

# Wisconsin's 1998 open water sportfishing effort and catch from Lake Michigan and Green Bay.

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**Abstract** - This paper documents the sport fishery in Wisconsin waters of Lake Michigan and Green Bay from March 1, 1998 through December 31, 1998. Fishing effort, catch and catch 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 system. Anglers spent an estimated 2,870,450 hours fishing on Lake Michigan or Green Bay in 1998 with boat angler effort at 2,201,945 hours or 77% of the total hours. The estimated harvest of 737,038 fish was dominated by yellow perch (257,197) and to a lesser degree chinook salmon (136,653), rainbow trout (110,888) and lake trout (82,247). The boat fishery, comprised of launched-boat, moored-boat and charter boat anglers dominated the fishery by harvesting an estimated 654,589 fish which was 89.0% of the total fish harvested and was dominated by yellow perch (227,172), chinook salmon (120,455) and rainbow trout (105,063). Pier, shore and stream anglers harvested primarily yellow perch, brown and rainbow trout. Overall catch rates were highest for yellow perch at 0.0896 fish/hour and chinook salmon at 0.0476 fish/hour.

Before the 1920s, fish biomass and abundance 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 in the 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 proved

to be very successful and expanded to include trouts (*Salmo* spp.), chars (*Salvelinus* spp.) and other pacific salmon (*Oncorhynchus* spp.). The stocking of exotic salmonids provided not only a practical way to control the alewife population but also a valuable sport fishery.

In order to manage the Lake Michigan sport fishery, assessments must be conducted on both the forage and predator fish stocks. Since 1973, the US Fish and Wildlife Service has conducted fall daytime bottom-trawl surveys in Lake Michigan to estimate the abundance of forage fish. These estimates are based on a series of 10 minute trawl tows along the contour of nine depths at each of seven index stations (Eck 1992). Since 1969, the WDNR has monitored the Lake Michigan sport fishery with a statewide contact creel survey. This provides the WDNR with 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, from moored-boat and charter boat anglers. Estimates were then calculated for fishing effort, catch and catch rates for 1998.

Grant Park	Riverfront Ramp
S. Metro Pier	N. City Shoreline

**STUDY AREA AND METHODS**

*Geographical Area*

The geographical area of this survey is illustrated in Figure 1. Wisconsin's share of Lake Michigan is second only to Michigan and encompasses 495 miles of shoreline and 25 tributaries. The Wisconsin waters of Lake Michigan include Green Bay and portions of two distinct lake basins (northern and southern). 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 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 (SMU) were assigned based primarily on county lines and include units like 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 based on the time of year and size of each SMU. Site groups were selected randomly on a daily basis without replacement 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

Three types of data were collected for each site sampled: angler, boat trailer or car counts for effort, angler or party interviews for harvest rates and biological information 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 and were corrected by the number of anglers in the car from interview data. The time the count was completed and count per site were recorded on the activity count form.

Angler or 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). If the angler indicated that they had harvested fish, biological information such as species, length, weight, finclip and tag numbers were collected (Figure 3). Standard weight calculations followed that of 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 involves 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. For each interview, the number of fish harvested and the hours fished were determined. The harvest and hours fished were summed over all interviews in a stratum, the ratio of the sum and the variance of the ratio were then calculated. For a complete description see Eggold (1995).

*Moored Boat Survey Design*

Anglers who moored their boat on Lake Michigan and 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, in 1988, creel clerks were asked to compile a list of boat registration numbers of moored-boats present 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 or Green Bay; 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 catch per boat. The harvest was 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 harvest for the entire moored-boat population.

*Harvest rate calculations.* Harvest rate, the number of fish caught per angler hour, was obtained by dividing the monthly reported catch of each species by the total fishing effort for that month for each harbor.

This type of survey is biased because only those interested and successful anglers tend to mail back the survey form. Therefore, the harvest will tend to be an overestimate of the actual number but should be comparable among years and locations. For a more detailed description of the calculations and formulas see Eggold (1993).

### *Charter Boat Survey Design*

At the beginning of each fishing season, a packet of information was sent to each licensee. This packet included notes on important fishing items, a sample of a completed monthly report, grid map of Lake Michigan, list of wardens, coded-wire tag collection stations, finclip 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 was to be mailed by the 10th of each month on the records for the preceding calendar month to the Plymouth Field Station of the WDNR. If a report was late or incorrectly filled out a warning letter was sent. Only one letter was sent per license holder and any subsequent violations were referred directly to a Wisconsin Conservation Warden.

The information obtained from each form included: license number, fishing port, date of fishing trip, grid fished, number of resident and nonresident anglers, number of fished harvested, time each trip started (am, pm, evening), number of lines fished and number of hours fished. This information had to be recorded within half an hour after completing each trip after returning to the dock or shore. The number of lake trout, coho salmon, brown trout, steelhead, chinook salmon and other species caught, tag numbers present 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**

For purposes of this report both harvest and catch will be used synonymously to mean the number of fish harvested. Fishing effort in Wisconsin waters of Lake Michigan and Green Bay was estimated at 2,870,450 ( $\pm 55,770$ ) hours for 1998 during the open water season from March 1 - December 31 (Table 1). Angler hours increased slightly from 1997 (2,868,547) (Figure 4). Green Bay anglers had the most fishing effort at 905,762 ( $\pm 35,986$ ) hours or 32% of all angler hours for 1998. Kewaunee Co. anglers came in second at 342,260 ( $\pm 28,589$ ) hours.

Angler hours were disproportionately spread among the four fishery types. Boat anglers spent 2,201,945 ( $\pm 53,459$ ) hours or 77% of all angler hours fishing on Lake Michigan or Green Bay (Table 5). Stream anglers fished the second most at 341,076 ( $\pm 13,667$ ) hours or 12% of the total (Table 8). Pier and shore anglers fished 137,907 ( $\pm 5,117$ ) and 189,522 ( $\pm 6,281$ ) hours respectively (Tables 6-7).

Fishermen caught an estimated 416,521 ( $\pm 8,064$ ) salmonids during the 1998 season (Table 2). Chinook salmon dominated the catch comprising 136,653 ( $\pm 4,702$ ) fish or 33% of the total. Rainbow trout was the most numerous species caught in 1993-1994 and chinook salmon from 1988-

1992 and 1995-1996. However, anglers caught more coho salmon in 1997 than any other salmonid, comprising 30% of the salmonid harvest. In 1998, chinook salmon has once again dominated the harvest. Coho salmon harvest numbers decreased to 59,203 ( $\pm$  2,706). Rainbow trout harvest increased from 1997 to 110,888 ( $\pm$  4,268) fish or 27% of the total. Lake trout were the third numerous salmonid harvested at 82,247 ( $\pm$  3,624) fish followed by brown trout at 27,371 ( $\pm$  2,062) and brook trout at 159 ( $\pm$  40).

The combined catch rate for salmonids are depicted in Table 2 and Figure 5. The catch rate decreased considerably in 1998 to 0.1451 fish/hour and was much higher lower than 1997. This can be attributed to a slight increase in angler hours, a decrease in the salmonid harvest especially coho salmon and brown trout and less than ideal fishing conditions in 1998.

Fishermen caught an estimated 257,197 ( $\pm$  20,829) yellow perch in 1998 (Table 3 and Figure 6). Anglers harvested 219,366 ( $\pm$  20,528) yellow perch in Green Bay with a harvest rate of 0.2422 fish/hour. Lake Michigan anglers caught 37,831 ( $\pm$  3,527) yellow perch and had a catch rate of 0.0193 fish/hour (Table 3 and Figure 6). Yellow perch comprised the majority of the catch from all areas combined at 257,197 ( $\pm$  20,829) fish and had an overall catch rate of 0.0893 fish/hour (Table 4). Yellow perch were the most numerous species caught for the boat and pier fishery although the majority (88.0%) were caught by boat fishermen (Table 5). Yellow perch catch rates were highest for the boat fishery at 0.1032 fish/hour followed by the pier fishery at 0.0909 (Table 5). The majority of the harvest took place in the summer months from July to September.

The catch in 1998 was slightly higher than previous years but considerably less than the 1992-1994 average. In the last several years, management decisions to protect the dwindling yellow perch population have been enacted and include: 1) closure of the Lake Michigan commercial yellow perch season; 2) a drop in the sport bag to 5/day with a June closure on Lake Michigan; and 3) a drop in the Green Bay commercial quota for yellow perch. These procedures not only should protect the remaining yellow perch stocks but also accounted for the decrease in the number of harvested yellow perch in recent years.

The total catch of 13 major species was 737,038 ( $\pm$  22,950) fish for 1998 (Table 4). The majority of the catch came from boat anglers (Table 5) who caught 654,589 ( $\pm$  22,301) fish or 88.8% of the total. The other angler types, pier, shore and stream accounted for 18,773 ( $\pm$  2,073), 17,530 ( $\pm$  1,491) and 46,146 ( $\pm$  4,779) fish respectively or 2.5%, 2.4% and 6.3% of

the total (Tables 6-8).

The coho salmon harvest decreased dramatically in 1998 to 59,203 ( $\pm$  2,706) fish which was the fewest caught since 1991 (Table 2). Overall coho salmon catch rates were 0.0206. Boat anglers harvested 94% of all coho salmon (59,203) and enjoyed catch rates of 0.0252 fish/hour (Table 5). The remaining harvest was divided among the pier, shore and stream anglers at 634, 1,166 and 1,957 fish, respectively (Tables 6-8). Biological data collected on coho salmon showed that the mean weight was 3.3 ( $\pm$  1.7) pounds and the mean length was 21.1 ( $\pm$  2.6) inches with a standard weight of 3.6 pounds (Table 9). All three parameters increased in 1998.

Anglers caught 136,653 ( $\pm$  4,702) chinook salmon in 1998, up slightly from 1997 (Table 2). The overall catch rate of 0.0476 was higher than those calculated for steelhead and coho salmon. Like those two species, the majority of the harvest occurred in the boat fishery with anglers harvesting 120,455 ( $\pm$  4,496) fish or 88% of all chinook salmon caught (Table 5). Boat angler catch rates were 0.0547. Stream anglers harvested 12,212 ( $\pm$  1,282) chinook salmon with catch rates at 0.0358 (Table 8). The average weight and length for chinook salmon were 9.9 ( $\pm$  6.2) pounds and 28.0 ( $\pm$  6.3) inches, while the standard weight was 9.9 pounds (Table 9).

Rainbow trout was the second most abundant salmonid and third most abundant species caught in 1998 at 110,888 ( $\pm$  4,268) fish (Table 2,4). Rainbow trout catch rates were the second highest among all salmonids at 0.0386 fish/hour. The majority of the catch occurred in the boat fishery with 105,062 ( $\pm$  4,228) fish caught (Table 5). Stream anglers caught 3,924 ( $\pm$  508) steelhead with catch rates at 0.0115 fish/hour (Table 8). Rainbow trout averaged 6.2 ( $\pm$  2.6) pounds and 26.0 ( $\pm$  3.6) inches with a standard weight of 3.6 pounds (Table 9) remaining constant from the previous years.

Anglers in Wisconsin harvested 82,247 ( $\pm$  3,624) lake trout in Lake Michigan and Green Bay. This was the largest harvest since 1991, coincidentally, the last time Wisconsin had a poor coho salmon fishery. While the harvest was fairly high, the overall catch rate was lower than expected at 0.0287 fish/hour (Table 4). Like coho and chinook salmon, boat anglers caught most of the lake trout, catching 82,224 ( $\pm$  3,624) fish or 99% of all lake trout. Boat catch rates were slightly higher than the overall catch rate estimated at 0.0373 fish/hour (Table 5). Lake trout size was calculated at 8.4 ( $\pm$  4.0) pounds and 27.5 ( $\pm$  3.9) inches with a standard weight of 5.7 pounds (Table 9).

An estimated 27,371 ( $\pm$  2,062) brown trout were harvested in

1998 from all surveyed areas, with an overall catch rate of 0.0095 fish/hour (Table 4). The Wisconsin harvest of brown trout has declined steadily since 1993. However, of all the major salmonids, brown trout are the most under sampled species in the creel because many get harvested in winter when the creel survey is not conducted. Unlike the other salmonids, which were almost exclusively caught in the boat fishery, brown trout harvest by boat anglers was 19,151 ( $\pm$  1,878) fish or only 70% of the total. Pier anglers harvested 1,212 ( $\pm$  284) brown trout and had catch rates of 0.0088 fish/hour (Table 6). This total was the highest of any species except yellow perch and rainbow trout and comprised 20% of the non-yellow perch pier harvest. Likewise, shore anglers caught 4,173 ( $\pm$  657) brown trout or 38% of the non-yellow perch shore harvest (Table 7). Shore catch rates were 0.0220 fish/hour. Brown trout biological data for 1998 showed that their mean size was 6.0 ( $\pm$  4.0) pounds, 21.9 ( $\pm$  5.2) inches and 3.7 pounds standard weight (Table 9).

Smallmouth bass were numerous in the catch, totaling 26,334 ( $\pm$  2,518) fish (Table 4). The harvest was highest in July and August. Overall catch rates were 0.0092 fish/hour, much less than those calculated for yellow perch. Again, boat anglers caught the majority of the smallmouth bass, harvesting 22,711 ( $\pm$  2,390) fish or 86% of the total (Table 5). Boat catch rates were slightly higher (0.0103) than the overall catch rate. The remainder of the harvest was spread among the three remaining fishery types, having catch rates of 0.0058, 0.0089 and 0.0033 fish/hour respectively (Tables 6-8).

White perch were also present in the catch at 9,141 ( $\pm$  3,789). Overall catch rates were fairly low at 0.0032 fish/hour (Table 4). The majority of the harvest occurred in the stream fishery at 6,314 ( $\pm$  3,391) fish representing 64% of the harvest. Stream catch rates were 0.0185 fish/hour the highest among all the species except yellow perch. The remaining fishery types comprised the remainder of the harvest (2,827 fish).

Walleyes were the last species harvested in large numbers during the open water fishing season. An estimated 23,362 ( $\pm$  2,561) walleyes were caught with the majority caught in spring (Table 4). This represents a substantial increase from 1996 (18,468) but a drop from 1997 (31,049). Like smallmouth bass, catch rates were lower than most salmonids at 0.0081 fish/hour. The harvest was concentrated exclusively in two fishery types, boat and stream. Boat anglers caught 16,557 ( $\pm$  2,303) walleyes (Table 5) while stream anglers caught 6,539 ( $\pm$  1,111) walleyes (Table 8). Stream catch rates of 0.0192 fish/hour were better than boat catch rates of 0.0075 fish/hour.

The remaining species, atlantic salmon, brook trout, splake and northern pike comprised only 0.6% of the total harvest and 1% of the non-yellow perch harvest.

## SUMMARY

Lake Michigan anglers spent an estimated 2,870,450 hours fishing on Lake Michigan or Green Bay with boat angler effort at 2,201,945 hours or 77% of the total hours. The estimated harvest of 737,038 fish was dominated by yellow perch (257,197) and to a lesser degree rainbow trout (110,888), chinook salmon (136,653) and lake trout (82,247).

The salmonid harvest decreased from 464,422 fish in 1997 to 416,521 fish in 1998. Overall catch rates were slightly lower in 1998, due to the poor coho salmon fishery. The salmonid catch would have been much lower except for the strong lake trout harvest of 82,247. A similar trend occurred in 1991, the last time over 80,000 lake trout were harvested by Lake Michigan anglers.

The yellow perch catch continues to decline with only 257,197 fish harvested. However, the 1998 harvest was up slightly from 1997. Likewise, catch rates have also declined, although the 1998 rate of 0.0896 fish/hour was up from 1997. Obviously the declining yellow perch population in both Lake Michigan and Green Bay have accounted for the large decreases recorded in this study.

Several factors had major impacts during the 1998 fishing season. Weather patterns during June, July and August were not ideal. Coho salmon were very difficult to catch especially nearshore forcing boaters to target other species (i.e. lake trout) Unlike 1995 through 1997, nearshore weather conditions were not ideal in the spring but did improve throughout the fishing season. This allowed boat anglers to harvest larger numbers of chinook salmon and lake trout than previous years.

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Table 1. Estimated angler effort (hours) by area in Wisconsin waters of Lake Michigan and Green Bay, March-December 1990-1998. Standard deviation in brackets.

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

Table 2. Estimated catch and catch rate of salmonids in Wisconsin waters of Lake Michigan and Green Bay, March-December 1990-1998. Standard deviation in brackets.

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998
Coho Salmon	64,085 [3,002]	44,195 [2,435]	70,876 [3,890]	74,304 [4,151]	110,001 [5,857]	65,647 [3,107]	104,715 [4,546]	138,423 [6,039]	59,203 [2,706]
Chinook Salmon	111,342 [4,399]	139,081 [5,318]	103,568 [6,571]	87,366 [3,707]	99,754 [4,424]	162,888 [5,953]	183,254 [7,746]	130,152 [5,050]	136,653 [4,589]
Rainbow Trout	51,708 [2,996]	67,878 [3,408]	79,525 [6,029]	104,765 [3,998]	114,774 [4,455]	117,508 [4,416]	77,099 [4,192]	94,470 [4,436]	110,888 [4,268]
Brown Trout	45,094 [3,605]	59,164 [4,182]	51,554 [2,794]	64,546 [3,735]	52,398 [2,695]	49,654 [2,630]	38,093 [2,160]	43,224 [3,411]	27,371 [2,062]
Brook Trout	5,928 [616]	1,661 [397]	4,432 [458]	1,967 [311]	7,482 [797]	1,914 [332]	419 [112]	299 [76]	159 [40]
Lake Trout	75,180 [3,067]	85,842 [3,279]	52,854 [2,504]	60,943 [2,776]	53,989 [2,337]	69,332 [2,797]	36,849 [1,806]	57,954 [2,371]	82,247 [3,624]
TOTAL	353,338 [7,753]	397,821 [8,615]	362,809 [10,438]	393,891 [8,290]	438,397 [9,332]	466,943 [8,913]	440,429 [10,304]	464,522 [9,945]	416,521 [8,064]
Catch Rate	0.0979	0.1103	0.0980	0.1213	0.1256	0.1426	0.1481	0.1619	0.1451

Table 3. Estimated catch and catch rate of yellow perch in Wisconsin waters of Lake Michigan and Green Bay, March-December 1992-1998.

Species	1992	1993	1994	1995	1996	1997	1998
<b>Yellow Perch</b>							
Green Bay	1,275,392	775,117	1,091,837	802,668	429,466	204,267	219,366
St. Dev.	[83,981]	[67,693]	[69,029]	[57,516]	[34,274]	[16,429]	[20,528]
Catch Rate	1.0730	0.6965	0.9165	0.7442	0.4414	0.2303	0.2422
Lake Michigan	959,925	545,901	289,905	246,945	95,100	31,146	37,831
St. Dev.	[43,456]	[30,016]	[18,389]	[20,677]	[14,985]	[4,103]	[3,527]
Catch Rate	0.3821	0.2557	0.1261	0.1125	0.0475	0.0157	0.0193
<b>TOTAL</b>	<b>2,235,317</b>	<b>1,321,018</b>	<b>1,381,742</b>	<b>1,049,613</b>	<b>524,566</b>	<b>235,413</b>	<b>257,197</b>
	[94,558]	[74,049]	[71,436]	[61,119]	[37,407]	[16,934]	[20,829]
Catch Rate	0.6040	0.4067	0.3959	0.3206	0.1764	0.0821	0.0896

Table 4. Estimated catch per hour, catch and effort for all survey areas and all fishery types for Wisconsin waters of Lake Michigan and Green Bay in 1998. Standard deviations in brackets.

Species	Total catch per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho salmon	0.0206	201 [64]	14,646 [1,651]	20,086 [1,361]	9,025 [1,067]	7,151 [941]	7,835 [844]	259 [53]	59,203 [2,706]
Chinook salmon	0.0476	17 [14]	2,436 [304]	27,894 [2,191]	43,268 [2,369]	32,252 [2,871]	28,466 [1,832]	320 [17]	136,653 [4,702]
Rainbow trout	0.0386	3,320 [478]	7,382 [836]	27,666 [1,708]	19,694 [1,509]	35,069 [2,808]	17,451 [2,051]	306 [61]	110,888 [4,268]
Atlantic salmon	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Brown trout	0.0095	9,141 [1,519]	1,520 [368]	2,669 [447]	5,678 [793]	3,585 [758]	3,941 [610]	837 [176]	27,371 [2,062]
Brook trout	0.0001	0 [0]	18 [18]	40 [21]	23 [19]	7 [0]	71 [22]	0 [0]	159 [40]
Lake trout	0.0287	399 [252]	5,372 [531]	18,506 [1,306]	33,544 [2,905]	16,275 [1,157]	8,098 [1,141]	53 [0]	82,247 [3,624]
Splake	0.0007	1,229 [410]	61 [61]	45 [45]	392 [182]	160 [138]	35 [16]	0 [0]	1,922 [476]
Northern pike	0.0009	266 [120]	264 [151]	53 [33]	271 [148]	644 [358]	1,063 [377]	0 [0]	2,561 [574]
White perch	0.0032	0 [0]	718 [501]	5,375 [3,348]	971 [447]	1,637 [1,596]	440 [387]	0 [0]	9,141 [3,789]
Smallmouth bass	0.0092	0 [0]	6,665 [1,573]	4,168 [836]	7,091 [1,380]	6,257 [994]	2,153 [526]	0 [0]	26,334 [2,518]
Yellow perch	0.0896	1,834 [584]	7,590 [1,511]	22,680 [5,297]	46,948 [9,232]	66,329 [10,117]	111,816 [14,683]	0 [0]	257,197 [20,829]
walleye	0.0081	3,470 [1,008]	9,080 [1,748]	3,754 [716]	3,616 [1,182]	1,642 [382]	1,800 [655]	0 [0]	23,362 [2,561]
<b>TOTAL</b>	<b>0.2568</b>	<b>19,877</b> [2,036]	<b>55,752</b> [3,468]	<b>132,936</b> [7,208]	<b>172,521</b> [10,339]	<b>171,008</b> [11,185]	<b>183,169</b> [15,051]	<b>1,775</b> [195]	<b>737,038</b> [22,950]
Angler hours		230,217 [18,041]	240,683 [10,522]	467,293 [21,569]	802,996 [29,186]	364,354 [31,792]	346,383 [18,551]	17,518 [1,445]	2,870,450 [55,770]

Table 5. Estimated catch per hour, catch and effort for the boat fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay in 1998. Standard deviations in brackets.

Species	Total catch per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho salmon	0.0252	178 [60]	14,550 [1,650]	19,761 [1,359]	8,647 [1,059]	7,116 [941]	5,169 [719]	25 [0]	55,446 [2,664]
Chinook salmon	0.0547	3 [0]	2,436 [304]	27,499 [2,187]	45,002 [2,367]	32,231 [2,871]	13,023 [1,223]	261 [0]	120,455 [4,496]
Rainbow trout	0.0477	60 [42]	7,369 [836]	26,144 [1,686]	19,264 [1,501]	35,062 [2,808]	17,104 [2,048]	60 [0]	105,063 [4,228]
Atlantic salmon	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Brown trout	0.0087	5,495 [1,353]	531 [140]	2,188 [435]	5,226 [785]	3,415 [756]	2,253 [549]	43 [0]	19,151 [1,878]
Brook trout	0.0000	0 [0]	0 [0]	5 [0]	4 [0]	7 [0]	3 [0]	0 [0]	19 [0]
Lake trout	0.0373	399 [252]	5,372 [531]	18,498 [1,306]	33,544 [2,905]	16,275 [1,157]	8,083 [1,141]	53 [0]	82,224 [3,624]
Splake	0.0006	740 [349]	61 [61]	45 [45]	392 [182]	160 [138]	0 [0]	0 [0]	1,398 [424]
Northern pike	0.0009	147 [80]	251 [151]	0 [0]	236 [145]	591 [354]	770 [347]	0 [0]	1,995 [544]
White perch	0.0011	0 [0]	0 [0]	321 [239]	0 [0]	1,637 [1,596]	440 [387]	0 [0]	2,398 [1,659]
Smallmouth bass	0.0103	0 [0]	5,586 [1,508]	4,029 [827]	6,646 [1,372]	4,960 [851]	1,490 [381]	0 [0]	22,711 [2,390]
Yellow perch	0.1032	267 [196]	4,769 [1,338]	19,447 [5,234]	37,599 [9,085]	63,688 [10,077]	101,402 [14,420]	0 [0]	227,172 [20,524]
walleye	0.0075	2,716 [997]	6,651 [1,550]	2,420 [634]	2,609 [1,008]	795 [298]	1,366 [633]	0 [0]	16,557 [2,303]
TOTAL	0.2973	10,005 [1,749]	47,576 [3,211]	120,357 [6,317]	159,169 [10,175]	165,937 [11,134]	151,103 [14,716]	442 [0]	654,589 [22,301]
Angler hours		91,625 [16,177]	189,773 [9,614]	394,449 [20,327]	716,065 [28,640]	510,693 [31,631]	297,478 [16,423]	1,862 [0]	2,201,945 [53,459]

Table 6. Estimated catch per hour, catch and effort for the pier fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay in 1998. Standard deviations in brackets.

Species	Total catch per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho salmon	0.0046	0 [0]	83 [52]	271 [74]	186 [65]	17 [17]	77 [43]	0 [0]	634 [120]
Chinook salmon	0.0072	0 [0]	0 [0]	395 [138]	266 [95]	21 [14]	312 [101]	0 [0]	994 [196]
Rainbow trout	0.0093	0 [0]	0 [0]	939 [196]	334 [137]	7 [7]	0 [0]	0 [0]	1,280 [239]
Atlantic salmon	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Brown trout	0.0088	340 [184]	249 [179]	208 [66]	240 [80]	54 [30]	121 [55]	0 [0]	1,212 [284]
Brook trout	0.0004	0 [0]	18 [18]	20 [15]	19 [19]	0 [0]	0 [0]	0 [0]	57 [30]
Lake trout	0.0002	0 [0]	0 [0]	8 [8]	0 [0]	0 [0]	15 [15]	0 [0]	23 [17]
Splake	0.0032	445 [213]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	445 [213]
Northern pike	0.0021	119 [89]	0 [0]	0 [0]	0 [0]	0 [0]	170 [116]	0 [0]	289 [147]
White perch	0.0031	0 [0]	0 [0]	0 [0]	429 [321]	0 [0]	0 [0]	0 [0]	429 [321]
Smallmouth bass	0.0058	0 [0]	414 [382]	7 [7]	56 [41]	323 [206]	0 [0]	0 [0]	800 [436]
Yellow perch	0.0909	1,537 [550]	2,385 [687]	518 [353]	6,781 [1,443]	1,317 [874]	0 [0]	0 [0]	12,538 [1,935]
walleye	0.0005	72 [46]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	72 [46]
TOTAL	0.1361	2,513 [625]	3,149 [909]	2,366 [438]	8,311 [1,492]	1,739 [898]	695 [170]	0 [0]	18,773 [2,073]
Angler hours		13,265 [1,702]	13,530 [1,607]	22,318 [2,112]	42,322 [3,009]	20,082 [1,720]	26,390 [2,054]	0 [0]	137,907 [5,117]

Table 7. Estimated catch per hour, catch and effort for the shore fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay in 1998. Standard deviations in brackets.

Species	Total catch per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho salmon	0.0062	23 [23]	13 [12]	54 [33]	192 [118]	18 [13]	866 [187]	0 [0]	1,166 [226]
Chinook salmon	0.0158	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	2,992 [458]	0 [0]	2,992 [458]
Rainbow trout	0.0033	144 [88]	13 [13]	286 [81]	96 [65]	0 [0]	82 [65]	0 [0]	621 [151]
Atlantic salmon	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Brown trout	0.0220	2,235 [555]	740 [290]	273 [84]	212 [84]	116 [47]	597 [151]	0 [0]	4,173 [657]
Brook trout	0.0002	0 [0]	0 [0]	15 [15]	0 [0]	0 [0]	30 [22]	0 [0]	45 [27]
Lake trout	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Splake	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	9 [9]	0 [0]	9 [9]
Northern pike	0.0010	0 [0]	13 [13]	0 [0]	0 [0]	53 [51]	123 [88]	0 [0]	189 [103]
White perch	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Smallmouth bass	0.0089	0 [0]	439 [197]	0 [0]	158 [77]	851 [466]	242 [144]	0 [0]	1,690 [532]
Yellow perch	0.0340	0 [0]	372 [136]	2,361 [702]	2,360 [735]	481 [226]	877 [308]	0 [0]	6,451 [1,094]
Walleye	0.0010	0 [0]	0 [0]	0 [0]	0 [0]	53 [40]	141 [125]	0 [0]	194 [131]
TOTAL	0.0925	2,402 [563]	1,590 [376]	2,989 [712]	3,018 [756]	1,572 [524]	5,959 [641]	0 [0]	17,530 [1,491]
Angler hours		25,400 [2,552]	14,059 [1,114]	20,701 [1,680]	27,286 [2,032]	18,972 [1,493]	83,104 [4,745]	0 [0]	189,522 [6,281]

Table 8. Estimated catch per hour, catch and effort for the stream fishery with all survey areas combined for Wisconsin waters of Lake Michigan and Green Bay in 1998. Standard deviations in brackets.

Species	Total catch per hour	Mar/Apr	May	June	July	August	Sept/Oct	Nov/Dec	Season
Coho salmon	0.0057	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	1,723 [399]	234 [53]	1,957 [402]
Chinook salmon	0.0358	14 [14]	0 [0]	0 [0]	0 [0]	0 [0]	12,139 [1,282]	59 [17]	12,212 [1,282]
Rainbow trout	0.0115	3,116 [468]	0 [0]	297 [170]	0 [0]	0 [0]	265 [80]	246 [61]	3,924 [508]
Atlantic salmon	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Brown trout	0.0083	1,071 [368]	0 [0]	0 [0]	0 [0]	0 [0]	970 [210]	794 [176]	2,835 [459]
Brook trout	0.0001	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	38 [0]	0 [0]	38 [0]
Lake trout	0.0000	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]	0 [0]
Splake	0.0002	44 [33]	0 [0]	0 [0]	0 [0]	0 [0]	26 [14]	0 [0]	70 [36]
Northern pike	0.0003	0 [0]	0 [0]	53 [33]	35 [28]	0 [0]	0 [0]	0 [0]	88 [44]
White perch	0.0185	0 [0]	718 [501]	5,054 [3,339]	542 [311]	0 [0]	0 [0]	0 [0]	6,314 [3,391]
Smallmouth bass	0.0033	0 [0]	226 [117]	132 [120]	231 [122]	123 [52]	421 [333]	0 [0]	1,133 [396]
Yellow perch	0.0324	30 [28]	64 [30]	354 [212]	208 [249]	843 [70]	9,537 [2,749]	0 [0]	11,036 [2,769]
walleye	0.0192	682 [143]	2,429 [809]	1,334 [333]	1,007 [617]	794 [236]	293 [110]	0 [0]	6,539 [1,111]
TOTAL	0.1353	4,957 [614]	3,437 [959]	7,224 [3,369]	2,023 [745]	1,760 [252]	25,412 [3,087]	1,333 [195]	46,146 [4,779]
Angler hours		99,927 [7,373]	23,323 [3,802]	29,827 [6,691]	18,323 [4,284]	14,607 [2,249]	139,413 [6,904]	15,656 [1,445]	341,076 [13,667]

Table 9. Average weight, average length and standard weight of salmonids from Wisconsin's Lake Michigan creel survey, all areas and fishery types combined, 1988-1998. std = standard deviation.

Year	Average weight	± 1 std	Average length	± 1 std	Standard weight
COHO SALMON					
88	4.38927	1.54369	22.4100	2.42620	3.99351
89	4.27399	1.78496	22.5015	2.84274	3.61157
90	4.49193	1.98750	22.6016	3.18498	3.91757
91	4.06888	2.43805	21.6905	3.43957	3.94545
92	4.14931	1.86944	21.9365	3.23596	3.80521
93	3.73333	1.73959	21.2199	2.67736	3.94100
94	3.30836	2.22174	20.1049	3.28443	3.81682
95	3.15977	1.99077	20.3647	3.47945	3.60603
96	4.63768	2.01798	22.5823	3.13583	3.86726
97	3.05433	1.48431	20.2170	2.79178	3.53675
98	3.34911	1.67759	21.0745	2.64935	3.56118
CHINOOK SALMON					
88	11.5957	5.9518	30.0629	6.19946	9.8516
89	9.1850	6.4074	27.4232	6.90950	9.7596
90	9.5136	6.5206	27.6409	7.20534	9.8052
91	8.1385	6.5538	25.7534	6.96827	10.2605
92	10.2518	7.2367	27.9216	7.73204	9.8032
93	10.5038	8.3701	27.4037	8.33738	10.1905
94	10.4453	8.3485	27.0273	8.71924	9.9749
95	9.8882	8.1733	26.3952	8.11261	10.4336
96	8.0482	6.7959	25.7176	7.10989	9.7475
97	9.1569	6.2956	27.3781	6.74607	9.7349
98	9.9393	6.1881	27.9896	6.31167	9.8589
RAINBOW TROUT					
88	6.18994	2.62653	25.4178	4.10865	3.92737
89	6.75515	2.64824	26.6901	3.99997	3.95339
90	6.78511	2.95833	26.2191	4.91875	3.84274
91	6.64343	2.79610	26.3469	4.22405	3.82737
92	7.18517	2.88283	27.0546	4.47526	3.79149
93	6.89070	3.42457	26.2585	4.66549	3.56237
94	6.21323	3.06970	25.5027	4.35808	3.85317
95	6.23276	2.94965	25.4630	4.14715	3.80152
96	6.79034	2.86028	25.8947	4.06373	3.88880
97	6.84737	2.85516	26.6210	4.04426	3.72070
98	6.19126	2.64612	25.9667	3.62382	3.58878
BROWN TROUT					
88	5.50485	2.87826	20.6188	3.94544	4.16698
89	5.49486	2.40390	21.4536	3.25663	4.04284
90	4.96225	2.78125	20.3590	3.76981	4.01236
91	5.11816	2.81203	20.5944	3.39683	4.14541
92	4.39258	2.74944	19.7675	4.06703	3.85596
93	4.82192	2.93521	20.3673	3.98565	3.73331
94	5.57982	3.95542	21.1341	4.70539	3.90347
95	5.27967	3.43907	21.1004	3.92262	3.95885
96	5.53499	3.85055	21.1594	4.26341	3.85055
97	4.89833	2.84844	21.1254	4.05403	3.41882
98	5.95000	3.99012	21.9235	5.16062	3.72114
BROOK TROUT					
88	1.26522	1.11659	13.2891	3.22257	0.97643
89	1.75833	1.52712	15.0167	3.35943	0.92961
90	1.34937	1.49648	13.5329	2.26595	1.02508
91	3.13023	2.88002	17.2930	3.89837	0.73253
92	1.12372	1.28716	12.6987	3.12662	0.86757
93	1.37581	1.36666	13.9435	3.60139	0.87697
94	1.09787	1.21434	12.8191	2.72769	0.89121
95	1.24588	1.03562	12.9365	2.60036	1.03696
LAKE TROUT					
88	8.37042	3.56947	27.5120	3.37376	5.84536
89	8.50272	3.69427	27.8936	3.40782	5.63748
90	8.89295	3.68464	28.1648	3.38979	5.78703
91	9.36891	3.91243	28.5284	3.53048	6.03743
92	9.05581	3.92863	28.6493	3.46747	5.69210
93	7.79163	4.09545	26.8924	3.86344	5.81264
94	7.16244	3.81730	26.3183	4.00574	5.71564
95	8.74280	4.38484	27.3754	3.94920	6.59102
96	7.52374	4.59381	26.3436	4.89904	5.41955
97	7.34694	3.77508	26.5681	3.97078	5.65128
98	8.42521	4.02759	27.4861	3.88826	5.67117

Figure 1. Geographical area of Wisconsin's share of Lake Michigan.

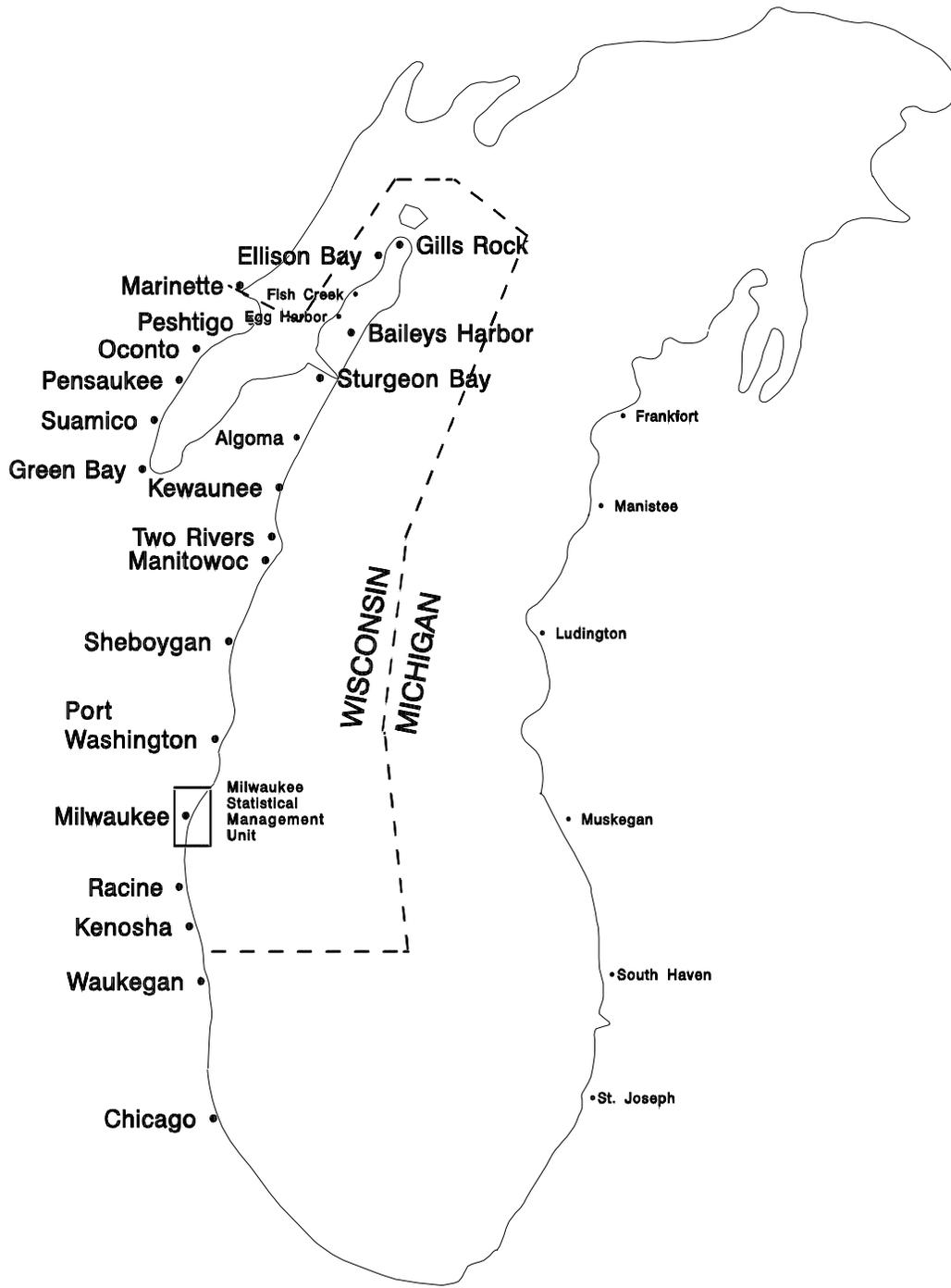
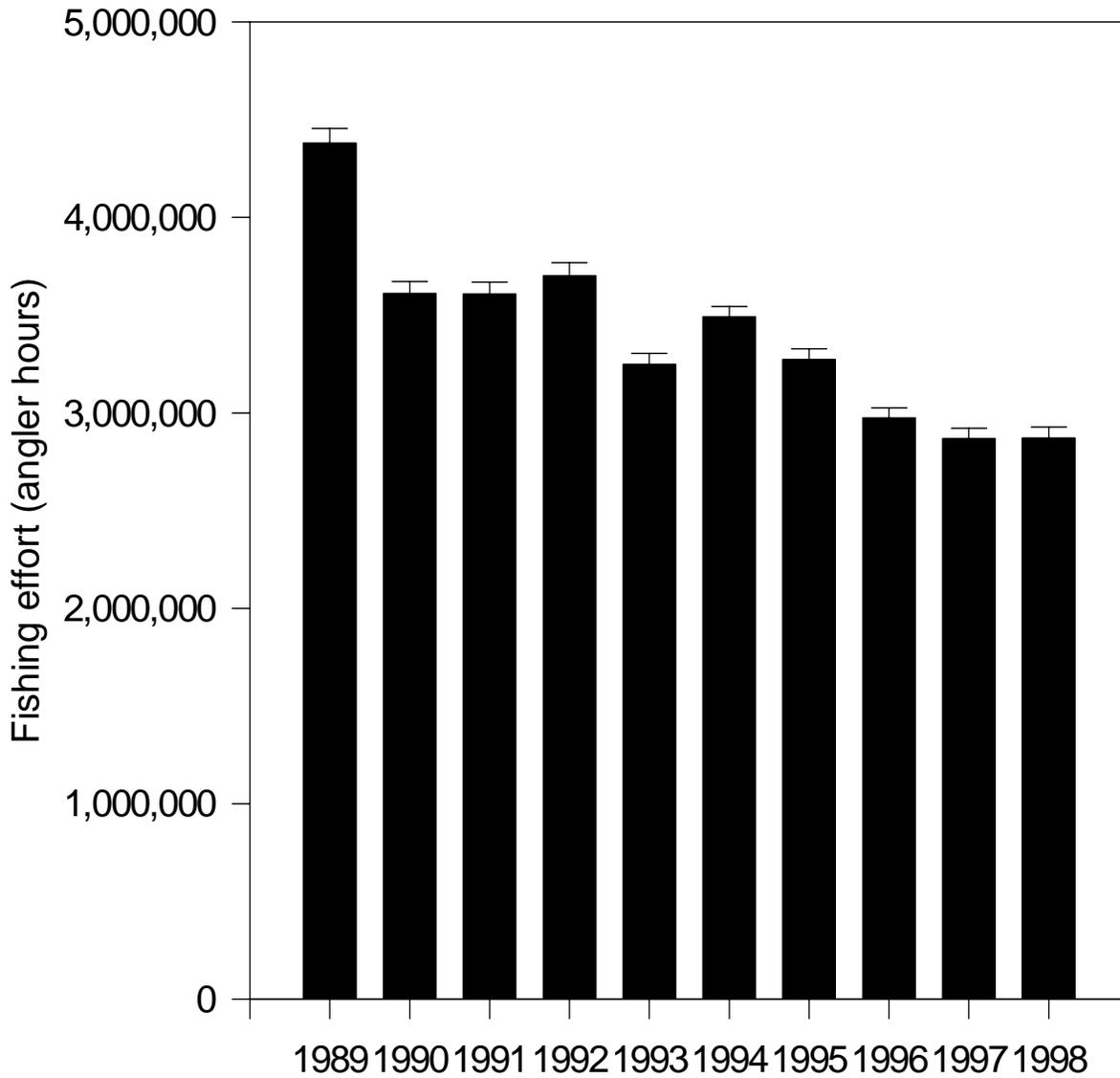


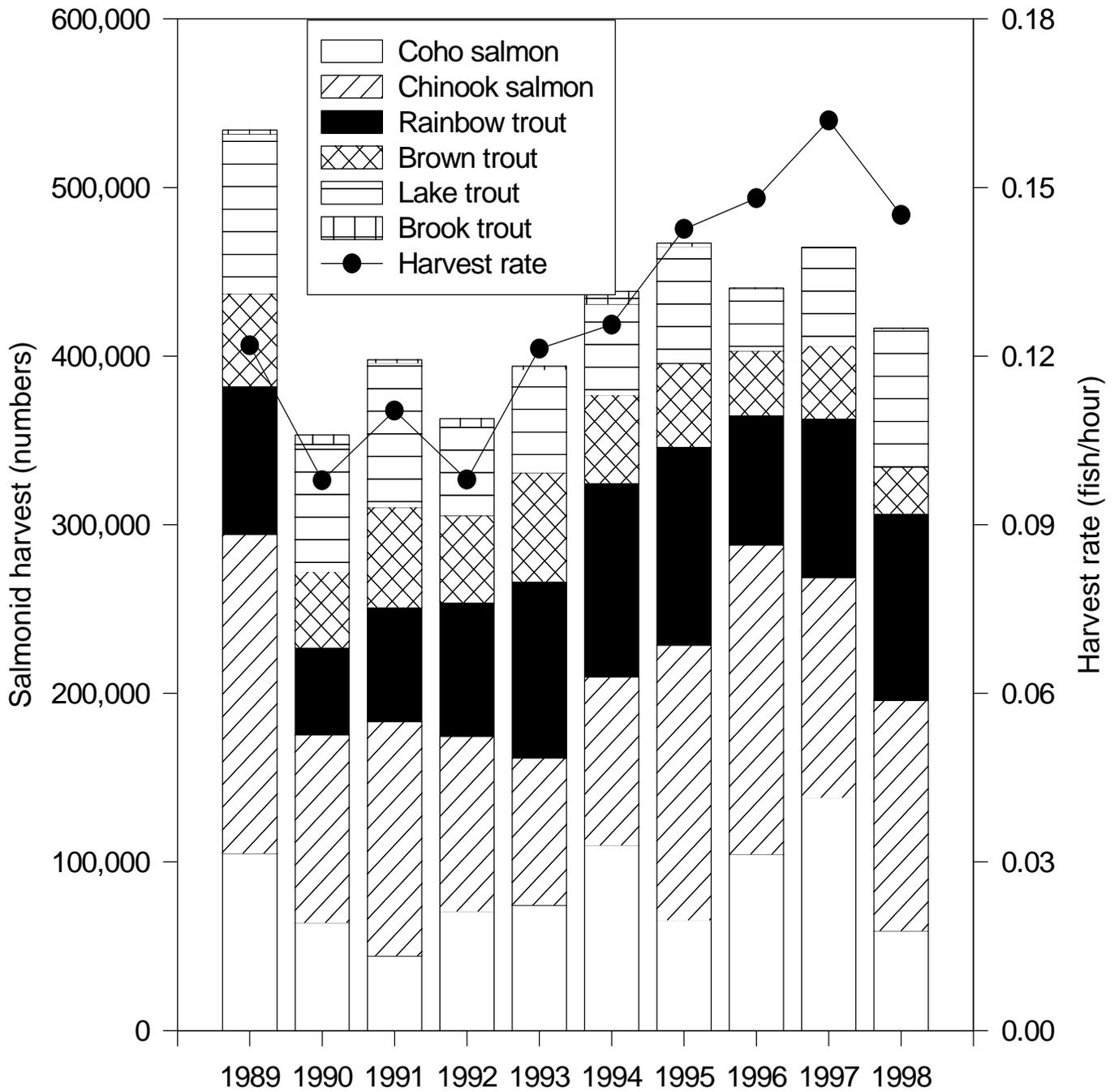
Figure 2. Angler Interview Form.

Figure 3. Catch Record Form.

**Figure 4. Fishing effort in angler hours from Wisconsin's waters of Lake Michigan and Green Bay, 1989-1998.**



**Figure 5. Salmonid harvest and harvest rate from Wisconsin's waters of Lake Michigan and Green Bay, 1989-1998.**



**Figure 6. Yellow Perch harvest and harvest rate from Wisconsin's waters of Lake Michigan and Green Bay, 1992-1998.**

