial fishery has harvested 1,378,077, 1,695,352, and 1,556,941 pounds of whitefish. During that same three year period an average of 5.5 percent of the harvest was caught with pound nets, 36.9 percent was harvested with trap nets, and 57.6 percent was harvested with gill nets. The catch per effort (CPE) has decreased over the last three years and as a result more gear is being fished by the commercial fishery to catch the quota.

Over the last three years there has been a distinct downward trend in length and weight at age. There has been enough of a change in the last three years that it has affected the age at which whitefish are recruited to the commercial fishery. In the spring fishery, mean age of whitefish captured has gone from 4.5 in 1995 to 5.4 in 1998. The same trend shows up in the fall fishery where the mean age has gone from 4.5 in 1994 to 5.3 in 1997.

There has been a continued progression of moderate to strong year classes of the North/Moonlight Bay stock of whitefish documented in the spring juvenile survey and recruiting to the commercial fishery with good survival to ages seven and older. The 1992 year class was identified as being relatively weaker than most recent year classes, while the 1991, 1993, 1994, and 1995 year classes were considered relatively strong. There is an early indication that the 1996 year class may be atypically weak. Total annual mortality, for ages 5-12, has increased slightly during the past five years but, has remained relatively stable for the youngest segment of the exploitable population (ages 5-8) since 1989.



North/Moonlight Bay population of lake whitefish mean length at age in spring 1985 through 1998.



North/Moonlight Bay population of lake whitefish mean weight at age in spring from 1985 through 1998.

Prepared by:

Paul Peeters
Wisconsin Department of Natural Resources
110 South Neenah Avenue
Sturgeon Bay, WI 54235-2718

STATUS OF YELLOW PERCH STOCKS IN SOUTHERN GREEN BAY

Population Assessment

In 1998, young of the year (yoy) assessment continued at the intensified level begun in 1997 with support from Sea Grant. Sampling was conducted at least weekly at Little Tail Point from first hatching on April 29 through September 8th. There was an earlier spring warm up in 1998. Mean water temperatures at the mouth of the Fox River were 51.1 degrees F. in April and 68.3 degrees in May compared to 46.4 and 57.0 respectively in 1997. In 1998 peak spawning occurred on April 18, compared to April 27, in 1997. The first larval perch were captured on April 29 in 1998 and May 13 in 1997. Pelagic yoy perch ranging from 3 to 22 mm. total length were sampled by light trap, Miller sampler, and neuston net. Benthic yoy perch ranging from 8 to 120 mm. total length were sampled by survey seine and trawl. Peak larval abundance measured by Miller Sampler was higher and earlier in 1998. On May 14, the peak catch was 500 per ½ mile transect compared to 327 on June 9, in 1997, mean lengths were 9.2 and 8.9 mm respectively. In 1998, yoy abundance in benthic sampling was also higher than 1997. Peak seine abundance was 3,197 per haul compared to 803, while peak trawl abundance was 1,084 per trawl hr. compared to 269.

Index station seining continued for the 17th consecutive year at approximately 14 sites spread over 130 miles of Green Bay shoreline. Through 1991, (last strong year class) June-July index seine catch rates correlated much better with August index trawl catch rates (R-Squared = .669) then since 1991, (R-Squared = .261). High index seine catch rates in 1994, 1997, and 1998 should have produced high trawl catch rates and a corresponding strong year class. While the relationship improved in 1998 it still indicates high mortality since 1991 between seine and trawling sampling. It appears that in 1994 and 1997 we lost those year classes after early July when the yoy averaged over 25 mm long. Again the situation in 1998 was some what improved.

Between May 6 and July 14, 1998, gill net sampling for potential predators was under taken in close proximity to where the yoy perch were located. Stomach contents from 526 fish of 16 species were examined. 115 stomachs from 7 species contained identifiable yoy yellow perch. Stomachs from 56 white perch (206 mm. mean length) contained up to 35 yellow perch ranging from 10 to 55 mm total length. Stomachs from 40 alewife (195 mm. mean length) contained up to 258 yellow perch ranging from 6 to 16 mm total length. Stomachs from 8 sheepshead (370 mm. mean length) contained up to 7 yellow perch ranging from 22 to 37 mm. total length. YoY yellow perch were also found in 4 walleyes, 3 black bullheads, 2 short nose gar, and 1 yellow perch. Because of the difficulty of catching predators in shallow set gill nets during day light hours all most all predators were caught after dark. Yellow perch were more frequently found in white perch stomachs in sets after mid-night (31.6 %) then in sets ½ hour after sunset (14.7%).

Even in the face of current alewife predation on yoy yellow perch up to16 mm. long, high enough numbers of yoy yellow perch are surviving to produce strong year classes, as demonstrated by post alewife predation shoreline seining sample abundance which was very high in 1994, 1997, and 1998. White perch are recent invaders to Green Bay, with the first one observed in 1988. Commercial catches and index trawling indicate they have dramatically increased in abundance. This, coupled with limited gill net predator sampling, points to white perch as the major predator on

yoy yellow perch between 20 and 50 mm. long and the probable cause for the poorer correlation between seine and trawl yellow perch abundance since 1991. The reason there was some improvement in the correlation in 1998 may be due to the earlier spring which allowed the yoy to grow through the predation size window sooner, and also several recent weak year classes of white perch has resulted in a decrease in abundance. On the negative side yoy white perch were extremely abundant last August in index trawl catches.

Index station trawling continued in 1998 at the standard sites established in 1978 and the deep sites established in 1988. The deeper sites were developed as a result of a trend of increasing abundance of yellow perch observed at a single deep site (off Marinette) established in 1985. Standard and deep site information has been combined based on the amount of habitat they represent and an adjustment made for standard site information prior to 1988 to account for the increasing area of occupancy, creating a weighted area average value. The number of yoy yellow perch caught per trawl hour (849) ranked it 6th in the past 21 years, since index sites were established in 1978. 1998 was above the median of 299 and mean of 843 (Figure 1).

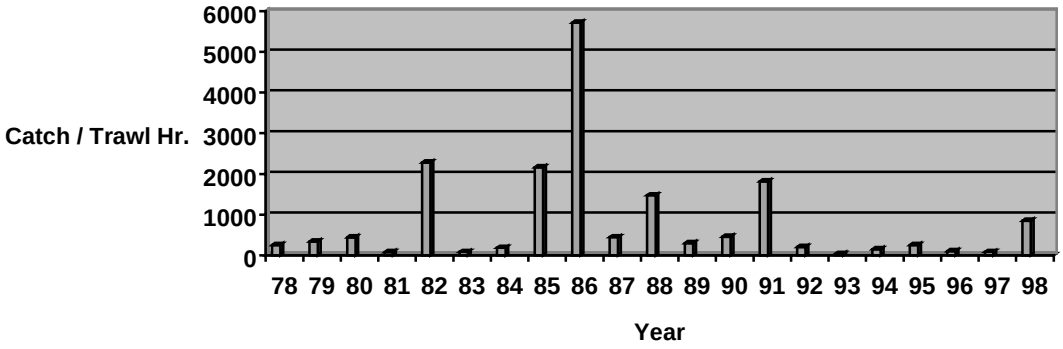


Figure 1. Index Trawl Rel. Abundance , YoY Yellow Perch (Weighted Area Avg.)

Yearling and older yellow perch abundance increased at index sites in 1998 (Figure 2). The weighted area average was 97.5, up slightly from 86.1 in 1997. The average number caught per trawl hour was lower at standard sites (59.0) than at deep sites (122.8).

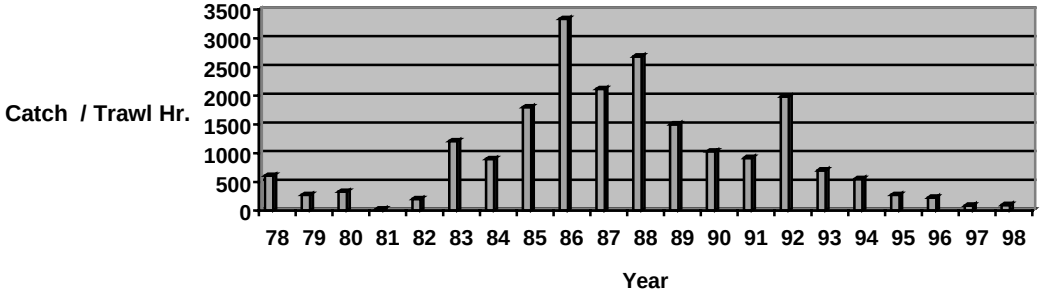


Figure 2. Index Trawl Rel. Abundance, Ylg. & Older Y. Perch (Weighted Area Avg.)

Table 1 shows the average length by year class for ages 1+ through 3+ at standard and deep sites. Average length at age increased in 1998 at both standard and deep sites for all ages from 1997.

Table 1.Yellow Perch Average Length (mm) at Age from Index Station Trawling

	Year Class – Average Length in mm													
Standard Sites	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Age 1+	154	143	137	138	139	136	140	128	132	137	140	143	131	145
Age 2+	191	175	169	170	169	168	165	159	171	173	175	166	187	
Age 3+	213	195	191	194	194	194	191	187	195	193	191	223		
Deep Sites														
Age 1+				137	137	134	134	122	126	134	141	133	135	137
Age 2+			162	171	166	166	158	154	166	168	170	163	166	
Age 3+		187	189	188	187	184	183	179	184	187	184	191		

As a measure of condition, the average weight of a 203 mm (8 inch) yellow perch has been followed. In general the average weight was highest during the very low population abundance of the early 1980's and was lowest during the high population abundance of the late 1980's. In 1998, it increased to 97.7 grams from 91.3 grams in 1997 (Table 2).

Table 2. Average Weight of a 203 mm Yellow Perch From Index Station Trawling

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Wt. Gr.	99.3	98.4	93.5	93.9	93.2	97.9	99.0	99.3	101.9	101.3	102.2	98.2	101.1	91.3	97.7

Harvest Assessment

Since the 1983-1984 commercial fishing license year, the yellow perch harvest in Green Bay has been managed under a quota system. Quota shares are allocated to individual licensees based on their harvest for four years prior to establishment of the quota. The license year quotas run from July 1 to June 30. The zone 1 quota has changed from 200,000 pounds the first year; to 350,000 pounds for 1984-85 and 1985-86; to 400,000 pounds in 1986-87, 1987-88 and 1988-89; to 475,000 pounds in 1989-90 and 1990-91; to 400,000 pounds in 1991-92 through 1993-94; to 300,000

pounds in 1994-95 through 1996-97. The 1997-1998 quota was reduced to 200,000 pounds, were it remained in 1998-1999. The number of licenses with quota shares has declined from 105 to 35 during this period. The number declined by 10 since the last license year.

Both a gill net and entrapment net fishery exists. From 1997 to 1998 the catch rate in gill nets increased from 20.5 pounds to 29.4 pounds per 1,000 feet of gill net lifted, below the ten-year average of 45.7 pounds per 1,000 feet. Effort increased from 4.1 million feet to 5.7 million feet fished. The catch rate in entrapment nets increased from 7.7 pounds to 14.0 pounds per pot lift, below the ten-year average of 22.3 pounds per pot lift. Effort decreased from 3,175 pots lifted in 1997 to 2,648 pots lifted in 1998.

The preliminary yellow perch harvest estimate for the Jan. through Dec.1998 commercial fishery in WM-1 is 204,228 pounds, or 732,023 fish Figure 3 shows the harvest in pounds since 1983.

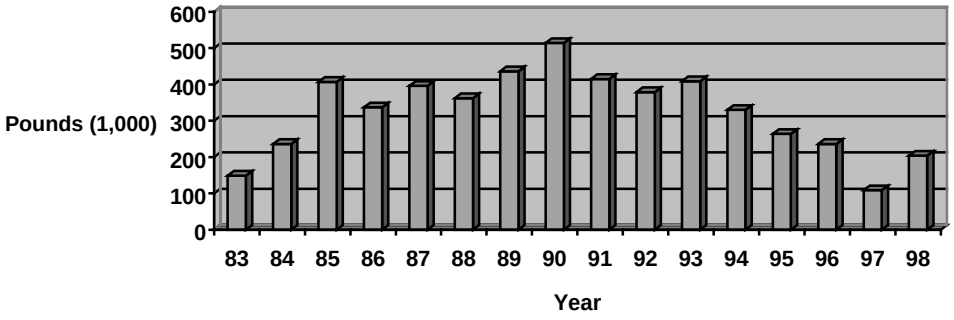


Figure 3. Commercial Yellow Perch Harvest

Both open water and ice sport fisheries exist on Green Bay. The preliminary creel survey harvest estimate for yellow perch in 1998 is 235,566 fish weighing 52,906 pounds compared to 272,179 fish weighing 49,615 pounds in 1997. Figure 4 shows the sport harvest in numbers since 1983.

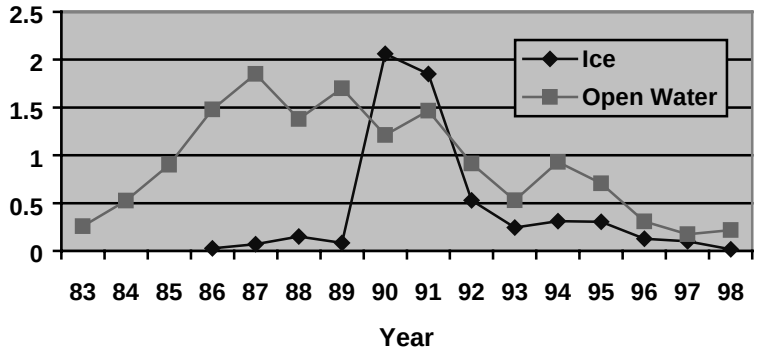


Figure 4. Yellow Perch Sport Creel Survey Harvest Estimate

Combining the sport and commercial harvest estimates, 257,067 pounds were harvested in 1998 (158,145 in 1997) totaling 967,590 fish (665,209 in 1997).

Table 3 shows the relative age distribution of the harvest in 1992 through 1998. In 1998 age 3+ dominated the harvest followed by age 2+. The higher proportion of the harvest of these ages reflects a combination of the diminishing effect of the strong 1991 year class at age 7 and the relative increasing strength of younger weak year classes, which bottomed out with the 1993 year class and increased slightly through the 1995 year class.

Table 3. Age Distribution of the Combined Sport and Commercial Harvest (% by No.)

Year	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+
1992	.0	7.22	30.06	37.82	12.41	10.99	1.36	.10	.03	.00
1993	.04	13.23	21.55	27.19	23.66	9.17	4.16	.87	.11	.02
1994	.0	5.27	62.56	19.56	7.59	3.34	1.18	.48	.02	.00
1995	.57	5.19	10.73	72.21	8.3	1.53	1.19	.48	.02	.00
1996	.84	38.09	13.42	7.60	36.62	2.18	.88	.28	.05	.04
1997	2.87	29.44	58.64	3.41	1.16	4.11	.18	.11	.08	.00
1998	2.61	19.27	58.14	17.70	.87	.62	.70	.06	.01	.02

Management Plans

As a result of a moderate 1998 year class and increased protection for the population instituted in the past several years, no changes in regulations have been proposed.

Prepared by:

Brian Belonger
Wisconsin Department of Natural Resources
Box 208
Peshtigo, WI 54157

STATUS OF YELLOW PERCH STOCKS IN WISCONSIN WATERS OF LAKE MICHIGAN

Yellow perch population in Lake Michigan continued to be on the decline. Recently many stringent management decisions have been made in order to protect the remaining adult population in Wisconsin waters as well as lakewide. The Yellow Perch Task Group identified several multi-state research objectives to understand the cause of perch decline. This report is a summary of status of young and adult perch in Lake Michigan assessed through several annual assessments and monitoring activities.

Seining

In southeastern Wisconsin, beach seining was done for young of the year (YOY) yellow perch at 21 sites between Kenosha and Sheboygan from August 10 to September 10, 1998 using a 25' bag seine. The bag-seine was found to be an effective gear in this area due to uneven bottom and hard substrate not conducive for trawling. 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 SED since 1989. No YOY perch were captured in 1994 sampling. One hundred and fifty three seine hauls at 21 index sites captured 466 YOY perch accounting for 3.02 CPE. Overall, the data indicated an improvement over the past seven years of recruitment of young perch.

Spawning Assessment

This assessment has been conducted on Black Can Reef and in the harbor at Milwaukee since 1990. The objective is to quantify the relative abundance of mature female perch in previously identified spawning areas. In 1998, in order to meet the sampling needs for research objectives of the yellow perch task group, the WDNR increased the effort of spawning assessment by contracting with a commercial trapnet fisherman along with DNR's gill net to capture spawning individuals. Unfortunately, the trapnets proved to be unsuccessful in bringing large number of fish. This was probably due to the kind of substrate and uneven bottom in this area. The DNR Dive Team observed that the leads were stretched so tight that fish could escape from the bottom. The sampling effort lasted from May 20 to June 15, 1998 in which a total of 4,514 yellow perch were captured. One of the objectives was to assist in Sea Grant funded research on early life study. Spawning individuals were supplied to the research team to obtain artificially fertilized eggs for further laboratory study. The WDNR Dive Team conducted 300-meter transect dives covering a total of 9,200 m^2 to document naturally deposited egg strands. No egg mass was identified in four days (total bottom time of 12hr and 48min) of diving effort. A total of 1,328 yellow perch were tagged off Milwaukee as part of the lake-wide yellow perch movement study. Ripe male yellow perch dominated the catch. The proportion of females in the sample was 5.1 per cent in 1998 compared 0.32 percent in 1997 (Table 1). Majority of the females were green and some were spent.

The females should begin to recruit to this assessment, as sexually mature fish at age 3. The females from any one year class should be fully recruited by age 4. Because of the difficulty in determining perch ages during May and June, we no longer attempt to age fish caught during this

assessment. However, poor catches of younger mature females may be due to the lack of recruitment of the early 90's year classes to the spawning population and reflect a decline in the number of available spawners.

Graded Mesh Gill Net Assessment

The WDNR conducts standardized graded mesh gill net assessments annually in January, in grids 1901 and 1902 off Milwaukee. The mesh sizes used in these assessments run from 1 inch to 3 inches on 1/4 inch increments. Yellow perch begin to recruit to this assessment gear by age 2 and are fully recruited by age 3.

Table 2 shows the relative abundance as catch per effort of perch, by age, for this assessment from 1986 through January of 1998. The data show variability in catch rates by calendar year. Strong year classes, such as the 1983 year class, can consistently be followed diagonally through the table. These data show very low CPEs of younger fish while the CPEs of the older year classes remains consistently high. Thus the low CPE's of the younger year classes can not be explained by sampling variability and these year classes are extremely weak. The dominant age-groups in 1992 were age 3 and 4 which got shifted to age 4 and 5 in 1993, age 5 and 6 in 1994, age 6 and 7 in 1995, and age 7 and 8 in 1996. Although ages 1 to 5 were not represented in 1996 samples at all, the 1997 and 1998 samples had fair number of 2-5 year old perch. A preliminary analysis of the data on the age and size distribution of yellow perch from the 1999 survey indicated smaller and younger perch (ages 1 to 3) were represented in the sample in significant proportion (Table 2). The sex ratio for the entire sample in 1999 was somewhat of a balanced nature consisting of 58% males and 42% females.

Harvest

The commercial yellow perch fishing was closed in the Wisconsin waters of Lake Michigan effective September 1996. 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 tremendously reduced in recent years which reflects in the total harvest (Table 3).

Tagging

A lake-wide tagging program was initiated as part of the research effort to understand the movement of yellow perch and their stock structure. In 1998 spawning season a total of 1,328 yellow perch were marked using individually numbered floy tags. Tag return information is being compiled by the Illinois Natural History Survey. We considerable fell short of our target number to tag due to insufficient number of perch in the nets.

Management Actions

All yellow perch assessment and harvest data from the Wisconsin waters of Lake Michigan show nine consecutive weak year classes beginning with the 1990 year class. These observations are consistent with data collected by other agencies throughout the lake. In June 1995 interim rule changes were implemented, as part of an agreement among four Lake Michigan states, in an

attempt to protect the remaining stock of yellow perch in Lake Michigan. Wisconsin's commercial quota was reduced by 65%, from 320,000 lb. to 112,000 lb. in zones 2 and 3, and daily sport bag limit was reduced from 50 to 25 fish. In addition, the sport fishing season for yellow perch was closed during the month of June. No improvement in the recruitment was noticed in the 1996 survey data. Consequently, more stringent regulations were implemented effective September 1996. Commercial fishing was closed in the Wisconsin waters of Lake Michigan and daily sport bag limit was further reduced to 5 fish with the month of June closed for fishing. These rule changes are implemented to benefit the perch population by reducing impact on spawning stocks.

Prepared by:

Pradeep Hirethota
Wisconsin Department of Natural Resources
600 E. Greenfield Ave.
Milwaukee, WI 53204

Tables 1-3 and Figure 1 follow . . .

Table 1. Yellow perch spawning assessment in Milwaukee waters (Black Can Reef) of Lake Michigan - 1990-1998

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]

[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 trapnet and 4 lifts of fyke nets were taken

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

Age	1988	1989	1990	1991	1992	1993	1994	1995	1996
1	0	0	0	0	0	0	0	0	0
2	464	626	724	159	49	60	0	0	0
3	453	1854	1037	865	276	98	25	0	0
4	386	1012	938	323	715	402	58	28	0
5	701	1563	394	327	281	757	218	65	0
6	324	1880	381	83	181	165	141	120	19
7	12	155	90	82	126	49	48	76	51
8	3	1	0	32	73	16	11	65	71
9	0	0	0	0	14	0	0	24	31
10	0	0	0	0	0	0	0	2	12
11	0	0	0	0	0	0	0	0	3
12	0	0	0	0	0	0	0	0	0
%Male	56	69	61	72	82	86	89	90	95.2
%Female	44	31	39	28	18	14	11	10	4.8

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

Year	Commercial harvest (lb x 1000)	Sport harvest (number x 1000)
1986	373	411
1987	550	639
1988	431	932
1989	267	681.5
1990	256	615.8
1991	326	841.4
1992	282	844
1993	267	496.6
1994	254	258
1995	128	237
1996	15[a]	85.5[b]
1997	closed	22.7[b]
1998	closed	24.1[b]

[a] commercial yellow perch fishery was closed effective September 1996
[b] sport bag limit was reduced to 5/day effective September 1996

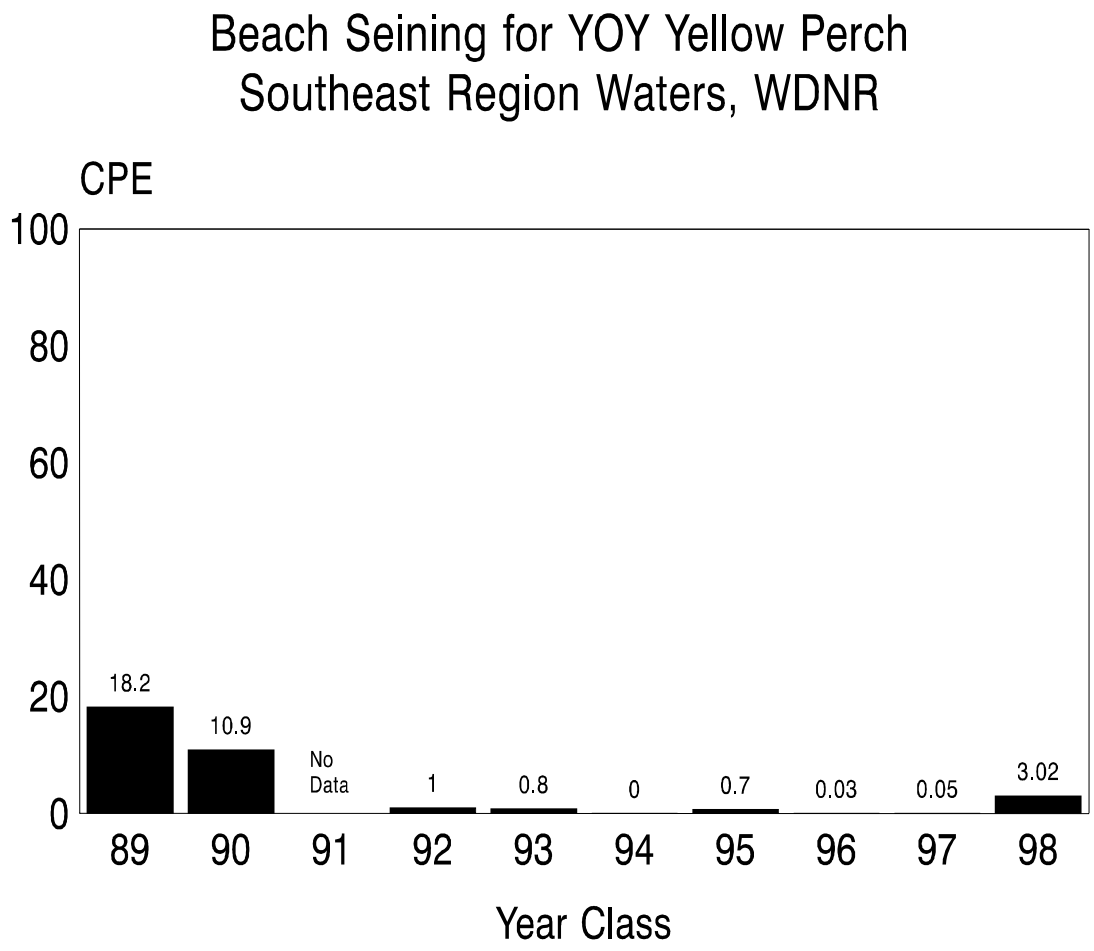


Figure 1. CPE (fish/100' seine haul) of YOY yellow perch caught in summer beach seining assessment.

SMELT WITHDRAWAL BY THE COMMERCIAL TRAWL FISHERY

Historically, commercial trawling has targeted three main species of fish in the Wisconsin waters of Lake Michigan. Much of the harvest was a mixed forage catch that included large numbers of 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. During 1991, additional rules regulating trawling in the waters of Lake Michigan and Green Bay were adopted. These rules were designed to maximize the harvest of rainbow smelt, and minimize the catch of alewife and bloater chub. The commercial rainbow smelt harvest was set at 2.358 million pounds, of which no more than 830,000 pounds could be caught in Green Bay. The regulations also restricted the areas, dates, and times fished, to establish a daylight, deep water (depths greater than 60 feet) Lake Michigan fishery from November 15 to April 20, and a nighttime, deep water (depths greater than 65 feet) Green Bay fishery from June 15 to September 30. These rules have been recently amended so that with the start of the 1998 summer season on Green Bay, trawlers will be able to fish four additional hours during daylight on Green Bay. Additionally during 1998, a new quota was established that reduced total harvest to 713,340 pounds, of which no more than 251,091 pounds could be harvested from Green Bay. The quota reduction reflected the percent decline in harvest from Lake Michigan and Green Bay as reported by trawlers since 1991.

By utilizing the required biweekly catch reporting forms, it can be determined that commercial smelt trawlers reported catching 397,471 pounds of rainbow smelt during 1998 (Figure 1). This was a decline of 17% from the 1997 harvest level. The 1998 harvest was the lowest reported harvest since 1984, and represented a 78% decline from the peak directed rainbow smelt harvest of 1,834,014 pounds caught in 1990.

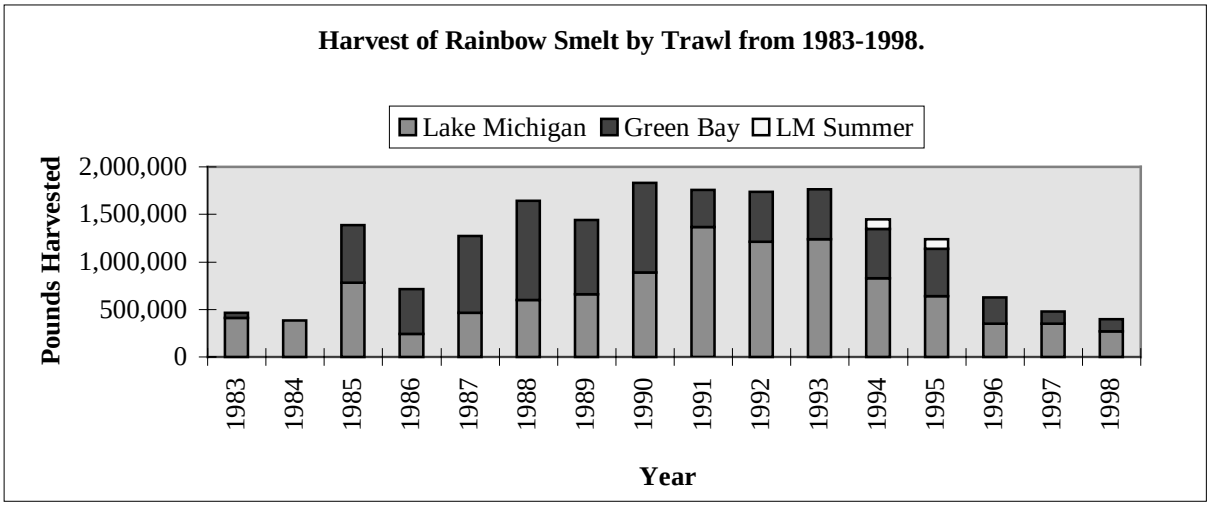


Figure 1. Reported rainbow smelt harvest by trawl from the Wisconsin waters of Lake Michigan for the years 1983 through 1998.

The Lake Michigan rainbow smelt harvest in 1998 was the lowest harvest since the inception of new regulations in 1991, and overall since 1986. The catch from Lake Michigan was 272,075 pounds with an average CPE of 161 pounds per hour trawled . This decline in harvest appears to be independent of the regulations imposed in 1991. CPE has shown a similar trend (Figure 2).

Commercial trawlers on Green Bay reported a catch of 125,396 pounds with a CPE of 94 pounds per hour trawled. Rainbow smelt harvest on Green Bay has declined to their lowest levels since the early 1980's. CPE on Green Bay which had remained stable through 1995, decreased markedly during the past three seasons (Figure 3). The decline of rainbow smelt harvest on Green Bay also appears to be independent of 1991 regulations.

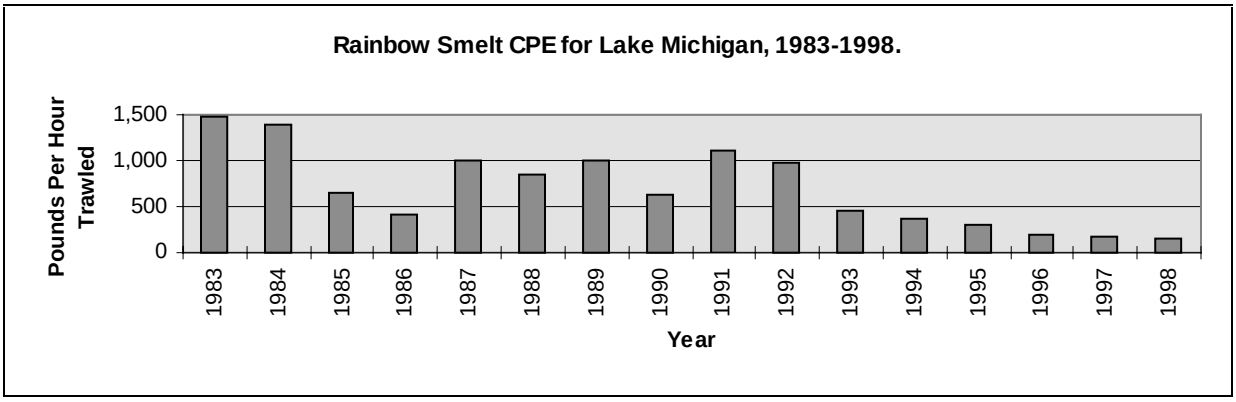


Figure 2. Rainbow smelt CPE in pounds per hour trawled on Lake Michigan during the years 1983 through 1998.

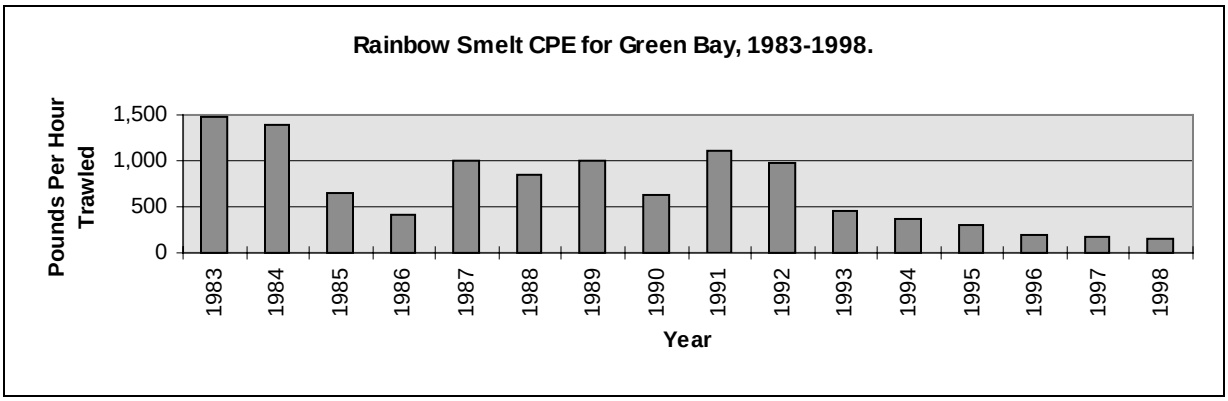


Figure 3. Rainbow smelt CPE in pounds per hour trawled on Green Bay during the years 1983 through 1998.

Declines in rainbow smelt harvested by trawlers on Lake Michigan and Green Bay and in lakewide abundance surveys conducted by the U.S.G.S. give a strong indication of an overall decline in rainbow smelt population in Lake Michigan.

Prepared by:
Steve Hogler and Steve Surendonk
Wisconsin Department of Natural Resources
2220 E. CTH V
Mishicot, WI 54228

A COMPARISON OF TWO METHODS OF REARING AND STOCKING COHO SALMON

Coho salmon (*Oncorhynchus kisutch*) have been stocked in Lake Michigan by the Wisconsin Department of Natural Resources since 1968 (Hansen et.al. 1990) using two stocking policies. Prior to 1984, Wisconsin's Lake Michigan coho salmon stocking program used only yearling coho salmon stocked at 14-16 months of age. This stocking program produced angler returns of 5.9% from 1968-1984 (Hansen et. al. 1990). In 1984 and from 1988 to 1993, Wisconsin began stocking accelerated-growth coho salmon. These fish were stocked as fall fingerlings at 9 months of age in October or November (Figure 1). The switch to accelerated-growth fall fingerlings was made to save on hatchery space and reduce rearing costs. However, the average angler return rate from 1992-1994 dropped to 4.0% (Eggold 1995).

Bilton and Jenkinson (1980a, 1980b) reported that accelerated-growth coho salmon were less expensive to raise but provided lower adult return rates than normal yearling coho salmon. However, Hemmingsen et. al. (1986), showed that accelerated growth coho salmon produced greater adult returns than yearlings.

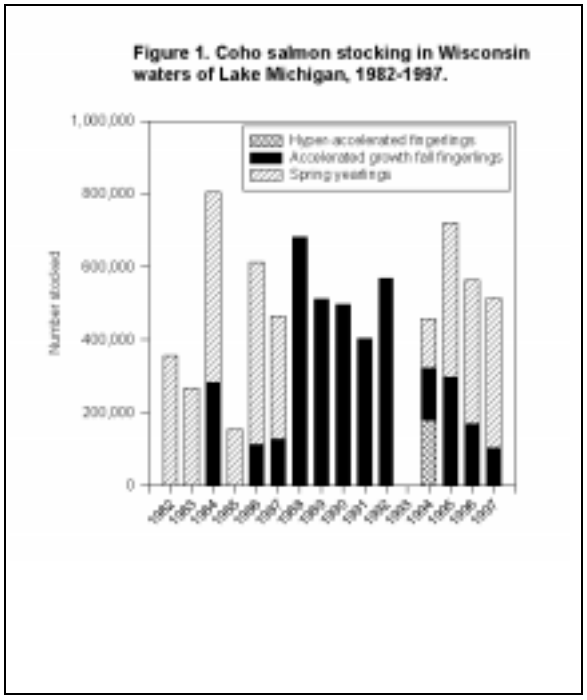


Figure 1. Coho salmon stocking in Wisconsin waters of Lake Michigan, 1982-1997.

Data from prior Wisconsin experiments were inconclusive, but suggested that accelerated-growth fall fingerling coho salmon were more likely to return to tributaries at age 1+ and less likely to contribute to the sport harvest as adults than coho salmon stocked as spring yearlings (Coshun, 1990).

The present study was designed to compare coho salmon stocked as accelerated-growth fall fingerlings at approximately 9 months old with coho salmon stocked as yearlings at approximately 15 months old (referred to as treatments hereafter). We attempted 1) to compare the return rates and percent returns for each treatment at weirs and in the sport fishery; 2) to compare the growth rates of fish in each treatment group; and 3) to evaluate the cost/benefit for each stocking regime.

Study design

The two methods of rearing and stocking coho salmon were compared in a three year study involving the 1994, 1995 and 1996 year classes (the year the eggs hatched). From each year class, 100,000 accelerated-growth fall fingerling (referred to as accelerated- growth hereafter) and 100,000 spring yearling coho salmon (referred to as normal hereafter) were used in the experiment. Equal numbers of fish were stocked in the Root and Kewaunee Rivers; each river received 50,000 accelerated-growth and 50,000 normal coho salmon annually. Each treatment was assigned a unique finclip (Table 1).

Results

Stocking for the three years of the study proceeded according to the study design (Table 1). Both the Root and Kewaunee River received about 50,000 accelerated-growth and 50,000 normal coho salmon, annually (Table 1). For all three year classes, normal yearlings were held in a pond or raceway for at least 5 months longer than accelerated-growth fish. Some loss occurred during this time that the WDNR did not supplement.

Prior to stocking, the lengths and weights recorded for the 1994 and 1995 year class of coho salmon stocked in the Kewaunee River were significantly smaller for accelerated-growth (LMLP and LMLV) than for normal (LMRP and LMLP) coho salmon (Mann- Whitney rank sum test, P <.0001)(Table 1). No lengths or weights were obtained from the 1996 year class of accelerated-growth coho salmon and therefore could not be compared to the normal coho salmon stocked into the Kewaunee River in that year (Table 1).

For the 1994 year class of coho salmon stocked as accelerated-growth and normal coho salmon into the Root River, lengths and weights were not signficantly different. For both the 1995 and 1996 year classes, lengths and weights for the Root River fish were significantly smaller for the accelerated-growth than for normal coho salmon (Mann-Whitney rank sum test, P <.0001) (Table 1).

In general, finclip retention was good. For 8 of the 9 finclips examined, 70% of the sample was rated as an excellent finclip. One treatment, Root River (RP) spring yearlings, had 58% of the sample rated as excellent finclips with 42% rated as bad finclips (Table 1).

1994 year class

Coho salmon returns to RRSF and BAFF in the fall of 1995 provided the first direct comparison of return rates of the treatment groups from the 1994 year class. At age 1+ (precocious males), accelerated- growth coho salmon returned at 0.88 (RMLP) and 0.12 (LMLP) percent to the Root and Kewaunee Rivers, respectively. Normal coho salmon returned at a rate of 0.41 (RMRP) and 0.56 (LMRP) percent to the Root and Kewaunee Rivers, respectively (Table 2).

The return of the 1994 year class as mature age 2+ adult coho salmon in the fall of 1996 showed that normal coho salmon returned at much higher rate than accelerated-growth fish (Table 2). Accelerated-growth coho salmon adults were recovered at a rate of 1.5% in the Root River and 1.01% in the Kewaunee River. Normal coho salmon adults returned at almost double these rates; 2.61% in the Root River and 2.04% in the Kewaunee River (Table 2).

The return rates for the 1994 year class of coho salmon to Wisconsin anglers mirrored the return to the weirs. Jack coho salmon (1+) returns were very low for both treatments (less than 2.0%). Adult return rates for normal coho salmon were double the return rate compared to accelerated-growth coho salmon (2.22% vs. 4.36% for Root River stocked fish and 1.17% vs. 3.15% for Kewaunee River stocked fish).

Adult coho salmon from the 1994 year class stocked as accelerated-growth fish were slightly longer and heavier than normal coho salmon at both the RRSF and BAFF. In the fall of 1996, age 2+ accelerated-growth male coho salmon averaged 21 mm and 14 mm longer and 0.3 kg and 0.3 kg heavier than normal male coho salmon at RRSF and BAFF, respectively. Likewise, age 2+ accelerated-growth female coho salmon were larger and heavier than normal coho salmon (14 mm and 4 mm longer, 0.2 kg and 0.1 kg heavier at RRSF and BAFF, respectively).

The Root River accelerated-growth coho salmon return ratio was very low at 1.70, as was the Kewaunee normal coho salmon return ratio of 3.66. Both the Kewaunee accelerated-growth and Root River normal coho salmon return ratios were higher at 8.42 and 6.37, respectively.

1995 year class

Accelerated-growth coho salmon returned to BAFF at 0.10 percent, while normal coho salmon returned at 0.09 percent (Table 2). Jack coho salmon returning in the fall of 1996 to the Root River had return rates much higher than those returning to the Kewaunee River. Accelerated-growth coho salmon returned at 0.70 percent while normal coho salmon returned at almost triple the rate, 2.09 percent (Table 2).

During the fall of 1997, adult 2+ coho salmon return rates were different not only between treatments but also between rivers. The return rates for both treatments in the Kewaunee River were very low, 0.60 percent (Table 2). Low water levels with little flow contributed to the reduced return of coho salmon to BAFF in 1997. The return rates of coho salmon to the Root River were much higher in 1997 that those at BAFF. Accelerated-growth coho salmon were recovered at a rate of 4.40 percent. This rate was much higher than the Kewaunee River accelerated-growth fish (0.60 percent). Normal coho salmon returned to the RRSF at 11.00 percent, 2.5 times the return rate of the accelerated-growth fish (Table 2).

The adult return rates for the 1995 year class of coho salmon stocked in the Root River to Wisconsin anglers were very similar to the weir return rates for the Root River stocked fish. Accelerated-growth adult 2+ coho salmon returned at 5.42 percent while normal 2+ fish returned at 15.56 percent, about a 2.8 times higher return rate. Kewaunee River coho salmon had much lower return rates of 1.58 percent for accelerated-growth fingerlings and 0.25 percent for normal yearlings.

Adult normal coho salmon from the 1995 year class were slightly bigger than accelerated-growth fingerlings. In the fall of 1997, age 2+ male normal coho salmon averaged 37 mm and 11 mm longer and 0.4 kg and 0.1 kg heavier than male accelerated-growth fish at RRSF and BAFF, respectively. Similarly, normal female coho salmon averaged 30 mm and 14 mm longer and 0.3 kg and 0.2 kg heavier than accelerated-growth coho salmon, RRSF and BAFF, respectively.

All four treatments from the 1995 year class had average return ratios. Kewaunee River accelerated-growth fish had return ratios of 6.00 while normal fish had a 6.66 return ratio. Root River accelerated-growth coho salmon exhibited a 6.29 return ration while normal fish had a 5.26 return ratio.

1996 year class

Coho salmon 1+ return rates in the fall of 1997 were very low for all treatments. The return rates for Kewaunee River stocked fish were 0.08 for accelerated-growth fish and 0.03 for normal fish (Table 2). Root River stocked fish had return rates for both treatments at 0.04 for accelerated-growth and 0.24 for normal fish (Table 2).

Summary

After three years of the study a few preliminary results are apparent. The stocking of hyper-accelerated coho salmon in 1994 performed poorly compared to both fall fingerling and spring yearling stocking methods. Return rates varied each year but never got higher than 0.590 percent much lower than other rearing methods (Table 2). After three complete year class return, preliminary evidence suggests that adult coho salmon stocked as spring yearlings returned at a much higher rate than adults stocked as fall fingerlings to both the Root and Kewaunee River facilities. This trend was apparent not only for returns to the facilities but also return to Wisconsin Fishermen.

Prepared by:

Brad Eggold
Wisconsin Department of Natural Resources
PO Box 408
Plymouth, WI 53073

Tables 1 and 2 follow……

Table 1. Summary of coho salmon stocked into the Root and Kewaunee Rivers by stocking location, finclip and treatment, 1994-1996. Biological data include average length and weight and sample size for finclip quality control. The study design called for 50,000 coho salmon each year, location and age. Finclips are abbreviated as follows: LM and RM, left and right maxillary bone; LP and RP, left and right prectoral fin; LV and RV, left and right ventral fin.

Year Class	Total Number	Stocking Location	Finclip	Age	Average Length (mm)	Average Weight (g)	Sample Size	Percent Excellent Clips	Percent Good Clips	Percent Bad Clips
1994	55,954	Root R.	RMLP	Accelerated-growth 0+	144.8	29.3				
	60,822	Kewaunee R.	LMLP	Accelerated-growth 0+	145.5	-	109	79	15	6
	65,100	Root R.	RMRP	Normal 1+	143.5	30.3				
	45,000	Kewaunee R.	LMRP	Normal 1+	164.5	42.8	300	81	-	19
1995	54,832	Root R.	RMLV	Accelerated-growth 0+	131.6	22.0	100	86	-	14
	54,808	Kewaunee R.	LMLV	Accelerated-growth 0+	130.2	23.5	87	86	3	11
	40,590	Root R.	RMRV	Normal 1+	159.0	40.1	152	91	-	9
	49,878	Kewaunee R.	LMRV	Normal 1+	156.6	37.4	223	85	-	15
1996	63,697	Root R.	LP	Accelerated-growth 0+	119.3	19.6	100	71	7	22
	66,486	Kewaunee R.	LM	Accelerated-growth 0+	122.0	17.7				
	48,107	Root R.	RP	Normal 1+	154.3	33.6	200	58	-	42
	62,886	Kewaunne R.	RM	Normal 1+	154.3	33.9	200	96	-	4

Table 2. Return rate of coho salmon (percent and number) by year class, treatment and age to the Root River Steelhead Facility and Besadny Anadromous Fisheries Facility. RR = Root River, KEW = Kewaunee River. See Table 1 for finclip descriptions.

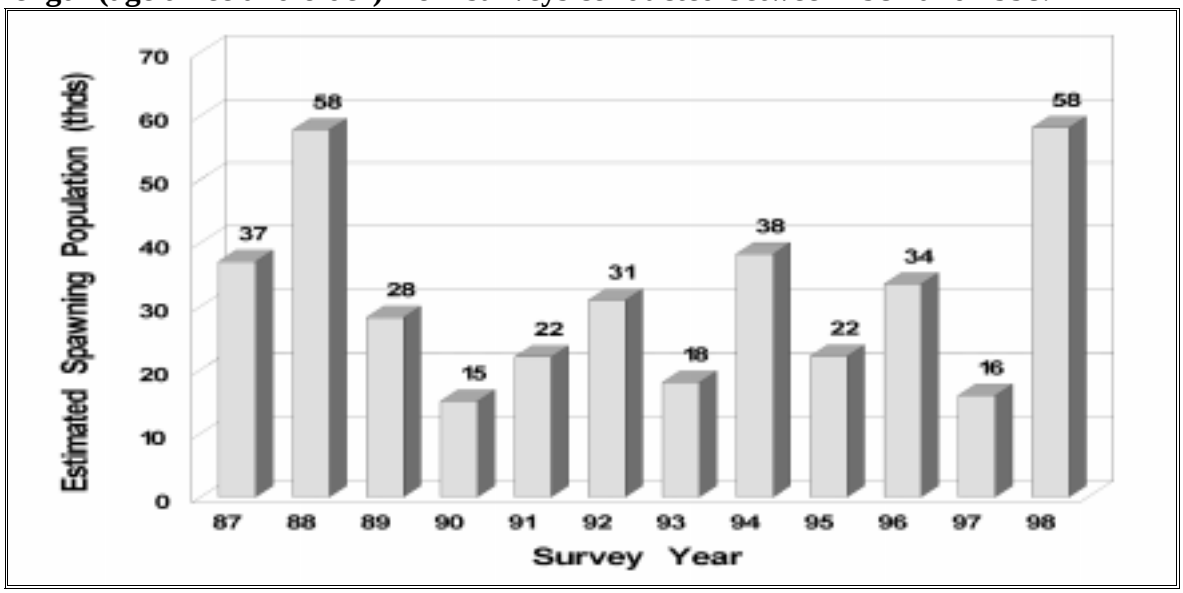
Year Class	Treatment	AGE AT RETURN (Percent) 1+	AGE AT RETURN (Percent) 2+	AGE AT RETURN (Numbers) 1+	AGE AT RETURN (Numbers) 2+
1994	Fall Fingerling (RMLP) RR	0.88	1.50	495	864
	Fall Fingerling (LMLP) KEW	0.12	1.01	73	614
	Spring Yearling (RMRP) RR	0.41	2.61	266	1,700
	Spring Yearling (LMRP) KEW	0.56	2.05	331	922
1995	Fall Fingerling (RMLV) RR	0.70	4.40	381	2,396
	Fall Fingerling (LMLV) KEW	0.10	0.60	55	329
	Spring Yearling (RMRV) RR	2.09	11.00	847	4,483
	Spring Yearling (LMRV KEW	0.09	0.60	44	303
1996	Fall Fingerling (LP) RR	0.04	0.92	23	583
	Fall Fingerling (LM) KEW	0.08	0.48	51	322
	Spring Yearling (RP) RR	0.24	3.17	117	1,526
	Spring Yearling (RM) KEW	0.03	0.38	16	240

STATUS OF WALLEYE STOCKS-GREEN BAY

Fox River

The estimated adult walleye spawning population (age 3 and older, greater than 370mm) in the Fox River reached the highest level in twelve years of surveys on the Fox River. An estimated 58,109 mature walleye (95% C.I. 47,773-70,655) utilized the river during the spring of 1998. This surpassed the previous high estimate of 57,807 adult walleye in 1988 (Figure 1.) and greatly surpassed the relatively low estimate of 15,994 in 1997. Although there has been considerable fluctuation in the size of spawning population, since reaching a low in 1990 of 15,102, one year after restrictive regulation were put in place (i.e. one fish bag, 28" minimum, March 1- first Saturday in May), there appears to be a trend toward higher abundance.

Figure 1. Spawning population estimates of adult walleye greater than 370mm in length (age three and older) from surveys conducted between 1987 and 1998.



Recruitment to the adult population was excellent from 1994-1996 the result of exceptionally strong 1991-1993 year classes (Figure 2.). Most recently the 1994 and 1995 year classes recruited poorly to the spawning population. Fall fingerling assessment had shown the 1995 year class as weak but the reason for the relatively strong 1994 year class showing poor survival to age three, as measured in these same surveys, is still unclear. (Figure 3.)

Females dominated the spawning population representing 68.4% of all walleye sampled. They were composed primarily of age four to age seven walleye (Table 1.). Ages five and six,

Table 1. Age Distribution of Spawning Walleye – Fox River 1998 (%)

Age	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+
Males	2.0	16.8	35.5	37.2	6.2	1.6	0.4	0.0	0.1	0.1		
Females		1.0	14.1	25.3	30.6	15.3	5.2	2.6	3.4	1.0	0.5	0.9

represented 59.6% of all females but the strong 1991 year class was evident by the presence of 15.3% age seven females.

Figure 2. Relative year class strength of Fox River walleye as measured by the estimated number of age three walleye recruited to the adult spawning population from surveys conducted in 1987-1998.

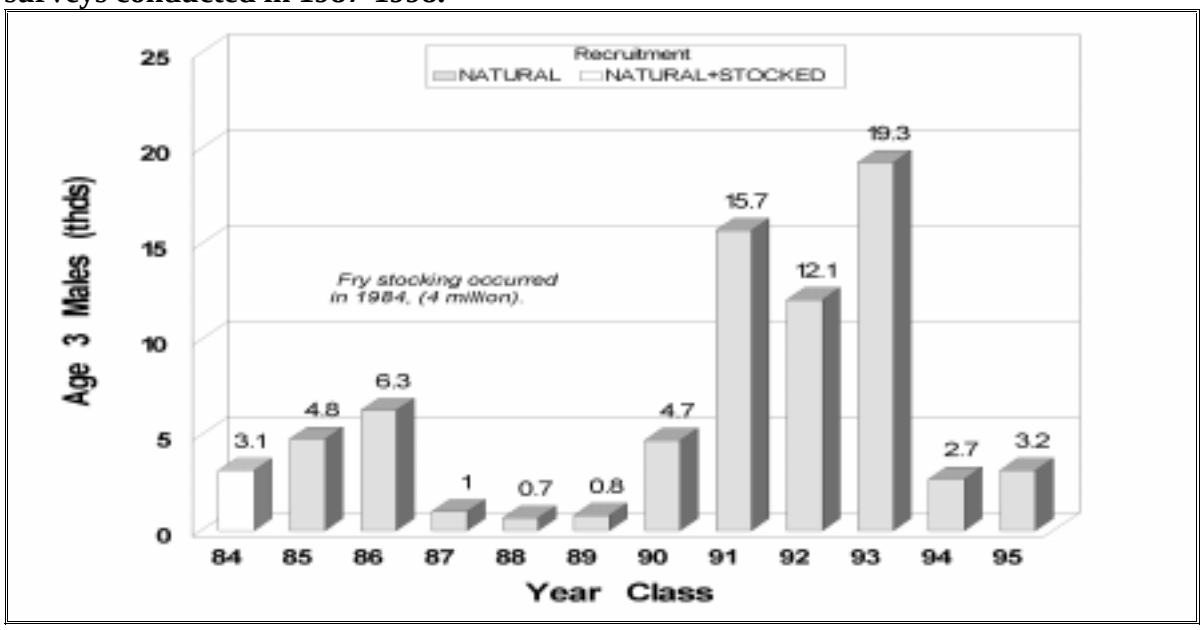
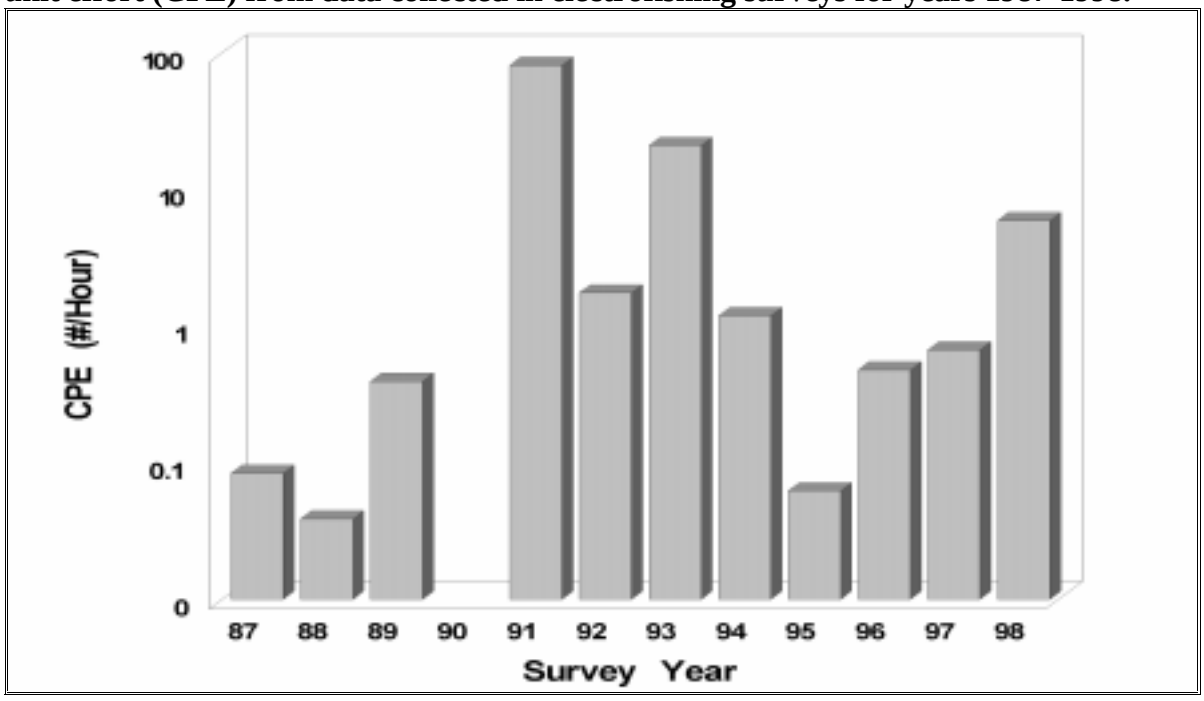


Figure 3. Relative abundance of YOY walleye in the Fox River as measure by catch per unit effort (CPE) from data collected in electrofishing surveys for years 1987-1998.



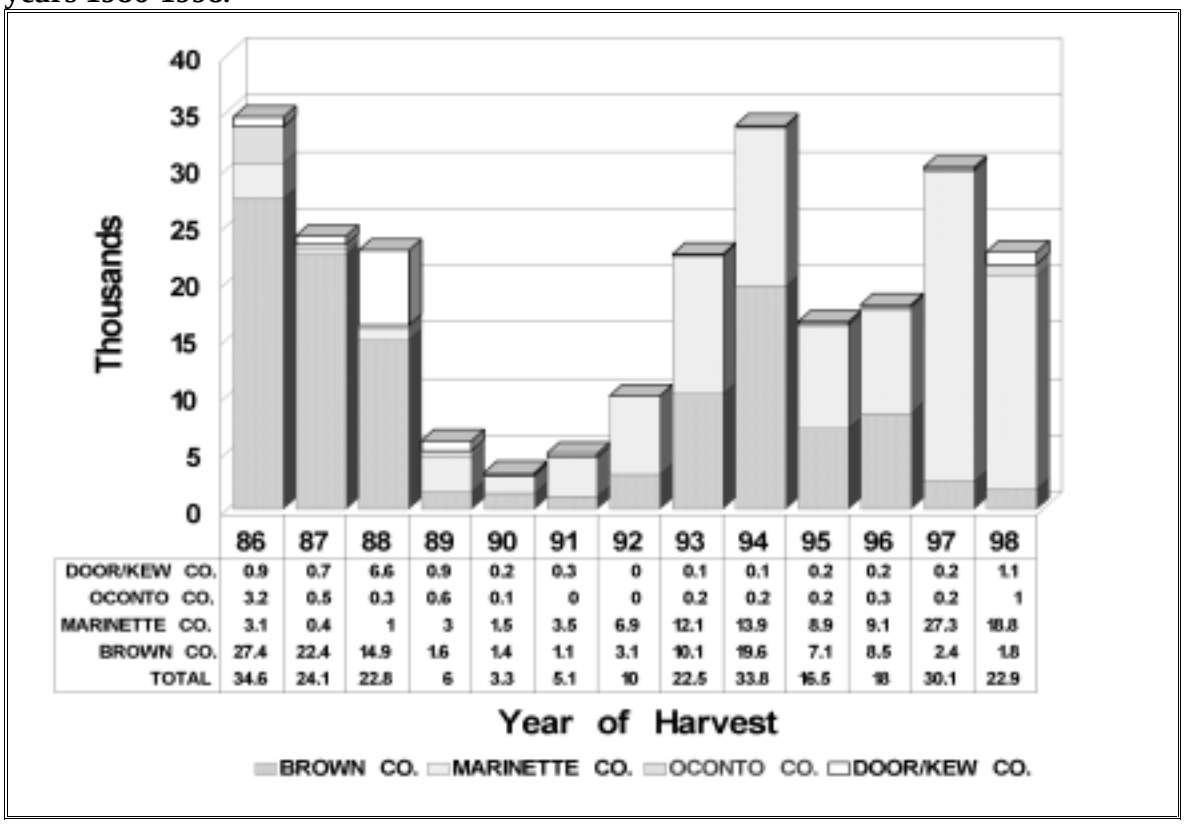
Males represented only 31.6% of all walleye captured as adults. Poor recruitment of three-year-old males accounted for the low abundance. The1995 year class contributed only 3,158 males to the spawning population. The dominant male age groups were ages four (35.5%) and five (37.2%).

Results of fall electrofishing surveys on the Fox River were encouraging. The catch per unit effort (CPE) of young-of -year walleye for 1998 was 5.9 YOY/hour (Figure 3.), the third highest in twelve survey years. The potential for good over winter survival of this year class is high because of the relatively large size of the fingerlings, averaging 239 mm. These were the largest fingerlings we have seen since the 1991 year class. If the 1996-1998 year classes survive to maturity proportional to their numbers as first season fall fingerlings, adult walleye abundance should continue its upward trend.

Catch and Harvest

The walleye harvest in Wisconsin's Green Bay waters approached 30,000 fish in 1998 (Figure 4). Over the past ten years Marinette and Brown counties have accounted for the majority of the harvest. This pattern continued in 1998 but both counties had reduced harvests. Marinette County, whose harvest primarily occurs in the Menominee River, dropped from 27,264 walleye to 18,750, a 31% reduction in harvest. Similarly, Brown County, primarily the Fox River, had a 26% reduction in harvest from 2,422 walleye to 1,784.

Figure 4. Total walleye harvest for Wisconsin waters of Green Bay by County for the years 1986-1998.



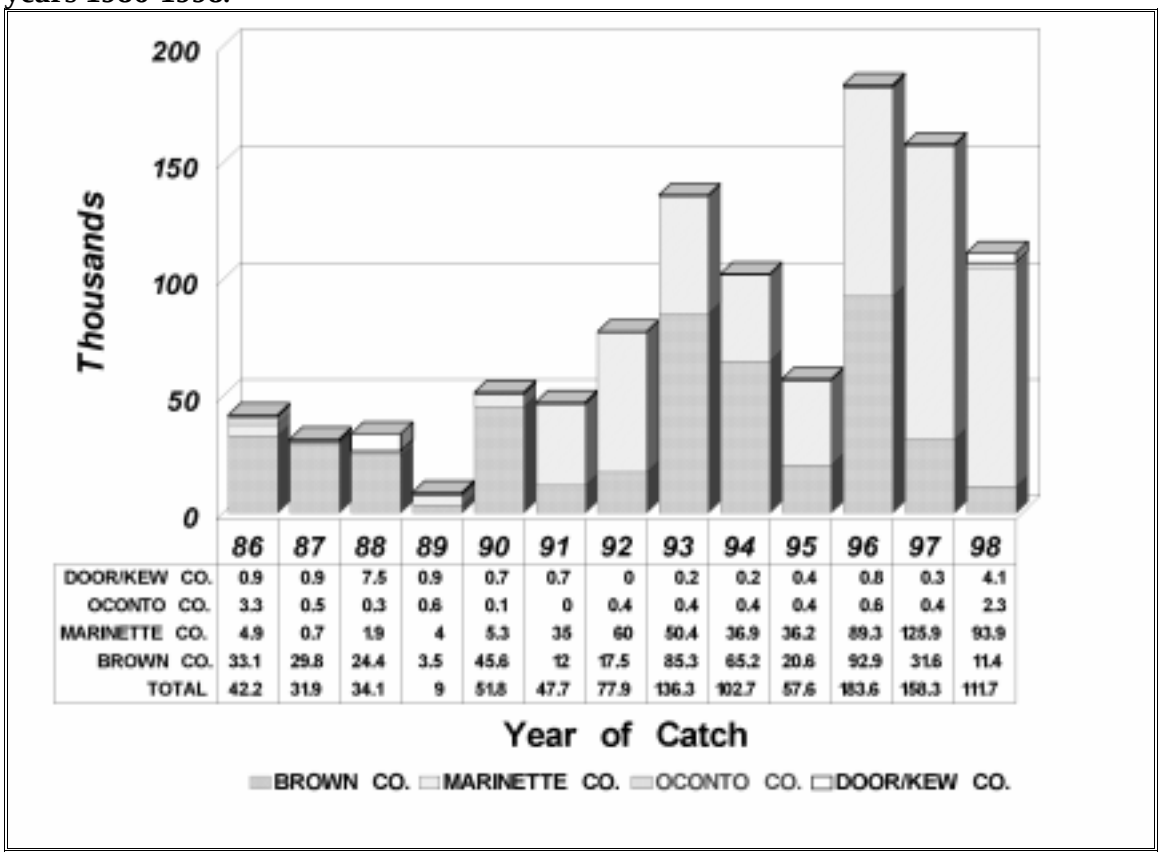
	86	87	88	89	90	91	92	93	94	95	96	97	98
DOOR/KEW CO.	0.9	0.7	6.6	0.9	0.2	0.3	0	0.1	0.1	0.2	0.2	0.2	1.1
OCONTO CO.	3.2	0.5	0.3	0.6	0.1	0	0	0.2	0.2	0.2	0.3	0.2	1
MARINETTE CO.	3.1	0.4	1	3	1.5	3.5	6.9	12.1	13.9	8.9	9.1	27.3	18.8
BROWN CO.	27.4	22.4	14.9	1.6	1.4	1.1	3.1	10.1	19.6	7.1	8.5	2.4	1.8
TOTAL	34.6	24.1	22.8	6	3.3	5.1	10	22.5	33.8	16.5	18	30.1	22.9

Both of these major walleye fisheries had reductions in catch as well (Figure 5). Marinette County catch was down 25% from 125,864 walleye to 93,871. Brown County dropped from 31,632 to 11,354 a 64% decline. Low numbers of young male walleye in the population may account for this reduction but directed fishing effort for walleye was also down in both counties. Marinette County effort was down 8% and Brown County was down 18%.

The greatest relative increase in both catch and harvest occurred in the Door/Kewaunee County area. Harvest increased to 1132 walleye from 217 and the catch increased considerably from 335 to 4147 walleye. Maintenance stocking of fingerling walleye in 1994 and 1996 most likely contributed to these increases.

Oconto County also showed significant increases in both catch and harvest. The catch increased from 443 walleye to 2284 and the harvest increased from 203 walleye to 1031.

Figure 5. Total walleye catch for Wisconsin waters of Green Bay by County for the years 1986-1998.



	86	87	88	89	90	91	92	93	94	95	96	97	98
DOOR/KEW CO.	0.9	0.9	7.5	0.9	0.7	0.7	0	0.2	0.2	0.4	0.8	0.3	4.1
OCONTO CO.	3.3	0.5	0.3	0.6	0.1	0	0.4	0.4	0.4	0.4	0.6	0.4	2.3
MARINETTE CO.	4.9	0.7	1.9	4	5.3	35	60	50.4	36.9	36.2	89.3	125.9	93.9
BROWN CO.	33.1	29.8	24.4	3.5	45.6	12	17.5	85.3	65.2	20.6	92.9	31.6	11.4
TOTAL	42.2	31.9	34.1	9	51.8	47.7	77.9	136.3	102.7	57.6	183.6	158.3	111.7

Prepared by:
Terry Lychwick and David Bougie
Wisconsin Department of Natural Resources
1125 N. Military Ave., P.O. Box 10448
Green Bay, WI 54307-0448