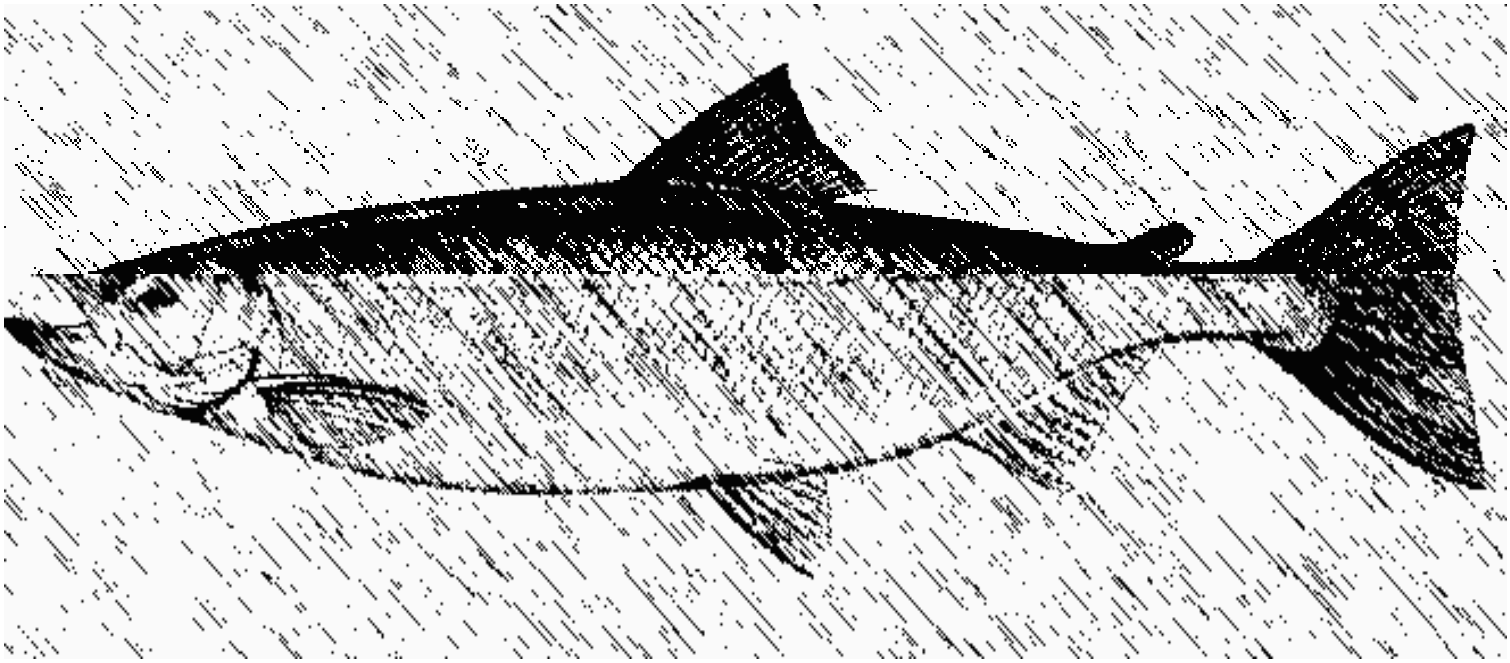
Wisconsin's 1999 open water sportfishing effort and harvest from Lake Michigan and Green Bay



Wisconsin Department of Natural Resources
Bureau of Fisheries Management and Habitat Protection

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Abstract - This paper documents the sport fishery in Wisconsin waters of Lake Michigan and Green Bay from March 1, 1999 through December 31,1999. Fishing effort, harvest and harvest rates were determined from 1) a stratified-random creel survey for launched-boat, pier, shore and stream anglers; 2) a randomized mail survey for moored-boat anglers; and 3) mandatory charter-boat reporting. Anglers spent an estimated 2,825,271 hours fishing on Lake Michigan and Green Bay during 1999 with boat-angler effort at 2,120,510 hours or 75% of the total hours. The estimated harvest of 710,582 fish was dominated by yellow perch (269,005), chinook salmon (157,934), rainbow trout (84,248) and coho salmon (56,297). The boat fishery, comprised of launched-boat, moored-boat and charter-boat anglers, dominated the fishery by harvesting an estimated 609,822 fish which was 86.0% of the total fish harvested and was dominated by yellow perch (243,447), chinook salmon (120,087), rainbow trout (77,328) and coho salmon (52,975). Pier, shore and stream anglers harvested primarily chinook salmon, yellow perch and brown trout. Overall harvest-rates were highest for yellow perch at 0.0952 fish/hour and chinook salmon at 0.0559 fish/hour.

Before the 1920s, fish biomass and abundance in Lake Michigan was dominated by lake whitefish (*Coregonus clupeaformis*), lake trout (*Salvelinus namaycush*), bloater chubs (*C. hoyi*), and yellow perch (*Perca flavescens*). During the 1920s to 1950s, the accidental introductions of several exotic species, including the rainbow smelt (*Osmerus mordax*), sea lamprey (*Petromyzon marinus*) and alewife (*Alosa pseudoharengus*), had a major impact on the fish populations in Lake Michigan. These exotic species, along with a deterioration of spawning habitat and increased commercial fishing pressure, were responsible for the decline of native fish populations (Hansen *et al.* 1990).

In response to the increasing alewife population and declining Lake Michigan fishery, the Wisconsin Department of Natural Resources (WDNR) in 1963 experimentally introduced 9,000 rainbow trout into several Door Co. tributaries with a twofold purpose: 1) to control or limit the abundant alewife population and 2) to provide a sport fishery. This initial stocking, and efforts by other states (see Keller et al. 1990) proved to be very successful and Wisconsin's Lake Michigan stocking program expanded to include trouts (*Salmo* spp.), chars (*Salvelinus* spp.) and other pacific salmon (*Oncorhynchus* spp.). The stocking of non-native salmonids provided a practical way to control the alewife population and a valuable sport fishery.

In order to manage the Lake Michigan sport fishery, assessments are conducted on both forage and predator-fish stocks. Since 1973, the US Fish and

Wildlife Service has conducted bottom-trawl surveys in Lake Michigan to estimate the abundance of forage fish. These trawl-estimates are based on a series of ten-minute tows along the contour of nine depths at each of seven index-stations (Eck 1992). Since 1969, WDNR has monitored the Lake Michigan sport fishery with a contact creel-survey. This provides a continuous record of harvest, harvest rates and biological data of the harvest.

This paper reports the results of the annual survey of anglers fishing the Wisconsin waters of Lake Michigan. Data were collected from anglers at ramps, piers, shores and streams and from moored-boat and charter-boat anglers. Estimates were then calculated for fishing effort, harvest and harvest rates for 1999.

STUDY AREA AND METHODS

Geographical Area

Wisconsin's share of Lake Michigan is second only to Michigan and encompasses 495 miles of shoreline and 25 tributaries (Figure 1). The Wisconsin waters of Lake Michigan include Green Bay and portions of distinct north and south lake basins. For a complete description see Eggold (1995).

Creel-Survey Design

The open-water creel survey was conducted using a modified access-point design called the Wisconsin Hybrid design. It differs from a true access-point design in that creel clerks visit several sites per site group. The fishing season for the open-water creel survey from March 15th to October 31st is stratified by statistical management unit (SMU) (i.e. counties), fishery types (i.e. ramp, pier, shore and stream), statistical survey periods (i.e. months or groups of months) and day type (i.e. weekday, weekend/holiday). Statistical management units were assigned based primarily on county lines and include units such as Kenosha, Racine, Milwaukee, etc. Survey sites within each SMU were placed into site groups. There may be one or several site groups in each SMU, depending on the time of year and SMU size. Site groups were selected randomly without replacement on a daily basis, and survey sites within a site group were visited randomly. Surveys were conducted on every weekend day and holiday and on either two or three days during the week, depending on the month. Each workday was comprised of two shifts, an AM and PM shift. Combined together, the two shifts covered the entire angling day. The clerk worked one shift per workday. The shifts were equal in duration, did not overlap and were sampled with equal probability. An example is shown below.

EXAMPLE:

Statistical Management Unit	MILWAUKEE	
Site Groups	MILW. SOUTH	MILW. NORTH
SurveySites	S. Shore Ramps	McKinley Ramps
	S. Shore Pier	McKinley Pier
	Oak Creek	Milwaukee River
	Grant Park	Riverfront Ramp
	S. Metro Pier	N. City Shoreline

Three types of data were collected for each site sampled: counts of anglers, boat trailers or cars for effort, interviews of anglers or parties for harvest rates and biological data on harvested fish.

Instantaneous counts were made by creel clerks at all sites in the survey. The type of count was dependent on the type of fishery. At most ramp sites, boat trailers were counted. At most pier, shore and stream sites, anglers were counted. However, due to poor access points on some tributaries, car counts were used. Car and trailer counts were corrected by the average number of anglers per car or boat from interview data. The time the count was completed and count per site were recorded on the activity count form.

Angler parties were interviewed at the completion of their fishing trips. Anglers were asked if they were state residents, what time they started their fishing trip, what they fished for and the number of caught and harvested fish. These data were recorded on the angler interview form (Figure 2). Biological information such as species, length, weight, fin clip and tag numbers were collected on harvested fish (Figure 3). Standard-weight calculations follow Hansen (1986).

Fishing-effort calculations. Fishing-effort estimates (expressed in angler hours) were derived from instantaneous counts of anglers at pier, breakwater,

shore and stream sites and from counts of boat trailers at boat ramps and from counts of cars at stream sites. Counts were made at randomly computed times at each site during each visit. We estimated angler effort and its variance within each stratum (SMU, fishery type, month and day type). The variance of angler effort includes variability among days and variability within days. Formulas for two-stage surveys were used to calculate variance. For a complete description see Eggold (1995).

Harvest and harvest-rate calculations. Harvest estimates were derived from interviews of anglers at all sites. The number of fish harvested and the hours fished from each interview were summed over all interviews in a stratum. The ratio of the two sums and the variance of the ratio were then calculated. The ratio was expanded by effort and summed across day types to estimate harvest. The harvest rate was obtained by dividing harvest by effort. For a detailed description see Eggold (1995).

Moored-Boat Survey Design

Anglers who moored their boat on Lake Michigan (including Green Bay) were surveyed by questionnaire beginning in 1988. The earlier surveys (1982-1985) were based on voluntary information from moored-boat owners who received their survey form from sport-fishing clubs. However, during 1988, creel clerks were asked to compile a list of boat registration numbers from boats moored on Lake Michigan during a day of bad weather. These numbers were used to develop a list of boat owners from the Wisconsin Department of Natural Resources master file of registered boats. Beginning in 1988, a mail survey was sent to all moored-boat owners to obtain information on 1) whether they moored their boat on Lake Michigan; 2) the port of call; 3) whether the boat was used for fishing during that week; 4) the number of days fished; 5) number of anglers in the fishing party; 6) number of hours fished; and 7) the number of each species caught on each day during the past seven-day period.

Fishing effort and harvest calculations. Fishing effort was calculated by harbor and month for each month of the survey. Party size and number of hours fished on each trip were multiplied, summed for each month and harbor, and divided by the number of responses received for the month. This total was multiplied by the boat count and the number of days in the month to obtain estimated angler-hours for the entire moored-boat population. Harvest estimates were calculated by harbor and month for each species based on harvest per boat. The harvest data were expanded similarly to effort estimates.

Harvest-rate calculations. Harvest rate, the number of fish harvested per angler hour, was obtained by dividing the reported harvest of each species by fishing effort.

This type of survey is biased because interested and successful anglers tend to return the survey at a higher rate than other moored-boat owners. Therefore, estimated harvest will tend to be an overestimate of actual harvest but should be comparable among years and locations. For a detailed description of the calculations and formulas see Eggold (1993).

Charter-Boat Census Design

At the beginning of the fishing season, a packet of information was sent to each licensee. This packet included instructions on how to properly report chartered trips, a sample of a completed monthly report, grid map of Lake Michigan, list of wardens, coded-wire tag collection stations, fin-clip list, sea lamprey information and a supply of monthly-report forms.

Each license holder was required by law to report all paid charters. The report for each calendar month was due by the 10th of the following month to the WDNR Plymouth Field Station. If a report was late or incorrectly filled out a warning letter was sent. Subsequent violations were referred directly to a Wisconsin Conservation Warden.

The information obtained from each trip included: license number, fishing port, date of fishing trip, grid fished, number of resident and nonresident anglers, number of fish harvested, time trip started (am, pm, evening), number of lines fished and number of hours fished. This information had to be recorded

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within half an hour after completing each trip and returning to the dock or shore. The number of lake trout, coho salmon, brown trout, steelhead, chinook salmon and other species harvested, any tag numbers and the number of lampreys attached to chinook salmon and lake trout had to be recorded prior to midnight of the day of each trip. The data were received at the Plymouth Field Station, entered and checked for errors.

RESULTS

Fishing effort in Wisconsin waters of Lake Michigan and Green Bay was estimated at 2,825,271 (± 49,492) hours during the 1999 open-water season of March 1 - December 31 (Table 1). Angler hours decreased slightly from 1998 (2,870,450) and were below the ten-year average (3,246,840) Figure 4). Green Bay anglers had the most fishing effort of any SMU, at 856,591 (± 29,469) hours or 30% of all angler hours for 1999. Kewaunee Co. anglers came in second at 355,612 (± 19,833) hours.

Angler hours were disproportionately spread among the four fishery types. Boat anglers spent 2,120,510 (± 45,615) hours or 75% of all angler hours fishing on Lake Michigan or Green Bay (Table 5). Stream anglers fished the second most at 381,994 (± 17,172) hours or 13% of the total (Table 8). Shore and pier anglers fished 199,410 (± 6,833) and 123,357 (± 5,211) hours respectively (Tables 6-7).

Fishermen harvested an estimated 376,059 (± 9,193) salmonids during the 1999 season (Table 2). Chinook salmon were the most-numerous salmonid species harvested in all years since 1988 except 1993 and 1994 (rainbow trout dominated) and 1997 (coho salmon). Chinook salmon dominated the 1999 salmonid harvest, comprising 157,934 (± 5,740) fish or 42% of the total. Rainbow trout harvest was second to chinook, with 84,248 (± 4,362) fish or 22% of the total. Coho salmon harvest was 56,297 (± 2,929), similar to 1998, and 16% of the total. Lake trout declined to 11% of the harvest at 39,819 (± 2,168), followed by brown trout at 37,187 (± 4,362), 10% of the total, and brook trout at 574 (± 472).

The combined harvest-rate for salmonids of 0.1331 was the lowest since 1994, but similar to the ten-year average of 0.1284. Low catches during early summer of 1999 were partially offset by excellent catches after mid-July (Table 4). The reduced harvest-rate was due to below-average harvest of lake trout (- 35%), coho salmon (- 29%), brown trout (-21%) and rainbow trout (- 7%) (Table 2, Figure 5). This was despite similar fishing effort to recent years and chinook salmon harvest 20% above the ten-year average.

Anglers harvested an estimated 269,005 (± 22,432) yellow perch during 1999 (Table 3, Figure 6). Anglers harvested 235,400 (± 22,037) yellow perch in Green Bay with a harvest rate of 0.2748 fish/hour. Lake Michigan anglers harvested 33,605 (± 4,186) yellow perch and had a harvest rate of 0.0171 fish/hour (Table 3, Figure 6). Yellow perch comprised the majority of the harvest from all areas combined with an overall harvest-rate of 0.0952 fish/hour (Table 4). Yellow perch were the most numerous species harvested for the boat, pier and shore fisheries, although the majority of the harvest (90.5%) was from boats (Table 5). Yellow perch harvest-rates were highest for the boat fishery at 0.1148 fish/hour followed by the shore fishery at 0.0652. The majority of the harvest took place in the summer months from June through September.

The harvest of perch during 1999 was slightly higher than 1997 and 1998, but considerably (82%) below the 1992-1995 average of 1,496,923. Recent management actions to protect the dwindling yellow perch population include: 1) closure of the Lake Michigan commercial season for yellow perch; 2) a drop in the sport bag to five per day with a June closure on Lake Michigan; and 3) a reduction in the commercial quota for yellow perch in Green Bay. These measures are intended to protect the remaining yellow perch stocks. They also account for some of the decreased harvest of yellow perch during recent years.

The total harvest of 13 major species was 710,582 (± 25,850) fish for 1999 (Table 4). The majority of the harvest came from boat anglers (Table 5) who harvested 609,822 (± 24,266) fish or 85.8% of the total. Pier, shore and stream anglers accounted for 12,438 (± 1,467), 26,006 (± 1,891) and 62,316 (± 8,581) fish respectively or 1.7%, 3.7% and 8.8% of the total (Tables 6-8).

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Coho salmon size during 1999 was the largest observed during the past 10 years (Table 9), but harvest decreased to 56,297 (± 2,929) fish, the lowest harvest since 1991 and 29% below the ten-year average (Table 2). Overall coho salmon harvest-rates were 0.0199. Boat anglers harvested 94% of all coho salmon (52,975) and enjoyed harvest rates of 0.0250 fish/hour (Table 5). The remaining harvest was divided among the pier, shore and stream anglers at 31, 869 and 2,422 fish, respectively (Tables 6-8). Biological data collected on coho salmon show a mean weight of 7.1 (± 3.7) pounds, 74% above the ten-year average (Table 9). Mean length was 25.1 (± 5.1) inches, while standard weight of a 22-inch coho was 4.2 pounds, 11% above the ten-year average (Table 9). All three parameters increased dramatically for 1999, and exceed values reported by Hansen (1986).

Anglers harvested 157,934 (± 5,740) chinook salmon during 1999, up 15% from 1998 and 20% above the ten-year average of 131,199 (Table 2). The overall harvest-rate was 0.0559. Boat anglers harvested 120,087 (± 4,711) fish or 76% of all chinook salmon harvested (Table 5). Boat-angler harvest rates were 0.0566. Stream anglers saw an excellent chinook harvest during 1999, with a harvest rate (0.0809) that exceeded the boat harvest-rate by 43% (Table 8). Chinook salmon were the most abundant species harvested by stream anglers, at 30,903 (± 3,188), in spite of the fact that the harvest occurred almost exclusively during September and October (Table 8). The average weight and length for chinook salmon were the highest observed over the previous ten years, at 12.5 (± 6.1) pounds and 31.1 (± 5.7) inches, but the standard weight was similar to previous observations at 9.9 pounds for a 30-inch chinook (Table 9). Thus, chinook harvested during 1999 tended to be longer and heavier than previous years, but this may be explained by the large harvest of spawning-run fish during September and October by stream anglers. Unlike coho, chinook of a given length were not heavier than similar-length chinook from previous years.

Rainbow trout was the second-most abundant salmonid and third-most abundant species harvested during 1999 at 84,248 (± 4,362) fish (Table 4). Rainbow trout harvest-rates were the second highest among all salmonids at 0.0298 fish/hour. The majority (85%) of the harvest occurred in the boat fishery with 77,328 (± 4,199) fish (Table 5). Stream anglers harvested 6,162 (± 1,171) steelhead with a harvest rate of 0.0161 fish/hour (Table 8). Similar to coho, rainbow trout were large during 1999. Rainbow trout averaged 7.2 (± 3.3) pounds and 25.9 (± 5.2) inches with a standard weight of a 22-inch rainbow equal to 4.0 pounds, the highest standard weight observed over the ten-year period (Table 9).

Anglers in Wisconsin harvested 39,819 (± 2,168) lake trout in Lake Michigan and Green Bay, 35% below the ten-year average of 61,501. This was the smallest harvest since 1996, following a near-record harvest during 1998. The overall harvest-rate was 0.0141 fish/hour (Table 4). Boat anglers harvested all but 22 lake trout (reported from the stream harvest), with 39,797 (± 2,168). Boat harvest-rates were 0.0188 fish/hour (Table 5). Lake trout size was calculated at 9.2 (± 3.9) pounds and 28.0 (± 3.8) inches with a standard weight of 6.1 pounds for a 25-inch lake trout, the second-highest standard weight of the 10-year period (Table 9).

An estimated 37,187 (± 4,362) brown trout were harvested during 1999 from all surveyed areas, with an overall harvest-rate of 0.0132 fish/hour (Table 4). This reflects an increase over 1998, but is still 21% below the ten-year average. Brown trout harvest by boat anglers was 25,392 (± 4,112) fish or only 68% of the total (Table 5). Pier anglers harvested 2,166 (± 874) brown trout and had harvest rates of 0.0176 fish/hour (Table 6). This total was the highest of any species except yellow perch and comprised 36% of the non-yellow perch pier harvest. Likewise, brown trout harvest by shore anglers was second only to yellow perch at 6,531 (± 738) brown trout or 50% of the non-yellow perch shore harvest (Table 7). Shore harvest-rates were 0.0328 fish/hour. Brown trout biological data for 1999 showed a mean size of 6.1 (± 3.5) pounds, 22.2 (± 4.5) inches and 3.9 pounds standard weight for a 20-inch fish (Table 9).

Smallmouth bass were numerous in the harvest, totaling 26,308 (± 3,231) fish (Table 4). Overall harvest-rates were 0.0093 fish/hour. Again, boat anglers harvested the majority of the smallmouth bass, harvesting 25,404 (± 3,221) fish or 97% of the total (Table 5). Boat harvest-rates were slightly higher (0.0120) than the overall harvest-rate.

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White perch were also present in the harvest at 11,135 (± 7,643). Overall harvest-rates were fairly low at 0.0039 fish/hour (Table 4). The majority (81%) of the harvest occurred in the stream fishery with 8,997 (± 7,594) fish. The mouths of several tributaries to Green Bay provided good catches of white perch. Stream harvest-rates were 0.0236 fish/hour, exceeded only by chinook salmon. The boat harvest (2,116 fish) accounted for most of the remainder.

Walleyes were the last species harvested in large numbers during the open-water fishing season. An estimated 21,659 (± 3,139) walleyes were harvested (Table 4). This represents an increase over 1996 (18,468) but a drop from 1997 (31,049). Like smallmouth bass, walleye harvest-rates were lower than most salmonids at 0.0077 fish/hour. Boat anglers harvested 17,606 (± 3,043) walleyes (Table 5) while stream anglers harvested 3,551 (± 749) (Table 8).

The remaining species, brook trout, splake and northern pike, comprised only 1% of the total harvest and 1.6% of the non-yellow perch harvest (Table 4).

SUMMARY

Lake Michigan anglers spent an estimated 2,825,271 hours fishing on Lake Michigan and Green Bay with boat-angler effort of 2,120,510 hours or 75% of total hours. The estimated harvest of 710,582 fish was dominated by yellow perch (269,005) and to a lessor degree by chinook salmon (157,934) and rainbow trout (84,248).

The salmonid fishery was extremely poor during early summer, 1999. Inconsistent wind patterns during this period may have prevented the buildup of normal thermal-patterns and caused trout and salmon to disperse widely. The poor early-summer fishing was partially offset by high harvest-rates later in the season, particularly for chinook salmon, but the salmonid harvest decreased from 416,521 fish during 1998 to 376,059 during 1999. The fish that were harvested averaged larger than usual. Length and weight of salmonids measured in the creel averaged higher than most of the previous ten years (Table 9). Standard weights of coho salmon and rainbow trout were the highest recorded in the last ten years, and the other three major species were above average.

The 1999 harvest of 269,005 yellow perch was up slightly from 1997 and 1998. However, yellow perch harvest remained well below the annual harvests of one to two million perch observed prior to 1996. Declining populations of yellow perch in Lake Michigan and Green Bay account for the large decreases in perch harvest. Tighter restrictions on angler bag-limits to allow perch stocks a chance to rebuild have also reduced the angler harvest.

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Table 1. Estimated angler effort (hours) by location in Wisconsin waters of Lake Michigan and Green Bay during March through December of 1990 through 1999. Standard deviations are in brackets.

Location	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Kenosha Co.	178,036	184,570	196,298	195,609	189,877	164,111	157,607	188,561	174,437	183,774	181,288
	[10,685]	[10,815]	[10,102]	[9,665]	[8,195]	[9,934]	[6,705]	[8,937]	[8,351]	[11,478]	[9,585]
Racine Co.	295,553	332,412	411,704	327,379	315,927	335,535	238,052	302,364	232,660	260,600	305,219
	[20,111]	[20,585]	[21,114]	[19,740]	[13,911]	[18,995]	[13,846]	[15,472]	[15,844]	[15,917]	[17,758]
Milwaukee Co.	441,728	465,734	491,750	368,467	404,704	343,545	280,704	283,356	295,991	244,605	362,058
	[16,495]	[19,160]	[19,696]	[13,736]	[14,303]	[12,115]	[9,625]	[10,492]	[9,162]	[8,620]	[13,886]
Ozaukee Co.	226,882	175,813	211,667	139,075	206,470	232,899	242,963	229,387	244,186	233,549	214,289
	[12,032]	[9,630]	[11,331]	[8,437]	[11,873]	[16,115]	[11,915]	[12,796]	[13,831]	[14,891]	[12,476]
Sheboygan Co.	240,318	191,250	211,947	152,770	244,500	249,426	262,948	216,834	219,642	244,929	223,456
	[11,690]	[10,632]	[11,732]	[8,747]	[13,999]	[16,183]	[14,697]	[13,730]	[12,123]	[14,004]	[12,920]
Manitowoc Co.	296,175	260,313	303,214	298,533	266,866	235,990	204,487	227,955	196,492	204,714	249,474
	[12,231]	[12,589]	[15,706]	[15,475]	[11,121]	[9,038]	[9,673]	[11,713]	[9,398]	[11,257]	[12,022]
Kewaunee Co.	279,385	328,171	295,724	342,852	338,864	329,637	334,736	327,253	342,260	355,612	327,449
	[15,959]	[21,383]	[13,318]	[17,627]	[18,617]	[16,500]	[23,955]	[19,421]	[28,589]	[19,833]	[19,951]
E. Door Co.	406,998	344,292	390,178	310,454	331,851	304,201	278,601	205,964	259,020	240,897	307,246
	[25,043]	[16,485]	[38,245]	[16,293]	[19,768]	[17,298]	[15,113]	[16,043]	[12,907]	[13,553]	[20,379]
Green Bay	1,245,291	1,324,911	1,188,588	1,112,877	1,191,252	1,078,522	972,938	886,873	905,762	856,591	1,076,361
	[39,981]	[40,786]	[38,041]	[39,002]	[34,804]	[32,379]	[34,570]	[35,678]	[35,986]	[29,469]	[36,223]
Total Effort	3,610,365	3,607,466	3,701,072	3,248,017	3,490,310	3,273,866	2,973,036	2,868,547	2,870,450	2,825,271	3,246,840
	[60,844]	[60,536]	[67,348]	[56,181]	[53,615]	[53,193]	[52,708]	[53,164]	[55,770]	[49,492]	[56,504]

Table 2. Estimated harvest and total harvest rate (number per hour, all anglers combined) of salmonids in Wisconsin waters of Lake Michigan and Green Bay during March through December of 1990 through 1999. Standard deviations are in brackets.

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Coho Salmon	64,085	44,195	70,876	74,304	110,001	65,647	104,715	138,423	59,203	56,297	78,775
	[3,002]	[2,435]	[3,890]	[4,151]	[5,857]	[3,107]	[4,546]	[6,039]	[2,706]	[2,929]	[4,053]
Chinook Salmon	111,342	139,081	103,568	87,366	99,754	162,888	183,254	130,152	136,653	157,934	131,199
	[4,399]	[5,318]	[6,571]	[3,707]	[4,424]	[5,953]	[7,746]	[5,050]	[4,702]	[5,740]	[5,478]
Rainbow Trout	51,708	67,878	79,525	104,765	114,774	117,508	77,099	94,470	110,888	84,248	90,286
	[2,996]	[3,408]	[6,029]	[3,998]	[4,455]	[4,416]	[4,192]	[4,436]	[4,268]	[4,362]	[4,322]
Brown Trout	45,094	59,164	51,554	64,546	52,398	49,654	38,093	43,224	27,371	37,187	46,829
	[3,605]	[4,182]	[2,794]	[3,735]	[2,695]	[2,630]	[2,160]	[3,411]	[2,062]	[4,362]	[3,256]
Brook Trout	5,928	1,661	4,432	1,967	7,482	1,914	419	299	159	574	2,484
	[616]	[397]	[458]	[311]	[797]	[332]	[112]	[76]	[40]	[472]	[428]
Lake Trout	75,180	85,842	52,854	60,943	53,989	69,332	36,849	57,954	82,247	39,819	61,501
	[3,067]	[3,279]	[2,504]	[2,776]	[2,337]	[2,797]	[1,806]	[2,371]	[3,624]	[2,168]	[2,723]
Total Harvest	353,338	397,821	362,809	393,891	438,397	466,943	440,429	464,522	416,521	376,059	411,073
	[7,753]	[8,615]	[10,438]	[8,290]	[9,332]	[8,913]	[10,304]	[9,945]	[8,064]	[9,193]	[9,128]
Harvest Rate	0.0979	0.1103	0.098	0.1213	0.1256	0.1426	0.1481	0.1619	0.1451	0.1331	0.1284

Table 3. Estimated harvest and total harvest rate (number per hour, all anglers combined) of yellow perch in Wisconsin waters of Lake Michigan and Green Bay during March through December of 1992 through 1999. Standard deviations are in brackets.

Location		1992	1993	1994	1995	1996	1997	1998	1999	Average
Green Bay	Harvest	1,275,392	775,117	1,091,837	802,668	429,466	204,267	219,366	235,400	629,189
	[stan dev]	[83,981]	[67,693]	[69,029]	[57,516]	[34,274]	[16,429]	[20,528]	[22,037]	[51,952]
	Harvest Rate	1.073	0.6965	0.9165	0.7442	0.4414	0.2303	0.2422	0.2748	0.5774
Lake Michigan	Harvest	959,925	545,901	289,905	246,945	95,100	31,146	37,831	33,605	280,045
	[stan dev]	[43,456]	[30,016]	[18,389]	[20,677]	[14,985]	[4,103]	[3,527]	[4,186]	[23,169]
	Harvest Rate	0.3821	0.2557	0.1261	0.1125	0.0475	0.0157	0.0193	0.0171	0.1220
Total Harvest		2,235,317	1,321,018	1,381,742	1,049,613	524,566	235,413	257,197	269,005	909,234
		[94,558]	[74,049]	[71,436]	[61,119]	[37,407]	[16,934]	[20,829]	[22,432]	[56,884]
Harvest Rate		0.604	0.4067	0.3959	0.3206	0.1764	0.0821	0.0896	0.0952	0.2713

Table 4. Estimated harvest rate (harvest per hour), harvest and effort for all survey areas and all fishery types for Wisconsin waters of Lake Michigan and Green Bay during 1999. Standard deviations are in brackets.

Species	Harvest per Hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho Salmon	0.0199	45	6,637	14,140	10,441	16,041	8,846	147	56,297
		[22]	[1,221]	[1,344]	[1,844]	[1,087]	[836]	[24]	[2,929]
Chinook Salmon	0.0559	0	336	4,616	47,411	40,202	64,794	575	157,934
		[0]	[123]	[511]	[3,035]	[2,002]	[4,410]	[17]	[5,740]
Rainbow Trout	0.0298	5,115	1,044	5,965	7,550	38,336	26,130	108	84,248
		[1,051]	[222]	[945]	[920]	[2,907]	[2,772]	[12]	[4,362]
Brown Trout	0.0132	10,299	581	2,960	5,703	8,359	8,961	324	37,187
		[2,914]	[176]	[1,220]	[885]	[2,685]	[1,011]	[38]	[4,362]
Brook Trout	0.0002	541	0	1	0	21	2	9	574
		[472]	[0]	[0]	[0]	[0]	[0]	[7]	[472]
Lake Trout	0.0141	94	5,073	7,385	14,436	8,698	4,034	99	39,819
		[59]	[913]	[690]	[1,449]	[905]	[683]	[0]	[2,168]
Splake	0.0004	979	74	39	0	0	0	0	1,092
		[361]	[60]	[47]	[0]	[0]	[0]	[0]	[369]
Northern Pike	0.0019	1,027	645	0	635	955	2,062	0	5,324
		[391]	[345]	[0]	[629]	[318]	[946]	[0]	[1,289]
White Perch	0.0039	0	5,498	3,499	606	260	1,272	0	11,135
		[0]	[6,639]	[3,686]	[426]	[182]	[730]	[0]	[7,643]
Smallmouth Bass	0.0093	0	3,348	4,474	9,338	6,339	2,809	0	26,308
		[0]	[1,161]	[915]	[2,340]	[1,366]	[955]	[0]	[3,231]
Yellow Perch	0.0952	229	2,529	43,601	75,916	65,064	81,666	0	269,005
		[161]	[597]	[8,042]	[13,118]	[9,425]	[13,313]	[0]	[22,432]
Walleye	0.0077	3,335	5,531	6,319	4,182	885	1,407	0	21,659
		[817]	[2,056]	[1,652]	[1,328]	[307]	[615]	[0]	[3,139]
Total Harvest	0.2515	21,664	31,296	92,999	176,218	185,160	201,983	1,262	710,582
		[3,287]	[7,249]	[9,314]	[14,008]	[10,611]	[14,466]	[51]	[25,850]
Angler Hours		243,761	224,967	421,089	777,578	546,982	605,505	5,389	2,825,271
		[13,507]	[13,127]	[17,497]	[28,759]	[24,086]	[19,522]	[481]	[49,492]

Table 5. Estimated harvest rate (harvest per hour), harvest and effort for the boat fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay during 1999. Standard deviations are in brackets.

Species	Harvest per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho Salmon	0.0250	23	6,613	14,123	10,441	16,032	5,656	87	52,975
		[0]	[1,221]	[1,344]	[1,844]	[1,087]	[692]	[0]	[2,891]
Chinook Salmon	0.0566	0	336	4,616	47,393	39,768	27,448	526	120,087
		[0]	[123]	[511]	[3,035]	[2,000]	[2,950]	[0]	[4,711]
Rainbow Trout	0.0365	1	893	5,259	7,445	38,283	25,336	81	77,328
		[0]	[207]	[800]	[919]	[2,907]	[2,766]	[0]	[4,199]
Brown Trout	0.0120	7,715	99	336	4,009	8,036	5,007	190	25,392
		[2,888]	[36]	[130]	[829]	[2,684]	[814]	[0]	[4,112]
Brook Trout	0.0000	0	0	1	0	21	2	0	24
		[0]	[0]	[0]	[0]	[0]	[0]	[0]	[0]
Lake Trout	0.0188	94	5,073	7,385	14,436	8,698	4,012	99	39,797
		[59]	[913]	[690]	[1,449]	[905]	[683]	[0]	[2,168]
Splake	0.0002	512	0	0	0	0	0	0	512
		[295]	[0]	[0]	[0]	[0]	[0]	[0]	[295]
Northern Pike	0.0024	976	519	0	635	942	2,062	0	5,134
		[388]	[340]	[0]	[629]	[317]	[946]	[0]	[1,287]
White Perch	0.0010	0	0	0	606	238	1,272	0	2,116
		[0]	[0]	[0]	[426]	[181]	[730]	[0]	[864]
Smallmouth Bass	0.0120	0	3,132	4,110	9,119	6,244	2,799	0	25,404
		[0]	[1,156]	[900]	[2,336]	[1,363]	[955]	[0]	[3,221]
Yellow Perch	0.1148	0	1,894	40,876	63,892	62,855	7,390	0	243,447
		[0]	[579]	[7,997]	[13,027]	[9,409]	[13,206]	[0]	[22,292]
Walleye	0.0083	2,010	5,075	5,303	3,391	660	1,167	0	17,606
		[727]	[2,049]	[1,570]	[1,289]	[263]	[578]	[0]	[3,043]
Total Harvest	0.2876	11,331	23,634	82,009	161,367	181,777	148,721	983	609,822
		[3,018]	[2,893]	[8,393]	[13,916]	[10,594]	[13,966]	[0]	[24,266]
Angler Hours		98,925	182,263	347,556	695,003	478,375	316,245	2,143	2,120,510
		[10,718]	[12,636	[15,139]	[28,215]	[23,241]	[15,515]	[0]	[45,615]

Table 6. Estimated harvest rate (harvest per hour), harvest and effort for the pier fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay during 1999. Standard deviations are in brackets.

Species	Harvest per hour	Mar/Apr	May	June	July	August	Sept/Oct	Season
Coho Salmon	0.0003	0	5	17	0	9	0	31
		[0]	[4]	[9]	[0]	[9]	[0]	[14]
Chinook Salmon	0.0172	0	0	0	18	265	1,841	2,124
		[0]	[0]	[0]	[13]	[49]	[344]	[347]
Rainbow Trout	0.0024	11	21	60	73	53	75	293
		[11]	[14]	[28]	[34]	[34]	[36]	[68]
Brown Trout	0.0176	789	36	514	331	149	347	2,166
		[258]	[18]	[821]	[91]	[57]	[113]	[874]
Brook Trout	0.0000	0	0	0	0	0	0	0
		[0]	[0]	[0]	[0]	[0]	[0]	[0]
Lake Trout	0.0000	0	0	0	0	0	0	0
		[0]	[0]	[0]	[0]	[0]	[0]	[0]
Splake	0.0035	387	0	39	0	0	0	426
		[200]	[0]	[47]	[0]	[0]	[0]	[206]
Northern Pike	0.0007	13	58	0	0	13	0	84
		[12]	[40]	[0]	[0]	[15]	[0]	[44]
White Perch	0.0001	0	0	0	0	13	0	13
		[0]	[0]	[0]	[0]	[15]	[0]	[15]
Smallmouth Bass	0.0039	0	60	334	55	26	0	475
		[0]	[49]	[166]	[56]	[21]	[0]	[183]
Yellow Perch	0.0516	229	131	1,214	3,227	562	1,003	6,366
		[161]	[101]	[444]	[815]	[201]	[459]	[1,072]
Walleye	0.0037	370	12	78	0	0	0	460
		[161]	[12]	[94]	[0]	[0]	[0]	[187]
Total Harvest	0.1008	1,799	323	2,256	3,704	1,090	3,266	12,438
		[398]	[122]	[954]	[823]	[219]	[586]	[1,467]
Angler Hours		10,387	11,433	18,938	27,912	23,152	31,535	123,357
		[1,575]	[1,677]	[1,935]	[2,924]	[1,827]	[2,497]	[5,211]

Table 7. Estimated harvest rate (harvest per hour), harvest and effort for the shore fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay during 1999. Standard deviations are in brackets.

Species	Harvest per hour	Mar/Apr	May	June	July	August	Sept/Oct	Season
Coho Salmon	0.0044	22	19	0	0	0	828	869
		[22]	[21]	[0]	[0]	[0]	[204]	[206]
Chinook Salmon	0.0242	0	0	0	0	169	4,651	4,820
		[0]	[0]	[0]	[0]	[72]	[682]	[686]
Rainbow Trout	0.0023	258	0	91	32	0	84	465
		[87]	[0]	[90]	[32]	[0]	[53]	[140]
Brown Trout	0.0328	1,412	446	1,324	1,363	174	1,812	6,531
		[259]	[172]	[409]	[296]	[48]	[437]	[738]
Brook Trout	0.0000	0	0	0	0	0	0	0
		[0]	[0]	[0]	[0]	[0]	[0]	[0]
Lake Trout	0.0000	0	0	0	0	0	0	0
		[0]	[0]	[0]	[0]	[0]	[0]	[0]
Splake	0.0004	0	74	0	0	0	0	74
		[0]	[60]	[0]	[0]	[0]	[0]	[60]
Northern Pike	0.0001	0	22	0	0	0	0	22
		[0]	[16]	[0]	[0]	[0]	[0]	[16]
White Perch	0.0000	0	0	0	0	9	0	9
		[0]	[0]	[0]	[0]	[10]	[0]	[10]
Smallmouth Bass	0.0008	0	17	30	50	69	0	166
		[0]	[14]	[22]	[26]	[74]	[0]	[82]
Yellow Perch	0.0652	0	92	618	8,658	1,579	2,061	13,008
		[0]	[95]	[451]	[1,295]	[518]	[573]	[1,577]
Walleye	0.0002	0	17	0	25	0	0	42
		[0]	[14]	[0]	[26]	[0]	[0]	[29]
Total Harvest	0.1304	1,692	687	2,063	10,128	2,000	9,436	26,006
		[274]	[208]	[616]	[1,329]	[530]	[1,014]	[1,891]
Angler Hours		23,240	10,286	16,327	37,630	27,023	84,904	199,410
		[1,905]	[843]	[1,381]	[2,864]	[2,368]	[5,160]	[6,833]

Table 8. Estimated harvest rate (harvest per hour), harvest and effort for the stream fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay during 1999. Standard deviations are in brackets.

Species	Harvest per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho Salmon	0.0063	0	0	0	0	0	2,362	60	2,422
		[0]	[0]	[0]	[0]	[0]	[423]	[24]	[423]
Chinook Salmon	0.0809	0	0	0	0	0	30,854	49	30,903
		[0]	[0]	[0]	[0]	[0]	[3,188]	[17]	[3,188]
Rainbow Trout	0.0161	4,845	130	555	0	0	605	27	6,162
		[1,047]	[77]	[495]	[0]	[0]	[157]	[12]	[1,171]
Brown Trout	0.0081	383	0	786	0	0	1,795	134	3,098
		[148]	[0]	[795]	[0]	[0]	[395]	[38]	[901]
Brook Trout	0.0014	541	0	0	0	0	0	9	550
		[472]	[0]	[0]	[0]	[0]	[0]	[7]	[472]
Lake Trout	0.0001	0	0	0	0	0	22	0	22
		[0]	[0]	[0]	[0]	[0]	[22]	[0]	[22]
Splake	0.0002	80	0	0	0	0	0	0	80
		[59]	[0]	[0]	[0]	[0]	[0]	[0]	[59]
Northern Pike	0.0002	38	46	0	0	0	0	0	84
		[46]	[37]	[0]	[0]	[0]	[0]	[0]	[58]
White Perch	0.0236	0	5,498	3,499	0	0	0	0	8,997
		[0]	[6,639]	[3,686]	[0]	[0]	[0]	[0]	[7,594]
Smallmouth Bass	0.0007	0	139	0	114	0	10	0	263
		[0]	[100]	[0]	[118]	[0]	[10]	[0]	[155]
Yellow Perch	0.0162	0	412	893	139	68	4,672	0	6,184
		[0]	[43]	[561]	[142]	[67]	[1,507]	[0]	[1,617]
Walleye	0.0093	955	427	938	766	225	240	0	3,551
		[337]	[161]	[503]	[316]	[159]	[210]	[0]	[749]
Total Harvest	0.1631	6,842	6,652	6,671	1,019	293	40,560	279	62,316
		[1,208]	[6,643]	[3,877]	[366]	[172]	[3,583]	[51]	[8,581]
Angler Hours		111,209	20,985	38,268	17,033	18,432	172,821	3,246	381,994
		[7,839]	[3,019]	[8,446]	[3,766]	[5,571]	[10,370]	[481]	[17,172]

Table 9. Average weight, average length and standard weight of salmonids from Wisconsin's Lake Michigan creel survey, all areas and fishery types combined during 1990 through 1999. std = standard deviation.

Year	Average weight	± 1 std	Average length	± 1 std	Standard weight
Coho salmon					
1990	4.4919	1.9875	22.6016	3.1850	3.9176
1991	4.0689	2.4381	21.6905	3.4396	3.9455
1992	4.1493	1.8694	21.9365	3.2360	3.8052
1993	3.7333	1.7396	21.2199	2.6774	3.9410
1994	3.3084	2.2217	20.1049	3.2844	3.8168
1995	3.1598	1.9908	20.3647	3.4795	3.6060
1996	4.6377	2.0180	22.5823	3.1358	3.8673
1997	3.0543	1.4843	20.2170	2.7918	3.5368
1998	3.3491	1.6776	21.0745	2.6494	3.5612
1999	7.1347	3.6900	25.1350	5.1092	4.2368
Chinook salmon					
1990	9.5136	6.5206	27.6409	7.2053	9.8052
1991	8.1385	6.5538	25.7534	6.9683	10.2605
1992	10.2518	7.2367	27.9216	7.7320	9.8032
1993	10.5038	8.3701	27.4037	8.3374	10.1905
1994	10.4453	8.3485	27.0273	8.7192	9.9749
1995	9.8882	8.1733	26.3952	8.1126	10.4336
1996	8.0482	6.7959	25.7176	7.1099	9.7475
1997	9.1569	6.2956	27.3781	6.7461	9.7349
1998	9.9393	6.1881	27.9896	6.3117	9.8589
1999	12.5209	6.0866	31.0947	5.7288	9.9412
Rainbow trout					
1990	6.7851	2.9583	26.2191	4.9188	3.8427
1991	6.6434	2.7961	26.3469	4.2241	3.8274
1992	7.1852	2.8828	27.0546	4.4753	3.7915
1993	6.8907	3.4246	26.2585	4.6655	3.5624
1994	6.2132	3.0697	25.5027	4.3581	3.8532
1995	6.2328	2.9497	25.4630	4.1472	3.8015
1996	6.7903	2.8603	25.8947	4.0637	3.8888
1997	6.8474	2.8552	26.6210	4.0443	3.7207
1998	6.1913	2.6461	25.9667	3.6238	3.5888
1999	7.2340	3.3254	25.9069	5.2089	3.9814

Table 9 (continued). Average weight, average length and standard weight of salmonids from Wisconsin's Lake Michigan creel survey, all areas and fishery types combined during 1990 through 1999. std = standard deviation.

Year	Average weight	± 1 std	Average length	± 1 std	Standard weight
Brown trout					
1990	4.9623	2.7813	20.3590	3.7698	4.0124
1991	5.1182	2.8120	20.5944	3.3968	4.1454
1992	4.3926	2.7494	19.7675	4.0670	3.8560
1993	4.8219	2.9352	20.3673	3.9857	3.7333
1994	5.5798	3.9554	21.1341	4.7054	3.9035
1995	5.2797	3.4391	21.1004	3.9226	3.9589
1996	5.5350	3.8506	21.1594	4.2634	3.8506
1997	4.8983	2.8484	21.1254	4.0540	3.4188
1998	5.9500	3.9901	21.9235	5.1606	3.7211
1999	6.0660	3.4702	22.1970	4.5156	3.9397
Brook trout					
90	1.3494	1.4965	13.5329	2.2660	1.0251
91	3.1302	2.8800	17.2930	3.8984	0.7325
92	1.1237	1.2872	12.6987	3.1266	0.8676
93	1.3758	1.3667	13.9435	3.6014	0.8770
94	1.0979	1.2143	12.8191	2.7277	0.8912
95	1.2459	1.0356	12.9365	2.6004	1.0370
Lake trout					
1990	8.8930	3.6846	28.1648	3.3898	5.7870
1991	9.3689	3.9124	28.5284	3.5305	6.0374
1992	9.0558	3.9286	28.6493	3.4675	5.6921
1993	7.7916	4.0955	26.8924	3.8634	5.8126
1994	7.1624	3.8173	26.3183	4.0057	5.7156
1995	8.7428	4.3848	27.3754	3.9492	6.5910
1996	7.5237	4.5938	26.3436	4.8990	5.4196
1997	7.3469	3.7751	26.5681	3.9708	5.6513
1998	8.4252	4.0276	27.4861	3.8883	5.6712
1999	9.2469	3.9323	28.0260	3.8194	6.0907

Figure 1. Geographical area of the Wisconsin waters of Lake Michigan.

(IMAGE NOT AVAILABLE)

Department of Natural Resources

ANGLER INTERVIEW FORM

GREAT LAKES CREEL SURVEY
Form 3600-073 Rev. 3-92

Survey Site _____ County _____ Clerk _____

Date 1 2 3 4 5 6 (M M D D Y Y) County 7 8 Survey Site 9 10 11 Fishery Type Ramp 1 Pier 2 Shore 3 Stream 4 Ice 5 12

	PARTY RECORD						BROWN			RAINBOW			LAKE			COHO			CHINOOK			PERCH		
	Activities	No. Res. Anglers	No. NonR Anglers	Trip Status	Time Interview	Time Started Fishing	% Time	No. Caught	No. Kept	% Time	No. Caught	No. Kept	% Time	No. Caught	No. Kept	% Time	No. Caught	No. Kept	% Time	No. Caught	No. Kept	% Time	No. Caught	No. Kept
1.																								
2.																								
3.																								
4.																								
5.																								
6.																								
7.																								

	WALLEYE			OTHER SPECIES				OTHER SPECIES				OTHER SPECIES			
	% Time	No. Caught	No. Kept	Species Code	% Time	No. Caught	No. Kept	Species Code	% Time	No. Caught	No. Kept	Species Code	% Time	No. Caught	No. Kept
1.															
2.															
3.															
4.															
5.															
6.															
7.															

Figure 2. Angler-interview form used by Wisconsin DNR to record Lake Michigan creel-survey data.

Figure 3. Catch-record form used by Wisconsin DNR to record Lake Michigan creel-survey data.

Department of Natural Resources

CATCH RECORD FORM
GREAT LAKES CREEL SURVEY
Form 3600-145 Rev. 2-97

Survey Site _____ County _____ Clerk _____

Date __ __ __ __ __ __ County __ __ Survey Site __ __ __ Fishery Type: Ramp 1 Pier 2 Shore 3 Stream 4 Ice 5 __
M M D D Y Y

Species	Weight	Length	Fin Clip	Tag Description			Species	Weight	Length	Fin Clip	Tag Description		
				Number	Color	Address					Number	Color	Address
_ _ _	_ _ _	_ _ _	_ _	_ _ _ _ _ _	_ _	_ _	_ _ _	_ _ _	_ _ _	_ _	_ _ _ _ _ _	_ _	_ _

Figure 4. Fishing effort (angler hours) in Wisconsin waters of Lake Michigan and Green Bay during 1990 through 1999.

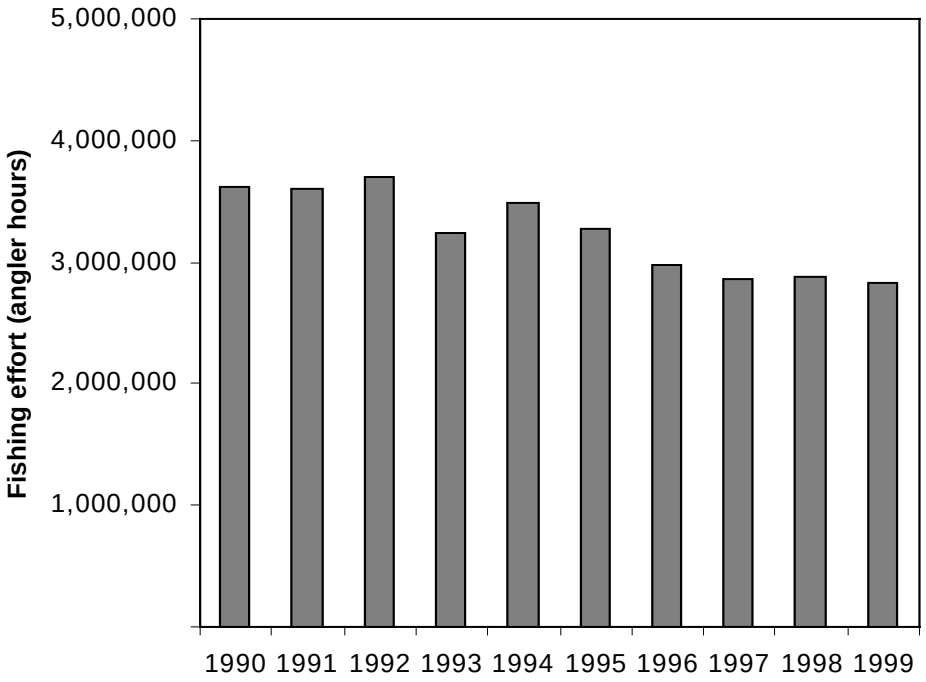

Figure 5. Trout and salmon harvest and harvest rate from Wisconsin waters of Lake Michigan and Green Bay during 1990 through 1999.

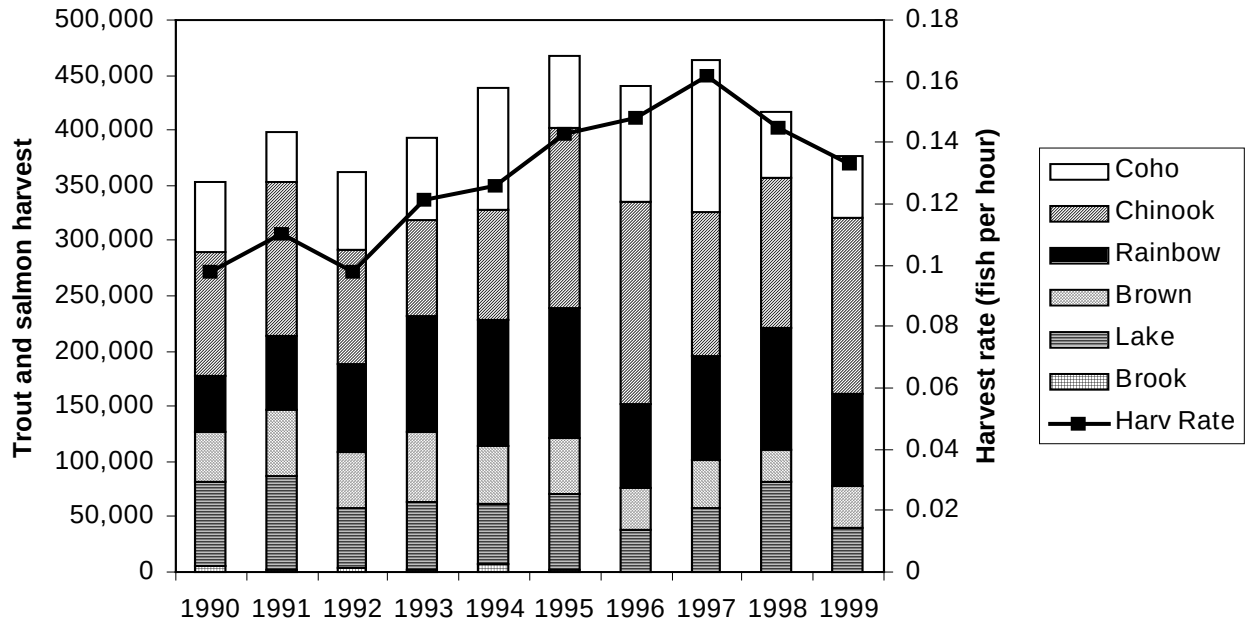

Figure 6. Yellow perch angler-harvest and harvest rate from Wisconsin waters of Green Bay and Lake Michigan during 1992 through 1999.