LAKE MICHIGAN

2010 Creel Survey Report

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EXECUTIVE SUMMARY

- A nonuniform probability creel survey was conducted on Lake Michigan from April 1 to October 31, 2010 and three Lake Michigan tributaries from March 1 to March 31, 2010, and July 1 to December 31, 2010. The survey covered sport fishing by shore anglers and boat anglers (including chartered trips) from several Indiana ports (Washington Park and Trail Creek Marina, Michigan City; numerous private ramps and slips on Burns Waterway, Portage; Pastrick Marina, East Chicago; Whihala Beach County Park boat launch, Whiting, and Hammond Marina, Hammond) and stream anglers on three tributaries of Lake Michigan (Trail Creek, LaPorte County; East Branch of the Little Calumet River, Porter County, and Salt Creek, Porter County).

- Due to Indiana's close proximity to neighboring states' borders and the migratory nature of trout and salmon, many boat fishing trips were conducted in other states' waters. The estimates provided represent estimates of fish returned to Indiana ports. Because a subset of all fishing locations was surveyed, the creel survey cannot yield estimates of total harvest and effort for southern Lake Michigan. Rather, the creel data is used to monitor trends in the Lake Michigan fishery.

- During the survey period anglers fished an estimated 383,231 h, which was -15% below the estimated number of hours anglers fished in 2009. Seventy-two percent of the fishing hours came from boat anglers. Angler effort was greatest during the month of July, followed by April, August, and June. Anglers spent the majority of time pursuing salmonine species, followed by yellow perch, and black bass species.

- Estimated total catch from the combined fisheries was 304,703 fish representing twenty-three fish species; a decline of 43% compared to the 2009 catch. More fish were caught in July than in any other month. Boat anglers accounted for the majority of the catch, 87% of the total.

- Yellow perch dominated the 2010 catch, comprising 67% of the total.

- Anglers from 52 of Indiana's 92 counties were represented in the creel survey. The majority of Indiana anglers interviewed were from Lake, Porter, and LaPorte counties. Angler parties from 21 different states were also represented during this survey, with the majority of these anglers from Illinois; primarily Cook and Will counties.

- Overall, the majority of salmonine, perch, and black bass anglers felt it was very important to have their targeted species in Lake Michigan and tributaries. However, more shore parties were displeased with the nearshore fishery than boat angler parties.

TABLE OF CONTENTS

	Page
LIST OF TABLES…….....	iii
LIST OF FIGURES……	v
LIST OF APPENDICES……	ix
INTRODUCTION……..	1
STUDY SITE…….....	2
METHODS…….	3
RESULTS……...	6
Trout and salmon…….....	8
Yellow Perch…….....	10
Black bass species…….	11
Species preference…….	12
Angler residency…….....	12
Angler satisfaction…….....	13
DISCUSSION…….	14
RECOMMENDATIONS……...	19
ACKNOWLEDGMENTS……..	20
LITERATURE CITED……...	20
APPENDICES……	51

LIST OF TABLES

Table		Page
1.	Number of trout and salmon stocked in Lake Michigan by Indiana Department of Natural Resources, 2001 through 2010…….....	22
2.	Millions of trout and salmon, fingerling and yearling stages combined, stocked in Lake Michigan between 2001 and 2010……..	23
3.	Estimated angler hours and catch from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010, based on total effort..	24
4.	Estimated angler hours and catch, by site and fishing method, from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010, based on total effort……..	24
5.	Boat fishery monthly estimated catch and effort from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010, based on total effort…….....	25
6.	Shore fishery monthly estimated catch and effort from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010, based on total effort…….....	25
7.	Stream fishery monthly estimated catch and effort from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010, based on total effort…….....	26
8.	Estimated salmonine catch and effort from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)…….....	26
9.	Estimated effort (angler-hours), catch (by species), and catch rates (CPUE) by anglers from the Indiana Department of Natural Resources Lake Michigan creel survey during April-October (lake) and March, July-December (stream), 2010. For yellow perch catch and catch rates, only data from anglers fishing for yellow perch were used. For salmonine catch and catch rates, only data from anglers fishing for salmonine species were used. For black bass catch and catch rates, only data from anglers fishing for black bass were used…….....	27
10.	Estimated salmonine catch and effort from the Indiana Department of Natural Resources Lake Michigan stream creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort).....	28

Table		Page
11.	Estimated yellow perch harvest, catch, and effort from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 though 2010. Only data from anglers fishing for yellow perch were used (directed effort).....	28
12.	Estimated number of black bass harvested and released by boat and shore anglers from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.....	29
13.	Preference categories of angler parties fishing Lake Michigan during 2010, by fishery…….	30
14.	Weather variables and possible scores used in determining the mean daily weather conditions by month in the Lake Michigan creel survey, 2009 and 2010……	31

LIST OF FIGURES

Figure		Page
1.	Indiana shoreline of Lake Michigan……..	32
2.	Number of trout and salmon stocked in Lake Michigan by Indiana Department of Natural Resources, 2001 through 2010…….	33
3.	Salmonine CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)…….	33
4.	Salmonine CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for salmonine species were used (directed effort)…….	34
5.	Coho salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)…….	34
6.	Coho salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for salmonine species were used (directed effort)…….	35
7.	Chinook salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)…….	35
8.	Chinook salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for salmonine species were used (directed effort)…….	36
9.	Steelhead trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)…….	36
10.	Steelhead trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for salmonine species were used (directed effort)…….	37

Figure Page

11. Brown trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)……. 37

12. Brown trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for salmonine species were used (directed effort)……... 38

13. Lake trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)……... 38

14. Salmonine CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by port. Only data from anglers fishing for salmonine species were used (directed effort)…….. 39

15. Salmonine CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by stream. Only data from anglers fishing for salmonine species were used (directed effort)…….. 39

16. Coho salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by stream. Only data from anglers fishing for salmonine species were used (directed effort)……. 40

17. Chinook salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by stream. Only data from anglers fishing for salmonine species were used (directed effort)……. 40

18. Steelhead trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by stream. Only data from anglers fishing for salmonine species were used (directed effort)……. 41

19. Number of coho salmon stocked in Trail Creek with corresponding coho CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)……..... 41

Figure		Page
20.	Number of coho salmon stocked in E. Branch Little Calumet River with corresponding coho CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)……	42
21.	Number of Chinook salmon stocked in Trail Creek with corresponding Chinook CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)……...	43
22.	Number of Chinook salmon stocked in E. Branch Little Calumet River with corresponding Chinook CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)…….....	44
23.	Number of steelhead trout stocked in Trail Creek with corresponding steelhead CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)…….	45
24.	Number of steelhead trout stocked in E. Branch Little Calumet River with corresponding steelhead CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort)……	46
25.	Yellow perch CPUE and harvest-per-unit-effort (harvest rate) from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for yellow perch were used (directed effort)……..	47
26.	Yellow perch CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for yellow perch were used (directed effort)…….	47
27.	Yellow Perch CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by Port. Only data from anglers fishing for yellow perch were used (directed effort)…….	48
28.	Black bass CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for black bass species were used (directed effort)……	48

Figure Page

29. County of residence of anglers that were surveyed in the Indiana Department of Natural Resources Lake Michigan creel survey fishing from boat, shore and stream during 2010 (n=2,829)…….. 49

30. Mean daily weather scores by month from the Indiana Department of Natural Resources Lake Michigan creel survey, 2009 and 2010……... 50

LIST OF APPENDICES

Appendix		Page
I (a).	Trail Creek public access map…….	51
I (b).	East Branch of the Little Calumet/Salt Creek public access map…….	52
II.	Estimated total catch for species other than salmonines, yellow perch, or black bass species from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010……..…….....	53
III.	Average length and weight of salmonine species and yellow perch observed from the Indiana Department of Natural Resources Lake Michigan creel survey during 2001 through 2010. Data from boat, shore, and stream fisheries combined. std. = standard deviation……..	54
IV (a).	Length frequency of coho salmon observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010…….....	56
IV (b).	Average total length of creeled coho salmon from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010….....	56
IV (c).	Average weight of creeled coho salmon from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010…….....	57
V (a).	Length frequency of Chinook salmon observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010……	57
V (b).	Average total length of creeled Chinook salmon from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010……..	58
V (c).	Average weight of creeled Chinook salmon from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.....	58
VI (a).	Length frequency of steelhead observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010…….....	59

Appendix		Page
VI (b).	Average total length of creeled steelhead from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.....	59
VI (c).	Average weight of creeled steelhead from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010…...	60
VII (a).	Length frequency of brown trout observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010……..	60
VII (b).	Average total length of creeled brown trout from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010…….	61
VII (c).	Average weight of creeled brown trout from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010…...	61
VIII (a).	Length frequency of lake trout observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010……...	62
VIII (b).	Average total length of creeled lake trout from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010……...	62
VIII (c).	Average weight of creeled lake trout from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.....	63
IX (a).	Length frequency of yellow perch observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010……...	63
IX (b).	Average total length of creeled yellow perch from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010…….	64
IX (c).	Average weight of creeled yellow perch from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010……...	64

Appendix		Page
X (a).	County of residence of anglers that were surveyed in the Indiana Department of Natural Resources Lake Michigan creel survey fishing from boat from during 2010 (n=970)…….....	65
X (b).	County of residence of anglers that were surveyed in the Indiana Department of Natural Resources Lake Michigan creel survey fishing from shore during 2010 (n=937)…….....	66
X (c).	County of residence of anglers that were surveyed in the Indiana Department of Natural Resources Lake Michigan creel survey fishing from stream during 2010 (n=922)…….....	67
XI (a).	Boat, shore and stream angler response to the species importance and species satisfaction questions on a scale from 1 to 5, with 5 being the highest degree of importance and/or satisfaction from the Indiana Department of Natural Resources Lake Michigan creel survey, 2010.	68
XI (b).	Boat angler response to the species importance and species satisfaction questions on a scale from 1 to 5, with 5 being the highest degree of importance and/or satisfaction from the Indiana Department of Natural Resources Lake Michigan creel survey, 2010……...	68
XI (c).	Shore angler response to the species importance and species satisfaction questions on a scale from 1 to 5, with 5 being the highest degree of importance and/or satisfaction from the Indiana Department of Natural Resources Lake Michigan creel survey, 2010……	69
XI (d).	Stream angler response to the species importance and species satisfaction questions on a scale from 1 to 5, with 5 being the highest degree of importance and/or satisfaction from the Indiana Department of Natural Resources Lake Michigan creel survey, 2010……...	69

INTRODUCTION

Since 1969, the Indiana Department of Natural Resources (IDNR) has stocked trout and salmon along the Indiana shoreline of Lake Michigan to utilize the population of non-native alewives and enhance the sport fishery. The area stocked extends from Whiting, Indiana to Michigan City, Indiana, and includes sites along Trail Creek, the East Branch of the Little Calumet River, and the St. Joseph River (Figure 1). Trout and salmon are reared at Mixsawbah State Fish Hatchery in Walkerton, Indiana and Bodine State Fish Hatchery in Mishawaka, Indiana. From 2001 to 2010, the number of trout and salmon stocked in Indiana waters of Lake Michigan by the IDNR has averaged 1.1 million fish per year (Table 1, Figure 2). Lake-wide, an annual average of 12.5 million fingerling and yearling trout and salmon have been stocked into Lake Michigan since 2001 (Table 2).

To effectively manage Lake Michigan, biologists need to annually evaluate what is occurring within the fishery. One evaluation technique is the creel survey, utilized to gauge angler use and harvest on a body of water. These data are collected and used to assess the quality and quantity of a fishery, and provide information to evaluate stocking and fishing regulations. Since 1966, the Indiana Department of Natural Resources Division of Fish and Wildlife (DFW) has collected sport harvest data on Indiana's portion of Lake Michigan (McReynolds 1966).

The objective of the Indiana Lake Michigan creel survey is to evaluate sport fishing effort, fish catch by species, angler preferences and angler attitudes from southern Lake Michigan and northwest Indiana tributaries as part of the DFW Work Plan 300FW1F10D43504. Due to limitations in site access (e.g. access restrictions to industrial areas based upon the National Threat Advisory level) and budgetary restrictions, the creel survey can only provide an index of fishing catch, harvest, and effort along southern Lake Michigan and its tributaries. These data assist the DFW Lake Michigan fishery management efforts in providing valuable trend information concerning the status of sport fish in Lake Michigan and provides the sport community with catch and effort statistics.

STUDY SITE

Indiana's portion of Lake Michigan is the smallest of the four states bordering the Lake (approximately 1% of the Lake Michigan area), encompassing about 43 miles of shoreline (224 square miles). Most of the area is highly developed and heavily industrialized, with the exception of the Dunes National Lakeshore and the Indiana Dunes State Park.

Several lakefront marinas provide boat and shore access, including: Washington Park and Trail Creek Marina, Michigan City; one municipal ramp and several private ramps along Burns Waterway, Portage; Robert A. Pastrick Marina, East Chicago; Lake County Parks and Recreation Whihala Beach boat launch, Whiting; and Hammond Marina, Hammond. Three coal-fired power plants are also located along the shoreline, including the Northern Indiana Public Service Company (NIPSCO) Michigan City Generating Station, Michigan City; NIPSCO Bailly Generating Station, Burns Harbor; and the Dominion State Line Power Plant, Hammond. The NIPSCO Michigan City station and State Line Power Plant provide fishing opportunities for pedestrian (i.e. shore) anglers. No public entry is allowed at the NIPSCO Bailly Generating Station, although limited access exists just west of the station near Indiana Dunes National Lakeshore boat-in beach. Various other industries and private clubs along the shoreline also provide limited access to pedestrian (shore) and/or boat anglers (e.g. Mittal Steel, Burns Harbor; Midwest Steel, Burns Harbor; Amoco Whiting Refinery, Whiting; etc.). Access, however, is typically limited to employees or members of those businesses or clubs. Implementation of access restrictions at private industrial properties is directly influenced by the National Threat Advisory issued through the United States Department of Homeland Security. In the past, high national threat levels have resulted in closure to some of these points of access.

Public access to the tributaries of Lake Michigan is limited to county parks, city parks, state access sites or private property with landowner permission. Main tributaries of the Lake Michigan coastal area include: the Little Calumet River, Grand Calumet River, Turkey Creek, Deep River, Salt Creek, Coffee Creek, Dunes Creek, Trail Creek, Galena River, and several smaller tributaries and man-made ditches.

METHODS

The Lake Michigan creel survey was divided into boat, shore, and stream components. Sport fishing from the boat and shore fisheries was monitored between April 1 and October 31, 2010 at Washington Park and Trail Creek Marina in Michigan City, numerous private ramps and slips on Burns Waterway (Portage Marina, Doyne's Marina, Treasure-Chest Marina) in Portage, Pastrick Marina in East Chicago, the Lake County Parks and Recreation Whihala Beach boat launch in Whiting, and Hammond Marina in Hammond (Figure 1). The shore fishery was also monitored at the Michigan City Washington park pier, Port of Indiana Public Access Site (Portage), East Chicago Pastrick Marina pier, and the Hammond Marina pier. The lake survey was conducted using a non-uniform probability access design. Sampling probabilities, proportional to the amount of fishing expected, were assigned to each site (based upon historic angler survey effort data). The sum of the probabilities assigned to the sampling sites equaled one.

Stream sport fishing surveys were conducted at main public access sites (i.e. county parks, state access sites) and popular fishing areas on Trail Creek, the East Branch of the Little Calumet River, and Salt Creek. Each stream was sampled separately, from March 1 through March 31, and from July 1 through December 31, 2010. Trail Creek was sampled from the Trail Creek basin upstream to Johnson Road (Appendix I); the East Branch of the Little Calumet River was sampled from the Ameriplex complex (S.R. 249) upstream to the Indiana National Lakeshore Heron Rookery located on 600 East (Appendix I), and Salt Creek was sampled from the Ameriplex complex upstream to U.S. 30 (Appendix I). The stream survey was conducted using a non-uniform probability roving-access design. Probabilities were assigned to each tributary (based upon historic angler survey effort data) so that the total of the probabilities equaled one.

Sample size determination followed the guidelines recommended by Shipman and Hudson (1980); survey time covered at least 25% of the available fishing hours. The fishing season was stratified by fishery type (lake or stream), site (port or tributary), survey period (i.e. months), and day type (i.e. weekday, weekend). A two-stage sampling design (see Pollock et al. 1994) was used to assign days (primary sampling unit, PSU) and the site/shift combination (secondary sampling unit, SSU). The creel survey was

conducted on most weekend days and on two to three randomly chosen days during the week. Weekends were sampled more heavily due to heavier fishing effort compared to weekday effort. Holidays were classified as weekend days; however, no holidays were sampled due to administrative restrictions.

Fishing day lengths were standardized for the entire creel season to represent daylight hours (sunrise to sunset). The fishing day was described as 14-hours in length (0600 hours to 2000 hours) from April through September, 12-hours in length (0600 hours to 1800 hours) in March and October, and 9-hours in length (0700 hours to 1600 hours) in November and December. The fishing day was divided into two periods, or shifts: AM and PM. Shifts were equal in duration, did not overlap, and were sampled with equal probability. One or two shifts were worked per workday. Although a seasonal night fishery on Lake Michigan and tributaries exists, personnel safety and staffing concerns precluded the justification of including an additional shift in the Lake Michigan creel design.

Two intermittent employees (i.e. clerks) performed the lake survey from April through October; one intermittent employee performed the stream survey in March and July through December. The shift included time for travel to the site, and scheduling of two non-overlapping periods ranging from 7-hours April through September (0600 to 1300 hours and 1300 to 2000 hours), 6-hours March and October (0600 to 1200 hours and 1200 to 1800 hours), and 4.5-hours November and December (0700 to 1130 hours and 1130 to 1600 hours). All times were adjusted by 1 hour (moved forward or back) during daylight savings. Dates and SSU's were selected via random selection with replacement. Minor adjustments were made to the schedule in order to comply with the maximum 75-hour bi-weekly state personnel requirements.

Three types of data were collected for each lake site or tributary sampled: angler and/or vehicle counts for effort, angler interviews for harvest rates and total catch, and biological information on harvested fish.

Two types of multiple counts were utilized for the lake creel survey: interval and instantaneous. For the interval count, fishing boats were counted for a twenty-minute period as they returned to the port being surveyed. Three counts were made each day at the selected port. The count times for the early or late shift were selected at random,

without replacement, to insure that counts were made at various hours throughout the day during any given month. Interval boat counts occurred at sample areas where all boats returned to the port through a defined channel. Shore anglers were counted using instantaneous counts, performed immediately following the interval boat counts. Stream effort was measured by utilizing progressive counts. The clerk drove the entire stream section, stopping at predetermined sites to count either angler vehicles or anglers (anglers counted only at the DNR Public Fishing area located in the Trail Creek basin). Two progressive counts were performed per shift. Count times were selected using systematic random sampling as outlined in Pollock et al. (1994).

Between counts, the clerk (s) interviewed anglers to obtain catch and fishing times. Boat angler parties were interviewed at the completion of their fishing trip while shore and stream angler parties were interviewed while they were actively fishing. Both incomplete and completed fishing interviews were obtained from shore and stream anglers. If applicable, incomplete shore and stream fishing trips were updated throughout the shift. Anglers or angler parties were asked what time they started their fishing trip, if they came by car and parked at the vehicle count site (stream anglers only), what they fished for, and the number/type of fish harvested and released. Additional information about angler county-of-residence, species preference, and angler satisfaction was also collected. If a large number of boat, shore or stream anglers were encountered, the clerk (s) sub-sampled anglers for interviewing. Biological information was taken on harvested fish, including species, total length (mm), weight (kg), and presence or absence of fin clip (s). Both length and weight data were converted to inches and pounds for reporting purposes.

Effort and catch calculations followed Lockwood et al. (1999) and Pollock et al. (1994). Catch (fish harvested and released) and effort estimates were generated for each combination of site (lake port or tributary), day type, fishing mode, month and target species (information on target species obtained from the interviews when anglers were asked what species they were seeking). From the sample of counts and interviews, catch rate (R) and angling effort (E) were calculated; catch (C) was estimated as their product. All calculations were based upon multiple-day estimates. Multiple-day estimates treat all interviews within a longer period (i.e. month) as though they were random samples from

that longer time period. A single catch-rate was calculated for the month, then multiplied by effort for that month to produce estimates of catch. Multiple-day estimates were summed over the creel survey time period and angling mode to provide a total estimate of angling effort (angler hours) and catch. Although the multiple-day estimate ignores day-to-day differences in catch rates, inadequate sample sizes precluded the use of daily estimates (Lockwood et al. 1999).

Targeted (directed) effort and targeted (directed) catch were calculated similar to estimated effort and catch. Targeted effort comes directly from angler interviews where they were asked what target they were fishing for. In some cases we are more interested in effort directed at certain targets. For example, we may want to use catch estimates of yellow perch as an index of that species abundance. Targeted effort rates were calculated using the effort equations by substituting targeted effort for total effort. For a detailed description of the effort, directed effort, catch and directed catch calculations utilized, see Palla (2007).

With Indiana's close proximity to neighboring states' borders and the migratory nature of fish, many boat trips were actually conducted in other states' waters. The estimates provided in this report represent estimates of fish returned to Indiana ports. Since the Lake Michigan creel sampling design differs among years, direct comparison of catch and effort is problematic. Catch-per-unit-of-effort (CPUE) comparisons, however, produce standardized indices of catch to allow yearly comparisons. CPUE is provided as a measure of fishing quality or fishing success for important Lake Michigan sport fish species. Catch, or the total number of fish caught (whether kept or released), provides a more detailed recreational description; thus CPUE was utilized to standardize each fishing season.

Estimates of catch and effort are presented without confidence intervals. All estimates derived in this survey are given here without qualification; for simplicity of expression, the word "approximately" is not repeated with each estimated value.

RESULTS

Total number of interviews collected during the creel survey period from pedestrian (shore and stream) and boat anglers was 2,846, representing 5,674 anglers.

Nearly 48% (2,715) of the interviews were boat anglers. Total fishing effort from the lakefront and 3 tributary streams during the study period was 383,231 angler-hours, -15% below the 2009 effort of 450,335 (Table 3). Boat effort declined 16%, shore effort declined 23%, and stream effort declined 7% relative to the prior fishing season. Effort ranged from 22,584 h at Hammond to 124,035 h at Michigan City (Table 4). Most effort occurred in July (83,481 h), April (58,387 h), August (55,762 h), and June (52,021 h). Boat angler effort dominated all angler hours fished on Lake Michigan, 275,166 h, or 72% of the total (Table 3). Boat fishing effort was greatest in July (70,433 h), followed by April (54,963 h), August (48,069 h), and June (43,651 h; Table 5). Shore angler effort peaked in July at 8,829 h (Table 6). September (23,702 h), October (20,175 h), and March (11,152 h) accounted for the greatest stream angler effort (Table 7).

Average trip length calculated from completed trips was 2.4 h (n=696; SD = 1.65) for shore anglers, 3.4 h (n=436; SD = 2.35) for stream anglers, and 4.5 h (n=978; SD = 2.04) for boat anglers. Average pedestrian party size was 1.6 persons/party (SD = 0.83) for shore anglers and 1.5 persons/party (SD = 0.73) for stream anglers. Boat anglers averaged 2.8 persons/boat (SD = 1.34).

Anglers spent the majority of time pursuing salmonine species, 246,441 h or 64% of the total. Effort directed at yellow perch and black bass species followed, with 98,253 h or 26% of the total and 27,460 h or 7% of the total, respectively. Michigan City accounted for the greatest salmonine effort (87,751 h). Yellow perch effort was highest at Burns Harbor (35,078 h) followed by Michigan City (32,698 h). East Chicago and Burns Harbor accounted for the greatest black bass effort, over 80% of the total fishing pressure for bass occurred at these two sites.

Total catch from the combined fisheries was 304,703 fish representing twenty-three fish species; a decline of 43% compared to the 2009 catch of 534,735 fish (Tables 5-7, Appendix II). More fish were caught in July (106,659) than in any other month. The next highest catch occurred in August at 67,217 fish. Boat anglers accounted for the majority of the catch, 263,737 fish, or 87% of the total. Boat anglers also accounted for the largest decline in catch between the 2009 and 2010 creel seasons; catch fell nearly half the level observed in 2009 (487,459 fish).

Anglers caught 203,670 yellow perch, 23,210 coho salmon, 16,005 black bass (mainly smallmouth), 13,405 Chinook salmon, 11,189 steelhead trout, 10,468 lake trout, 8,819 smolts (sub-legal juvenile salmonines), and 1,280 brown trout (Tables 5-7). In addition to the species listed above, several other fish species were reported caught in or near the harbors and from area tributaries. These minor species included: catfish, creek chub, carp, crappie, freshwater drum, northern pike, rock bass, round goby, suckers, sunfish species, and walleye (Appendix II). Yellow perch dominated the overall catch, comprising 67% of the total. Coho salmon dominated the salmonine catch, comprising 34% of the total. Juvenile salmonines were mainly caught from the stream fishery. These sub-legal catches occurred mostly in the fall and spring, which directly corresponds to state fish hatchery stockings (Table 7). Angler catch was highest at Michigan City, accounting for 42% (127,941) of the total (Table 4). Of the tributary total, East Branch of the Little Calumet River reported the highest number of fish caught (7,947).

Trout and salmon

Anglers spent 246,441 h pursuing trout and salmon, catching 67,680 salmonines, all fisheries combined (Table 8). Of the fish caught, 86%, or 58,249, were equal to or greater than the minimum size limit of 14 inches. Catch was greatest during the months of April, July, and June for the boat fishery; June for the shore fishery; and November, October, and September for the stream fishery. Michigan City accounted for the greatest salmonine effort (87,751 h) and catch (26,801; Table 9).

Salmonine effort and catch both declined compared to 2009, 10% and 31%, respectively. Overall, shore anglers had the largest negative percent change in effort (-42%) and catch (-67%) between the 2009 and 2010 fishing seasons. Catch fell 36% each within the stream and boat fisheries; effort declined -9% and -6%, respectively.

The combined salmonine CPUE was 23.9 fish/100 h[1], a 30% decline in what was observed in 2009 and 16% lower than the ten-year average of 28.5 (Figure 3). The 2010 salmonine catch rate fell to one of the lowest rates observed during the 2001-2010 data

[1] The CPUE excludes juvenile salmonids. Juvenile salmonid catch data estimates are unavailable for 2001-2005.

series. Angler success for salmonines (i.e. CPUE) decreased for all fisheries compared to 2009 (Figure 4). The 2010 boat, shore, and stream catch rates all fell below their long-term averages.

By species, CPUE for coho salmon and Chinook salmon fell compared to the prior fishing season; whereas the steelhead trout, brown trout and lake trout CPUE increased (Figures 5, 7, 9, 11, and 13). Coho salmon catch rates declined to 9.2 fish per 100 h, which is one of the lowest observed during the 2001-2010 data series (Figure 5). Steelhead and lake trout catch rates increased to 4.5 fish per 100 h and 4.2 fish per 100 h, respectively, the highest CPUE observed during the 2001-2010 data series for these two salmonine species (Figures 9 and 13). Since boat anglers accounted for the majority of the catch and effort, their success throughout the fishing season had a substantial influence on salmonine catch rates (Table 9; Figures 4, 6, 8, 10, 12, and 13). For coho salmon and steelhead trout, however, the overall CPUE was directly influenced by the success (i.e. positive and negative) within the pedestrian fisheries (Figures 6 and 10). The 2010 shore coho salmon catch rate of 0.8 fish per 100 h was 90% lower than the 2009 catch rate of 7.6 fish per 100 h. Overall, salmonine catch rates were low at all lakefront pedestrian locations (Table 9). By port, East Chicago and Michigan City accounted for the highest salmonine catch rates (Figure 14). Within the stream fishery, East Branch of the Little Calumet River had the greatest salmonine catch rate (Figure 15).

Comparing 2010 salmonine catch rates with their long-term averages, only coho salmon and brown trout were caught at below-average rates (Figures 5 and 11). By fishery, boat anglers experienced an average to above-average season for Chinook salmon, brown trout, steelhead, and lake trout, but a below-average season for coho salmon. The 2010 boat coho salmon CPUE was nearly half the ten-year average of 23.8 fish per 100 h. Shore anglers had an average season for Chinook, steelhead, and brown trout, and a below-average season for coho salmon. Stream anglers experienced an average season for all salmonine species with the exception of Chinook salmon. Chinook salmon catch rates fell from 2.8 fish per 100 h in 2009 to 1.3 in 2010 (Table 10, Figure 8).

Annual stream sport salmonine CPUE estimates for 2001-2010, by species (i.e. species stocked by the IDNR into Trail Creek and E. Branch of the Little Calumet River),

are shown in Figures 16 to 18. Between 2001-2010, Salt Creek accounted for some of the highest coho, Chinook, and steelhead angler catch rates; even though Salt Creek is not directly stocked with trout and salmon. Figures 19 to 24 show the total number of fish stocked, by species and tributary, along with the annual stream sport salmonine CPUE estimates, by species and tributary, from 2001-2010. The primary y-axis portrays number of fish stocked; CPUE is plotted on the secondary y-axis. Only data from anglers fishing for salmonine species were used (directed effort). It is apparent that trends in catch rates are no longer related to stocking alone. These relationships are likely masked by changes in abundance from natural reproduction (e.g. Chinook salmon), changes in lake sport fishing success, forage levels, and other environmental factors.

Biological data collected on angler-caught coho salmon, Chinook salmon, lake trout, and steelhead show their average size decreased relative to 2009 (Appendix III-VIII). However, coho salmon and lake trout mean size remained higher than their long-term average (Appendix IV and VIII). Coho salmon had an average length of 21.1 (± 2.4) in and average weight of 3.12 (± 1.3) lb, an increase in length from the ten-year average of 20.4 (± 2.6) in and weight of 3.08 (± 1.5) lb. Lake trout average length was slightly above (+2%) the ten-year average, weight was 3% above the ten-year weight average. Chinook salmon average size of 26.1 (± 4.7) in and 6.85 (± 3.4) lb was lower than the ten-year average of 28.7 (± 4.8) in and 9.54 (± 4.4) lb. Steelhead trout average size of 24.1 (± 4.3) in and 5.08 (± 2.5) lb was also lower than the ten-year average of 27.1 (± 4.0) in and 7.33 (± 2.9) lb. Small sample sizes collected from brown trout precluded their inclusion in the analysis.

Yellow perch

Anglers spent 98,253 h pursuing yellow perch, catching 202,232 fish, all fisheries combined (Table 11). Boat anglers accounted for the majority of the perch catch, 191,987 fish or 95% of the total. Harvest was 101,623 fish, or 50% of the total catch, the third lowest harvest observed from the 2001-2010 time series. Sorting of fish is allowed within the bag limit as long as fish are in healthy condition at time of release.

Catch was greatest during the months of July, August, and June for the boat fishery and July and August for the shore fishery. Michigan City accounted for the greatest yellow perch effort (32,698 h) and catch (91,948; Table 9).

Yellow perch effort declined 33% compared to 2009. Catch was nearly half the 2009 estimate. Overall, boat anglers had the largest negative percent change in effort (-34%) and catch (-50%) between the 2009 and 2010 fishing seasons.

Yellow perch ranked first in angler catch, with an overall CPUE of 2.1 fish/h (Table 11, Figure 25). The 2010 yellow perch CPUE decreased 21% compared to the 2009 CPUE of 2.7 fish/h, and was 6% below the ten-year mean of 2.2 fish/h. Boat anglers experienced a below-average season, 2010 CPUE fell 9% from the ten-year average of 2.4 fish/h (Figure 26). Shore anglers experienced an above-average season, 2010 CPUE rose 25% over the ten-year average of 0.8 fish/h (Figure 26). Michigan City accounted for the highest yellow perch catch rates (Figure 27). By fishery, East Chicago and Michigan City accounted for the highest pedestrian perch CPUE and Michigan City and Hammond had the greatest boat perch catch rates (Table 9).

The average length and weight of yellow perch kept by anglers fell to 9.3 in (± 1.7) and 0.38 lb (± 0.28) in 2010, respectively (Appendix III and IX). Harvested yellow perch ranged in size from 5.5 to 14.8 in (Appendix IX). Mean total length and mean weight were 7% and 22% lower than the 2001-2010 data series mean of 10.0 (± 1.8) in and 0.49 (± 0.3) lb (Appendix IX).

Black bass species

A total of 16,005 black bass were caught during the survey, with 328 of those harvested, mainly smallmouth (Tables 5-7). Anglers targeting bass fished 27,460 h. Nearly 50% (7,841) were caught in July and May. Catch and effort were 12% and 14% higher than the observed 2009 bass catch and fishing effort (Table 12). The majority of fishing occurred from boats, accounting for 87% of the effort and 88% of the catch. The majority of bass were released, only 2% of the total catch was harvested. Within the boat and pedestrian fisheries, the number of legal-sized bass released outnumbered the sub-legal releases (bass less than 14.0 in). Smallmouth bass catch was greatest at East Chicago followed by Burns Harbor (Table 9).

Both the boat and pedestrian bass fishing season could be categorized as below-average comparing 2010 catch rates with their 10-year mean of 0.66 fish/h and 0.57 fish/h, respectively (Figure 28). East Chicago accounted for the highest pedestrian and boat perch CPUE (Table 9).

Species preference

To measure species preference, anglers were asked which species of fish they preferred to catch from Lake Michigan and its tributaries. A total of 2,807 responses were recorded from boat, shore and stream angler-party interviews (Table 13).

Fifty percent of boat anglers included at least one salmonine species in their response. On a species by species basis, boat anglers ranked yellow perch as their most preferred fish (38%), followed by Chinook salmon (22%), smallmouth bass (12%), coho salmon (10%), and steelhead trout (9%). Typically, steelhead trout preference has ranked third for boat anglers, following yellow perch and coho salmon. The average to below-average catch rates for steelhead trout from the boat fishery the prior fishing season continues to influence overall boat angler preference (Figure 10). The high yellow perch catch rates, ranking first in angler catch, also directly influenced overall boat angler preference.

Fifty percent of shore anglers also included at least one salmonine species in their response. By species, 26% of shore anglers ranked yellow perch as their most preferred fish (Table 13). Steelhead (24%), coho salmon (8%), Chinook salmon (8%), and smallmouth bass were also among the preferred species.

Stream anglers continue to rank steelhead trout as their most preferred species, accounting for 62% of the responses (Table 13). Chinook salmon (13%), any trout or salmon species (9%), and coho salmon (7%) followed.

Angler residency

Anglers from 52 of Indiana's 92 counties were represented in the creel survey (Figure 29). The majority of Indiana anglers interviewed were from Lake County, accounting for 25% of all anglers (Figure 29, Appendix X). Porter and LaPorte counties followed, accounting for 19% and 18% of the anglers, respectively. Another 9% came

from St. Joseph, Elkhart, Allen, Marshall, Starke, Jasper, and Kosciusko counties, located in northern Indiana. Angler parties from 21 different states were also represented during this survey, with the majority of these anglers from Illinois (87%); primarily Cook and Will counties.

Angler satisfaction

During the interview process, each fishing party was asked to rate the importance they placed on having the species they were targeting in Lake Michigan (or tributary), and their overall satisfaction with the quality of that specific fishery within the past 2-year period. If the fishing party was targeting any trout or salmon, all five trout and salmon species were asked to be rated.[2] Parties were instructed to rate the importance and satisfaction questions on a 5-point scale of "Not Important" or "Not Satisfied" (a 1 rating) to "Very Important" or "Very Satisfied" (a 5 rating). If the party was unable to rate these questions because of lack of fishing experience, the rating was recorded as a 6 (don't know).

Overall, the majority of salmonine, perch, and black bass anglers felt it was very important to have their targeted species in Lake Michigan and its tributaries (Appendix XI). One percent of anglers responded with a rating of 1 or 2 (i.e. not important/of little importance).

Most anglers were satisfied with the trout and salmon fishery; 64% of the salmonine anglers rated satisfaction between 3 and 5. However, 27% of boat anglers, 18% of shore anglers, and 30% of stream anglers were dissatisfied with the brown trout fishery. Twenty-four percent of the shore anglers and 17% of the stream anglers were less than satisfied with the Chinook salmon fishery. Over 50% of shore anglers were dissatisfied with the lake trout fishery; however, lake trout typically are not available to pedestrian shore anglers. In 2010, the percentage of displeased boat and pedestrian (i.e. shore and stream) anglers was lower for individuals targeting brown trout, lake trout, and steelhead compared to 2009. The number of boat anglers dissatisfied with the coho

[2] Stream anglers were not asked to rate lake trout since lake trout are confined mainly to Lake Michigan proper.

salmon fishery increased between 2009 and 2010, likely due to the poor coho boat fishing season (Figure 6).

For yellow perch, 14% of the angler parties targeting perch gave a low satisfaction rating. This percentage was similar to what was reported in 2009. More shore angler parties were dissatisfied with the yellow perch fishery than boat angler parties.

Less than six percent of the angler parties targeting black bass gave a low satisfaction rating. Again, more shore angler parties were dissatisfied with the bass fishery than boat angler parties.

DISCUSSION

The Lake Michigan recreational catch continues to be influenced by numerous variables including the environment (i.e. weather, water temperatures), changes in lake-wide stocking levels and forage levels, and threats from the unintentional introduction of aquatic invasive species such as *Dreissenid* mussels which have significantly changed the pelagic productivity of Lake Michigan.

The overall 2010 salmonine CPUE of 23.9 fish/100 angler-hours, one of the lowest observed from the prior ten-year period, was the direct result of a poor coho salmon fishing season. Coho CPUE fell from 21.7 fish/100 angler-hours to 9.2 fish/100 angler-hours, a 58% decline relative to 2009 and the second lowest catch rate observed from the 2001-2010 data series. Had it not been for the average/above-average Chinook salmon, steelhead trout, lake trout and yellow perch catch rates, the 2010 Lake Michigan creel season would have been marginal.

During 2010, the best fishing in southern Lake Michigan was for steelhead trout, lake trout, Chinook salmon, yellow perch, and smallmouth bass; for stream anglers, steelhead trout. Although differences in catch rates exist between the boat, shore and stream fisheries, in general, catch rates for these species were near-average to above-average from the 2001-2010 data series.

Typically, the majority of coho salmon caught from the lake occurs in April and May. In April and May, the average number of coho caught from southern Lake Michigan by boat and shore anglers is 29,300 fish, based on the 2001-2009 fishing

seasons. Salmonine angler effort averages 82,000 h. In 2010, an estimated 13,182 coho were caught in April and May; salmonine effort was 71,373 h. The decline in coho catch and angler effort could be attributed to a combination of lower coho salmon abundance in Lake Michigan coupled with poor spring weather conditions.

Coho stocking reductions, primarily by the Michigan Department of Natural Resources (MDNR) from 2007-2009 and by the Wisconsin Department of Natural Resources (WDNR) in 2008, contributed to the spring coho catch decline (Table 2). MDNR's standard coho stocking level of 1.6 million fish per year was not met between 2007- 2009 due to budgetary constraints and hatchery production issues. Only 931,897 yearlings were stocked in 2007, 1.2 million yearlings in 2008 and 670,000 yearlings in 2009. WDNR coho fingerling stocking level dropped 58% between 2007 and 2008. Given that the average size of coho salmon harvested in April and May from the creel survey was 20.2 in (±1.70; n=283), or age 2+ fish, this corresponds directly with the WDNR 2008 fingerling and MDNRE 2009 yearling coho stocking reductions. Additionally, in 2010 the weather was generally poorer compared to 2009, especially during May week days and April and May weekend days (Figure 30). Weather data were collected throughout the course of the 2010 Lake Michigan creel survey using on-site observations. Variables recorded each day the survey was performed included: wind direction, wind speed, wave height, air temperature, average sky, and precipitation. Each variable was subjectively assigned a point value based on expected effect (based on personal observation and experience) on angler effort, and a composite score was produced for each day (Table 14). Scores ranged from 7 to 29, with higher scores reflecting better weather.

The rise in the number of steelhead and lake trout caught was a direct result of the success boat anglers found during the summer months from June to August, especially within the nearshore waters of Lake Michigan. The steelhead trout summer catch was nearly 5.5 times the 2009 catch; the lake trout summer catch was 2.5 times the 2009 catch (Palla 2010). Catch rates for these species were also the highest to one of the highest reported from the 2001-2010 time period. Cold nearshore water temperatures can explain the higher salmonine catch observed during this three-month period. Preliminary temperature data collected by Cary Troy (Assistant Professor, Hydraulics and Hydrology

Group, School of Civil Engineering, Purdue University) using an autonomous underwater vehicle (AUV) off Michigan City July 26, 2010, showed water temperatures of 51 to 54F in waters ≥ 20 ft (Brian Breidert, personal communication). Temperature measurements collected by Lake Michigan office field staff July 28, 2010 confirm these colder water temperatures with surface readings of 78F and temperatures ranging from 50 to 60F between 40 and 50 ft of water. Those colder temperature pockets concentrated trout and salmon in nearshore areas at a time when these fish are usually found in offshore waters in depths greater than 150 ft. Between June-August 2009, 54% of the trout and salmon boat trips occurred in waters <70 ft. Between June-August 2010, 75% of the trout and salmon boat trips occurred in waters less than 70 ft, demonstrating that anglers were able to concentrate fishing effort and locate trout and salmon within the shallow nearshore waters of southern Lake Michigan. The Chinook salmon summer catch also increased, nearly 78% over what was observed in 2009 (4,555 fish). Although Chinook catch rates fell between the 2009 and 2010 fishing seasons, they were still above the ten-year long-term average (Figures 7 and 8).

Whether these above-average catch rates can be sustained is dependent upon lake-wide stocking levels, fish availability, forage levels and environmental variables such as water temperatures. Declines in Chinook salmon abundance likely reduced the overall demand on the prey fish population resulting in better survival of older salmonine age classes (Claramunt et al. 2010). However, Lake Michigan prey fish biomass levels still remain much lower than levels found in the 1990s (Warner et al. 2010). Total 2010 prey fish biomass was the third lowest biomass from the Great Lakes Science Center (GLSC) lake-wide survey of the fish community in Lake Michigan since 1973 (Brian Breidert, personal communication). The abundance of young alewives (age 0) in 2009 from the GLSC and MDNR acoustic surveys was the lowest of any acoustic survey which may negatively influence future salmonine growth and survival. However, the 2010 alewife year-class was the second largest in the time series which could positively affect future salmonine survival, especially if this year-class successfully over-wintered.

The length frequency distribution for coho salmon and lake trout were similar to what was observed in 2009. However, the length frequency distribution for Chinook salmon and steelhead showed a larger number of small, young fish in the 2010 creel. A

higher percentage of Chinook ranging from 21 to 28-in were measured in 2010 (>50%) compared to 2009 (23%). The bulk of these fish were caught in April, May, June, and July and likely represented fish age 2+ to 3+. The length frequency distribution for steelhead showed a higher percentage of fish ranging from 18 to 23-in were measured in 2010 (42%) compared to 2009 (8%). The bulk of these fish were caught in April and May and likely represented fish age 2+. The increase in the number of young Chinook and steelhead measured within the creel survey suggests that an abundance of alewives vulnerable to young, small salmonines currently exists in Lake Michigan.

Management of salmonine populations in Lake Michigan will remain a balancing act with the continued adjustment of stocking and harvest levels in an attempt to better match forage abundance along with other ecosystem components (Clapp and Horns 2008). Indiana stocking levels remain stable; the number of salmonines stocked by the IDNR between 2001 and 2010 has averaged 1.1 million fish each year. Unfortunately, the number of fish that Lake Michigan can sustain may change as new species and habitat alterations continue to affect the ecosystem. In Lake Michigan, stocking additional trout and salmon does not lead to additional harvest. Too much stocking can lead to poor feeding conditions and increased mortality; too little stocking could lead to negative effects of alewife on other native species.

The yellow perch fishing season was below average which is reflected in the perch CPUE of 2.1 fish per h. The 2010 yellow perch CPUE decreased 21% compared to 2009, and was 6% below the ten-year mean of 2.2 fish/h. While the cold summer nearshore temperatures were favorable for trout and salmon anglers, the opposite was true for perch anglers. Yellow perch schools were scattered throughout the southern basin which impacted the ability of anglers to find fish. Ball State University sampling was also impacted. It appears that yellow perch were deeper than 10 m depths and not concentrated when compared to historical summer collections from their preliminary 2010 data of yellow perch research in Indiana waters (Lauer 2011).

Perch fishing should remain average to above average in the short term as a result of the dramatic surge in yellow perch reproduction in 2005 (Makauskas and Clapp 2010). The current yellow perch population continues to be supported mainly by the 2003 and 2005 year classes (age-5 and age-7 fish). Poor year-classes have been produced since

2005, lake-wide, which directly impacts future adult yellow perch abundance. Although yellow perch assessments throughout the lake continue to show sustained low adult yellow perch abundance, recent increases in the catch of age-0 perch in 2009 and 2010 may increase future perch abundance. Recruitment in 2009 and 2010, however, was still relatively low in most areas of the lake in comparison to long-term averages (Brian Breidert, personal communication). Since the 2010 lake-wide sampling did not provide evidence that the yellow perch population abundance is changing and their abundance still remains much lower than historical levels, current management actions will remain in place to protect the remaining stocks. Those management actions include: 1) closure of the Lake Michigan commercial season for yellow perch, with the exception of Green Bay where the quota for 2011 is 100,000 lb; and 2) daily bag limit of 15 fish in Indiana and Illinois, with a July closure in Illinois (exception: under 16 years of age a 10 fish bag limit); daily bag limit of 35 fish (south of the 45th parallel) and 50 fish (north of the 45th parallel and Grand Traverse Bays) in Michigan; daily bag limit of 5 fish in Wisconsin waters of Lake Michigan with a May 1 to June 15 sport fishing closure, and a daily bag of 15 fish in Green Bay with a March 16 to May 19 sport fishing closure.

Smallmouth bass and other minor species (e.g. catfish, drum, rock bass, etc.) continue to provide good angling opportunities for both boat and shore anglers. However, shore angler parties continue to be dissatisfied with the nearshore fishery; primarily for smallmouth bass and yellow perch. The low satisfaction ratings are likely related to the lack of fish availability at the shore/marina fishing piers, which is more a function of the nearshore environment rather than fish abundance.

Salmonine species, yellow perch, and smallmouth bass continue to be important components of the Lake Michigan fish community. Trout and salmon, originally planted to utilize an overabundant population of non-native alewives, provide sport fishing opportunities for lake and tributary anglers. Stocking levels have been adjusted in an attempt to minimize the risk of a prey fish and salmon population crash and its overall impact to the fishery. Balanced predator-prey levels remain critical for a stable Lake Michigan salmonine fishery (Claramunt et al. 2010). Lake-wide stocking levels, forage levels and other environmental variables (i.e. water temperatures) will continue to influence fishing success within southern Lake Michigan. Indiana waters are unique and

diverse, with a shallow basin and the presence of coldwater fish species (i.e. trout and salmon), coolwater fish species (i.e. yellow perch), and warmwater fish species (i.e. smallmouth bass). This diversity within the fish community not only provides valuable fishing opportunities but also provides an economic impact to local communities. Fishing related expenditures such as bait, tackle, food, license fees, lodging, and transportation represent a large monetary value. While our survey does not have an economic component, recent national surveys of hunting and fishing from 2001 to 2006 estimate that nearly five percent of all angling nationwide occurred in Great Lakes waters (U.S. Department of Interior 2006). This represented $1.5 billion dollars in expenditures per year. One measure that may directly address the fishery value is looking at yield values (theoretical value) of harvested fish. Based on yield values provided by Illinois Natural History Survey (i.e. market prices of salmonine and perch fillets), we can look at a simplified monetary value. The Illinois Natural History Survey (INHS) added yield values in their Lake Michigan creel report beginning in 1986 to assess the hypothetical price harvested fish represented (Wayne Brofka, personal communication)[3]. Using INHS methodology and 2009 national market data, the 2010 yield value of salmonines and perch harvested by sport anglers from the IDNR Lake Michigan creel survey was nearly $2 million.

RECOMMENDATIONS

- The Lake Michigan Fisheries Research Office should continue to assess sport fish harvest, fishing pressure and angler opinions through the Lake Michigan creel survey. Information on sport fishery harvest and catch per unit effort is essential to make management decisions and develop a better understanding of population dynamics.

- The Lake Michigan Fisheries Research Office should continue to provide creel survey data to the Lake Michigan Technical Committee for use in the recreational database, the lake-wide harvest extraction database, as well as for the SWG in the development of a management strategy for predator/prey communities in the lake, and the YPTG in the development of a management strategy for yellow perch.

[3] For a detailed description of how INHS calculated yield values, see Brofka and Czesny (2010).

- The Lake Michigan Fisheries Research Office should continue to provide an Indiana representative for the Lake Michigan Technical Committee Creel Working Group. A representative will allow additional information/idea exchange with other state and university professionals to further refine and improve Indiana's Lake Michigan creel survey methodology.

- The Lake Michigan Fisheries Research Office should continue to utilize naturalist aides to conduct creel during the summer and fall months. This is a cost-saving measure for the Division and allows the Division to hire quality individuals with a fishery/wildlife background.

- The Lake Michigan Fisheries Research Office should continue assessments of how to increase fishing opportunities, including but not limited to the addition of public fishing sites, increase fish availability for shore anglers, and emphasize and improve marketing of this extraordinary resource beyond the surrounding Lake Michigan communities.

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Table 1. Number of trout and salmon stocked in Lake Michigan by Indiana Department of Natural Resources, 2001 through 2010.

	LAKE MICHIGAN				ST. JOSEPH RIVER			
	Brown Trout	Chinook Salmon	Coho Salmon	Steelhead	Chinook Salmon	Coho Salmon	Steelhead	Total
2001	0	297,195	157,048	297,971	153,520	0	293,475	1,199,209
2002	35,000	253,000	224,797	298,884	0	0	306,297	1,117,978
2003	40,400	232,395	233,248	309,134	0	0	282,857	1,098,034
2004	46,238	237,052	236,026	334,968	0	0	278,109	1,132,393
2005	36,371	251,281	237,009	645,576	0	0	287,471	1,457,708
2006[1]	42,900	225,000	79,018	257,206	0	0	234,211	838,335
2007[2]	41,110	217,389	231,342	349,497	0	0	279,255	1,118,593
2008	22,446	215,770	248,667	295,489	0	0	276,511	1,058,883
2009	23,039	206,714	239,846	314,177	0	0	288,268	1,072,044
2010	35,053	232,789	243,296	305,163	0	8,890	261,007	1,086,198
Avg.	32,256	236,859	213,029	340,807	n/a	n/a	278,746	1,117,937

[1]Due to the shut-down and rehabilitation of Mixsawbah State Fish Hatchery in 2006, the coho salmon plantings were reduced by 60%; the spring release skamania steelhead were stocked in the fall of 2005 as fingerlings; Michigan steelhead (winter-run) were stocked in 2007 as yearlings instead of December 2006 as fingerlings; and the St. Joseph River fall steelhead plantings were reduced by approximately 40,000 fish to offset changes to the Trail Creek and Little Calumet River steelhead stockings

[2]Due to the shut-down and rehabilitation of Mixsawbah State Fish Hatchery in 2006, the spring release skamania steelhead were stocked in the fall of 2006 as fingerlings.

Table 2. Millions of trout and salmon, fingerling and yearling stages combined, stocked in Lake Michigan between 2001 and 2010.

	Brook Trout	Brown Trout	Chinook Salmon	Coho Salmon	Lake Trout	Rainbow Trout	Splake	TOTAL
2001	0.102	1.749	4.518	2.765	2.382	1.849	0.131	13.496
2002	0.050	1.754	4.015	2.690	2.224	1.861	0.126	12.720
2003	0.024	1.649	4.422	3.124	2.609	2.078	0.104	14.010
2004	0.001	1.601	4.303	1.687	2.354	1.583	0.122	11.651
2005	0.000	1.523	4.306	2.561	2.887	2.170	0.099	13.546
2006	0.001	1.611	3.253	2.430	2.770	1.788	0.166	12.019
2007	0.000	1.487	3.173	2.269	3.624	2.010	0.125	12.688
2008	0.005	1.550	2.724	2.029	3.415	1.761	0.087	11.571
2009	0.000	1.632	3.020	1.746	2.771	2.069	0.000	11.238
2010	0.041	1.426	3.295	2.516	3.385	1.677	0.000	12.340
Avg.	0.022	1.598	3.703	2.382	2.842	1.885	0.096	12.528

Table 3. Estimated angler hours and catch from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010, based on total effort.

Fishery	Total Effort	%	Catch	%
Boat	275,166	(72%)	263,737	(87%)
Shore	34,818	(9%)	24,192	(8%)
Stream	73,247	(19%)	16,774	(5%)
TOTAL	383,231	(100%)	304,703	(100%)

Table 4. Estimated angler hours and catch, by site and fishing method, from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010, based on total effort.

Site	Boat Effort	Pedestrian Effort	*Total Effort*	Boat Catch	Pedestrian Catch	*Total Catch*
Hammond	18,701	3,883	*22,584*	26,830	1,505	*28,335*
East Chicago	89,047	3,254	*92,301*	57,000	7,229	*64,229*
Burns Harbor	61,188	9,876	*71,064*	65,366	2,058	*67,424*
Michigan City	106,230	17,805	*124,035*	114,541	13,400	*127,941*
Salt Creek	---	27,013	*27,013*	---	4,682	*4,682*
E. Branch Little Calumet	---	22,648	*22,648*	---	7,947	*7,947*
Trail Creek	---	23,586	*23,586*	---	4,145	*4,145*
Total	275,166	108,065	*383,231*	263,737	40,966	*304,703*

Table 5. Boat fishery monthly estimated catch and effort from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010, based on total effort.

Species	April	May	June	July	Aug.	Sept.	Oct.	Total
Steelhead	1,206	492	1,207	2,450	1,161	54	0	6,570
Coho	10,250	2,888	4,969	2,303	624	116	19	21,169
Chinook	919	1,890	2,515	4,248	1,797	966	34	12,369
Lake trout	1,336	2,398	1,389	1,727	3,322	225	71	10,468
Brown trout	752	89	43	180	65	0	0	1,129
TOTAL	14,463	7,757	10,123	10,908	6,969	1,361	124	51,705
Yellow perch	18,804	1,477	36,283	77,889	52,038	5,833	0	192,324
Black Bass sp.	895	2,713	943	4,392	908	2,513	1,730	14,094
Other	214	468	1,671	2,182	704	262	113	5,614
Angler hours	54,963	33,033	43,651	70,433	48,069	12,895	12,122	275,166

Table 6. Shore fishery monthly estimated catch and effort from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010, based on total effort.

Species	April	May	June	July	Aug.	Sept.	Oct.	Total
Steelhead	43	42	443	77	0	0	4	609
Coho	44	0	0	0	0	63	4	111
Chinook	0	0	0	0	0	118	8	126
Lake trout	0	0	0	0	0	0	0	0
Brown trout	36	0	0	0	0	0	0	36
TOTAL	123	42	443	77	0	181	16	882
Yellow perch	0	54	1,585	5,573	4,034	100	0	11,346
Black Bass sp.	85	622	81	114	609	168	74	1,753
Other	321	3,508	2,073	2,160	1,356	486	307	10,211
Angler hours	3,424	4,550	8,370	8,829	4,967	3,093	1,585	34,818

Table 7. Stream fishery monthly estimated catch and effort from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010, based on total effort.

Species	March	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Steelhead	1,116	310	306	757	228	1,088	205	4,010
Coho	46	0	0	579	934	371	0	1,930
Chinook	0	0	0	119	652	139	0	910
Brown trout	47	16	0	0	0	0	52	115
smolts*	1,220	2,453	126	434	223	2,626	1,737	8,819
TOTAL	2,429	2,779	432	1,889	2,037	4,224	1,994	15,784
Yellow perch	0	0	0	0	0	0	0	0
Black Bass spp.	0	20	0	60	78	0	0	158
Other	16	565	167	20	64	0	0	832
Angler hours	11,152	4,219	2,726	23,702	20,175	7,141	4,132	73,247

*juvenile salmonids.

Table 8. Estimated salmonine catch and effort from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort).

Year	Chinook Salmon	Coho Salmon	Steelhead Trout	Lake Trout	Brown Trout	Smolts[1]	Total	Directed Effort (hrs.)
2001	9,644	75,207	11,857	4,708	2,602	---	104,018	334,359
2002	17,309	107,432	15,299	1,709	2,654	---	144,403	362,228
2003	8,396	56,144	11,133	624	1,122	---	77,419	290,486
2004	11,407	23,668	5,566	308	1,191	---	42,140	197,291
2005	19,937	37,222	9,748	3,441	1,914	---	72,262	274,161
2006[2]	12,092	21,768	6,044	1,513	787	5,666	47,870	168,650
2007	15,219	17,083	8,452	3,635	1,980	4,384	50,753	187,785
2008	14,166	32,390	7,353	8,279	1,841	1,498	65,527	202,862
2009	19,353	59,252	7,776	6,380	836	3,938	97,535	272,806
2010	13,378	22,712	11,107	10,406	1,258	8,819	67,680	246,441

[1] Smolt (juvenile salmonid) catch data estimates unavailable for 2001-2005.
[2] Indiana Lake Michigan creel survey re-designed; modifications implemented in 2006.

Table 9. Estimated effort (angler-hours), catch (by species), and catch rates (CPUE) by anglers from the Indiana Department of Natural Resources Lake Michigan creel survey during April-October (lake) and March, July-December (stream), 2010. For yellow perch catch and catch rates, only data from anglers fishing for yellow perch were used. For salmonine catch and catch rates, only data from anglers fishing for salmonine species were used. For black bass catch and catch rates, only data from anglers fishing for black bass were used. HA=Hammond; EC=East Chicago; BH=Burns Harbor; MC=Michigan City; SC=Salt Creek; LC=East Branch of the Little Calumet River; TC=Trail Creek.

			Catch (CPUE)						
Type of angler	Area	Effort (angler-hours)	Chinook Salmon[1]	Coho Salmon[1]	Steelhead Trout[1]	Brown Trout[1]	Lake Trout[1]	Yellow Perch[2]	Black Bass[2]
Boat	HA	18,701	160 (3.7)	297 (6.9)	73 (1.7)	15 (0.3)	488 (11.3)	24,381 (2.0)	473 (0.2)
	EC	89,047	5,194 (8.3)	10,835 (17.3)	2,084 (3.3)	858 (1.4)	1,450 (2.3)	27,023 (1.8)	7,475 (0.7)
	BH	61,188	968 (5.4)	924 (5.2)	618 (3.4)	70 (0.4)	209 (1.2)	54,903 (1.7)	5,282 (0.6)
	MC	106,230	6,026 (7.8)	8,614 (11.2)	3,739 (4.8)	163 (0.2)	8,259 (10.7)	85,682 (3.0)	507 (0.5)
Pedestrian	HA	3,883	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	11 (<0.1)	344 (0.3)
	EC	3,254	7 (2.2)	0 (0)	0 (0)	0 (0)	0 (0)	3,852 (1.9)	381 (0.7)
	BH	9,876	17 (0.8)	59 (2.5)	0 (0)	8 (0.3)	0 (0)	114 (<0.1)	212 (0.2)
	MC	17,805	100 (0.9)	52 (0.5)	583 (5.4)	28 (0.2)	0 (0)	6,266 (1.4)	58 (0.1)
	SC	27,013	306 (1.1)	758 (2.8)	975 (3.6)	0 (0)	0 (0)	0 (0)	0 (0)
	LC	22,648	372 (1.7)	909 (4.1)	1,590 (7.2)	99 (0.4)	0 (0)	0 (0)	0 (0)
	TC	23,586	228 (1.1)	264 (1.2)	1,445 (6.7)	17 (<0.1)	0 (0)	0 (0)	0 (0)
	TOTALS	383,231	13,378 (5.4)	22,712 (9.2)	11,107 (4.5)	1,258 (0.5)	10,406 (4.2)	202,232 (2.1)	14,732 (0.5)

[1]CPUE for salmonine species = fish per 100 angler-hours
[2]CPUE for yellow perch and black bass = fish per angler-hour

Table 10. Estimated salmonine catch and effort from the Indiana Department of Natural Resources Lake Michigan stream creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort).

Year	Chinook	Coho	Steelhead	Brown Trout	Total	Directed Effort (hrs.)
2001	2,263	1,840	6,951	302	11,356	105,885
2002	3,308	1,371	4,300	143	9,122	92,106
2003	1,177	1,229	4,080	71	6,557	89,393
2004	629	1,705	3,428	256	6,018	64,099
2005	966	2,567	3,601	381	7,515	67,257
2006[1]	1,963	1,544	2,643	153	6,303	48,002
2007	653	579	3,236	167	4,635	50,481
2008	664	1,669	2,228	113	4,674	43,907
2009	2,131	3,209	5,473	117	10,930	77,191
2010	910	1,930	4,010	115	6,965	70,550

[1] Indiana Lake Michigan creel survey re-designed; modifications implemented in 2006.

Table 11. Estimated yellow perch harvest, catch, and effort from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 though 2010. Only data from anglers fishing for yellow perch were used (directed effort).

Year	Effort (hrs.)	Harvest	Total harvest/hr.	Catch	Total Catch/hr.
2001	122,770	140,089	1.14	216,341	1.76
2002	97,161	124,656	1.28	198,275	2.04
2003	119,200	207,401	1.74	309,561	2.60
2004	97,971	144,442	1.47	201,906	2.06
2005	129,630	178,945	1.38	332,320	2.56
2006[1]	99,691	152,202	1.53	267,907	2.69
2007	87,208	89,655	1.03	161,126	1.85
2008	79,177	80,528	1.02	136,032	1.72
2009	146,567	214,367	1.46	395,015	2.69
2010	98,253	101,623	1.03	202,232	2.06

[1] Indiana Lake Michigan creel survey re-designed; modifications implemented in 2006.

Table 12. Estimated number of black bass harvested and released by boat and shore anglers from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.

			Released		Released			
	Harvest		<14	≥14	<14	≥14	Directed Effort	
Year	Boat	Pier	Boat	Boat	Pier	Pier	Boat	Pier
2001	322	70	1,988	4,447	862	275	10,475	2,208
2002	111	132	9,022	7,606	438	207	18,257	2,101
2003	367	78	1,253	4,220	902	135	13,794	1,850
2004	194	89	1,789	2,081	901	151	6,020	1,247
2005	106	108	3,410	4,288	1,033	254	8,470	2,134
2006[1]	94	80	1,532	4,179	527	377	11,605	917
2007	93	149	1,509	6,989	326	345	11,889	1,628
2008	541	77	4,742	8,916	188	273	23,270	2,509
2009	376	67	4,262	8,144	636	430	20,977	3,431
2010	83	245	3,876	10,135	647	861	23,907	3,553

[1] Indiana Lake Michigan creel survey re-designed; modifications implemented in 2006.

Table 13. Preference categories of angler parties fishing Lake Michigan during 2010, by fishery.

BOAT		SHORE		STREAM	
Species	No. Anglers (%)	Species	No. Anglers (%)	Species	No. Anglers (%)
Yellow Perch	360 (38%)	Yellow Perch	239 (26%)	Steelhead Trout	563 (62%)
Chinook Salmon	214 (22%)	Steelhead Trout	222 (24%)	Chinook Salmon	120 (13%)
Smallmouth Bass	114 (12%)	Coho Salmon	79 (8%)	Any Trout or Salmon	81 (9%)
Coho Salmon	100 (10%)	Chinook Salmon	74 (8%)	Coho Salmon	66 (7%)
Steelhead Trout	88 (9%)	Smallmouth Bass	73 (8%)	Anything	30 (3%)
Any Trout or Salmon	32 (3%)	Anything	52 (6%)	Brown Trout	15 (2%)
Walleye	14 (2%)	Any Trout or Salmon	52 (6%)	Catfish	13 (1%)
Lake Trout	10 (1%)	Catfish	51 (5%)	Any Black Bass Species	8 (<1%)
Brown Trout	7 (<1%)	Brown Trout	21 (2%)	Yellow Perch	4 (<1%)
Largemouth Bass	7 (<1%)	Walleye	19 (2%)	Bluegill	3 (<1%)
Anything	4 (<1%)	Bluegill	12 (1%)	Smallmouth Bass	3 (<1%)
Any Black Bass Species	4 (<1%)	Any Black Bass Species	11 (1%)	Northern Pike	2 (<1%)
Carp	4 (<1%)	Largemouth Bass	11 (1%)	Carp	1 (<1%)
Bluegill	1 (<1%)	Freshwater Drum	7 (<1%)	Largemouth Bass	1 (<1%)
Crappie	1 (<1%)	Lake Trout	6 (<1%)	Walleye	1 (<1%)
Any Sunfish Species	1 (<1%)	Round Goby	3 (<1%)		
		Crappie	1 (<1%)		
		Rock Bass	1 (<1%)		
		Whitefish	1 (<1%)		

Table 14. Weather variables and possible scores used in determining the mean daily weather conditions by month in the Lake Michigan creel survey, 2009 and 2010.

Wind direction		Wave height		Air temperature		Cloud cover	
Wind direction	Points	Feet	Points	Degrees F	Points		Points
N	1	0-3	4	below 20	1	Cloudy	3
NE	1	3-5	2	20 – 39	2	Clear	5
E	2	5+	1	40 – 59	3		
SE	4			60 – 80	4		
S	4			80+	3		
SW	3						
W	2						
NW	1						
Wind speed		Precipitation		Composite			
0 – 15	5	Yes	0	Scores		Ratings	
10 – 20	4	No	5	26 – 29		Perfect	
15 – 25	3			23 – 25		Good	
20 – 30	2			20 – 22		Fair	
30+	1			17 – 19		Mediocre	
				11 – 16		Poor	
				7 – 10		Atrocious	

Note: This subjective rating system gauges the effect of weather on angler effort, not angler success. Outstanding angler success does occur under inclement weather conditions; however, inclement weather generally results in light angler effort.

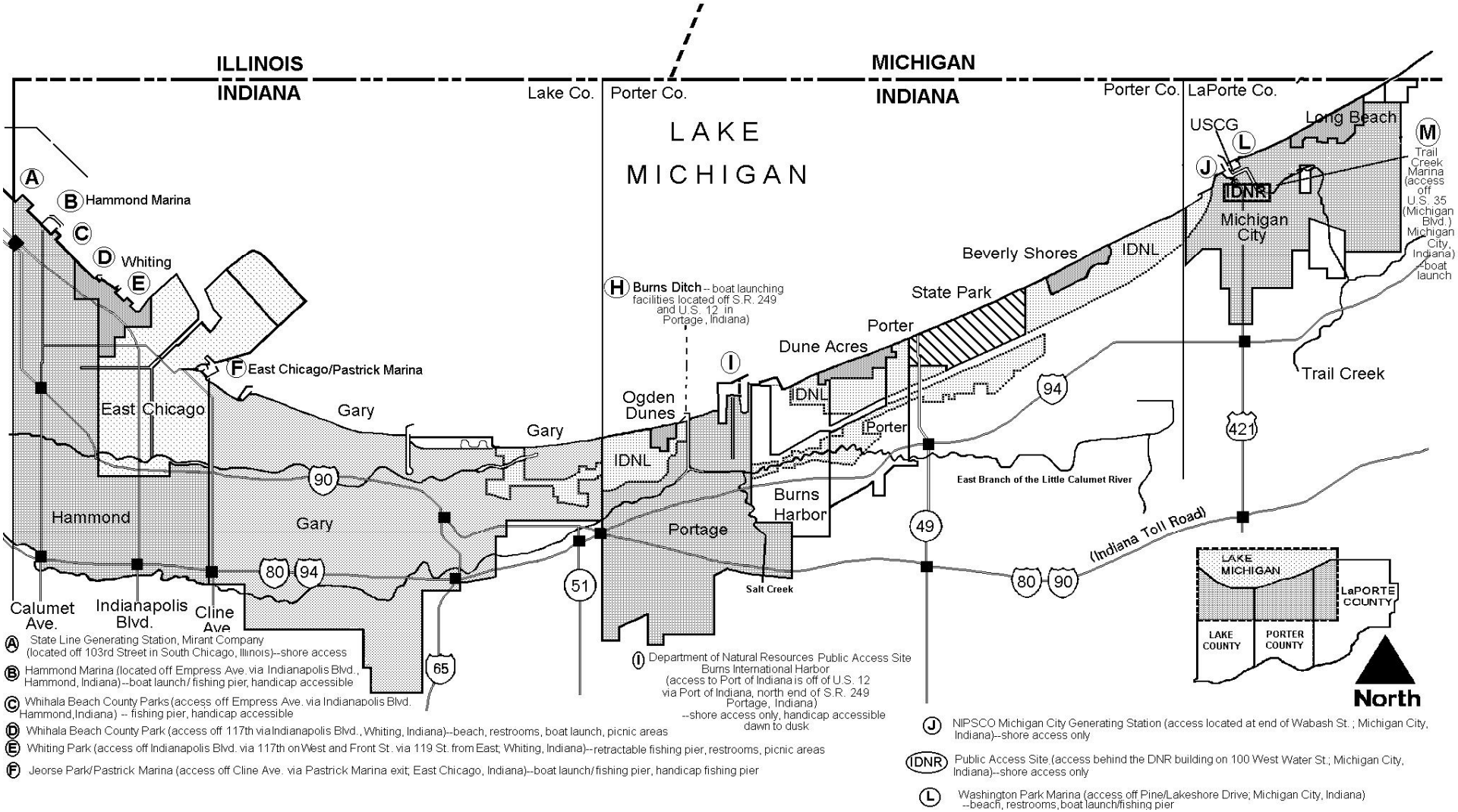


Figure 1. Indiana shoreline of Lake Michigan.

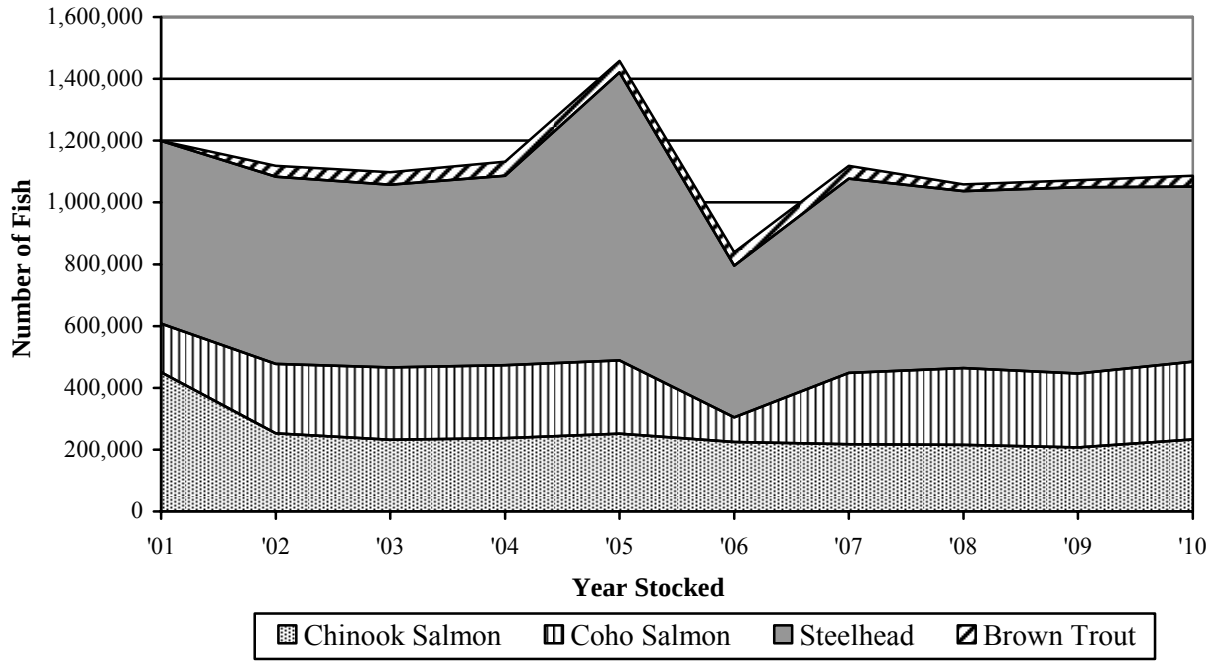


Figure 2. Number of trout and salmon stocked in Lake Michigan by Indiana Department of Natural Resources, 2001 through 2010.

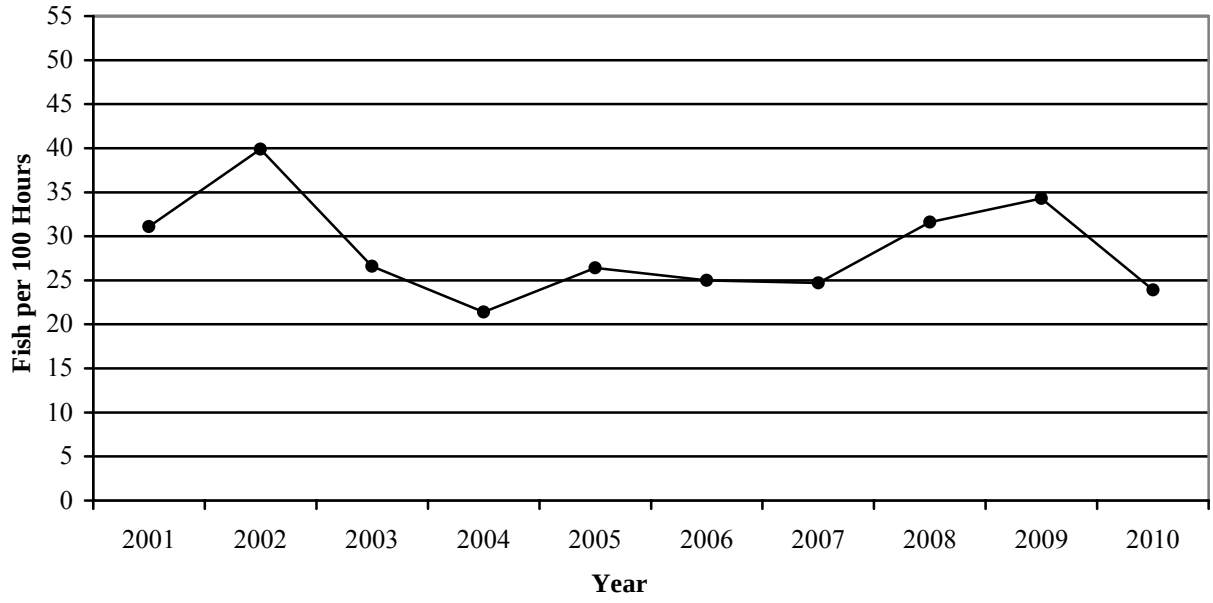


Figure 3. Salmonine CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort).

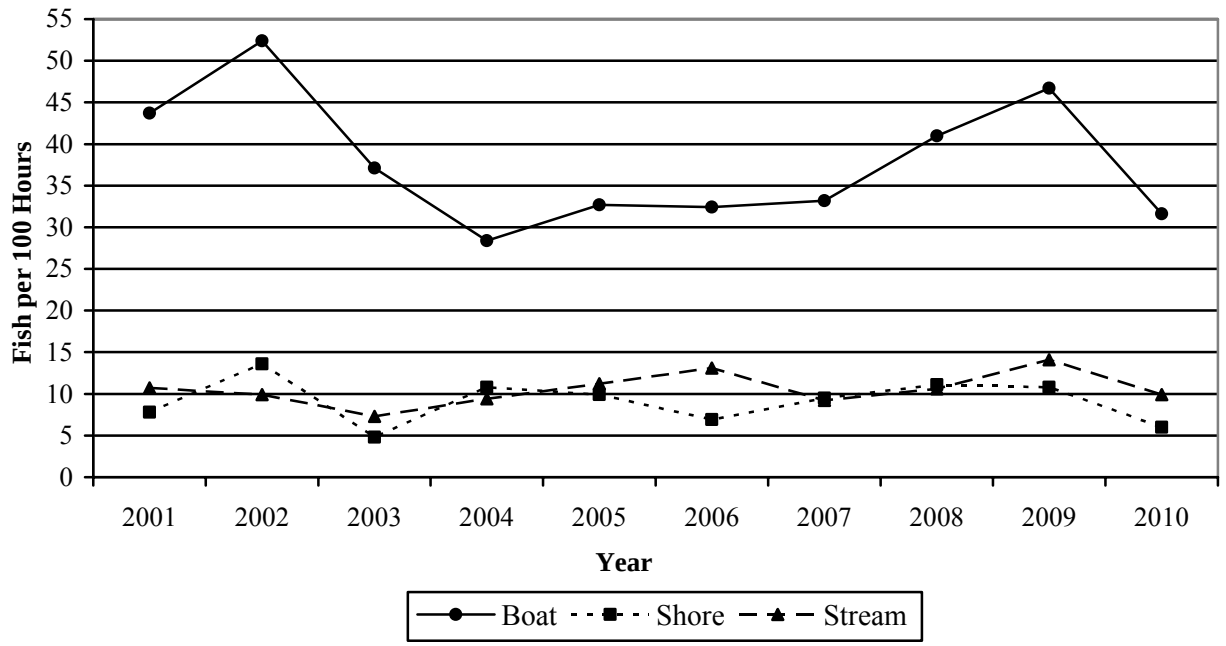


Figure 4. Salmonine CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for salmonine species were used (directed effort).

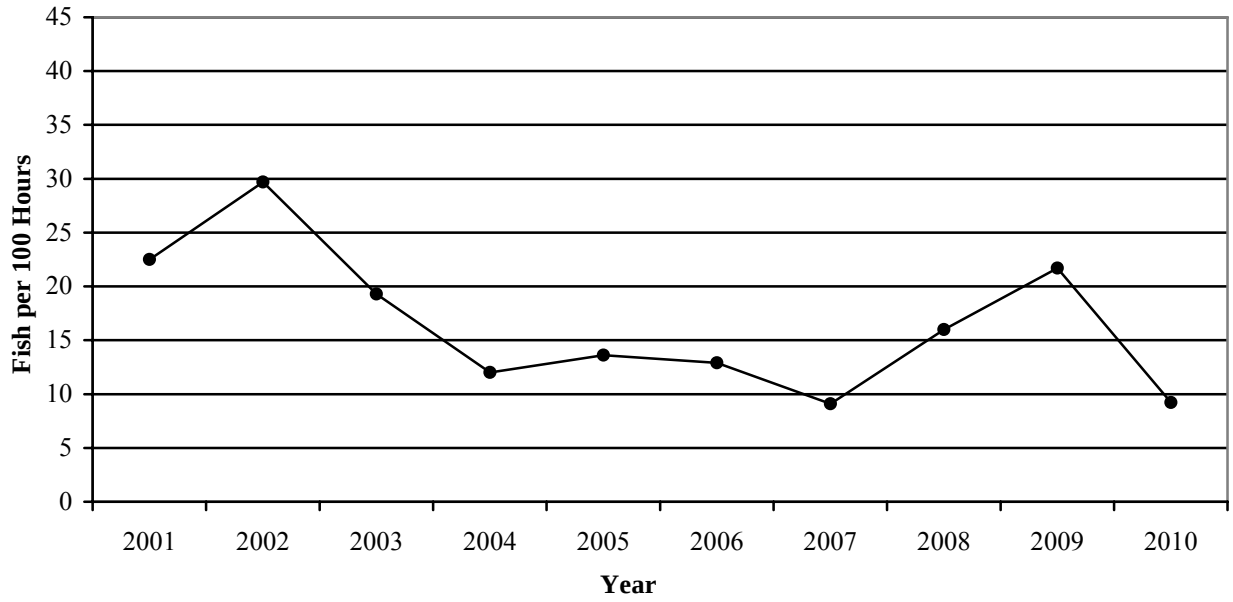


Figure 5. Coho salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort).

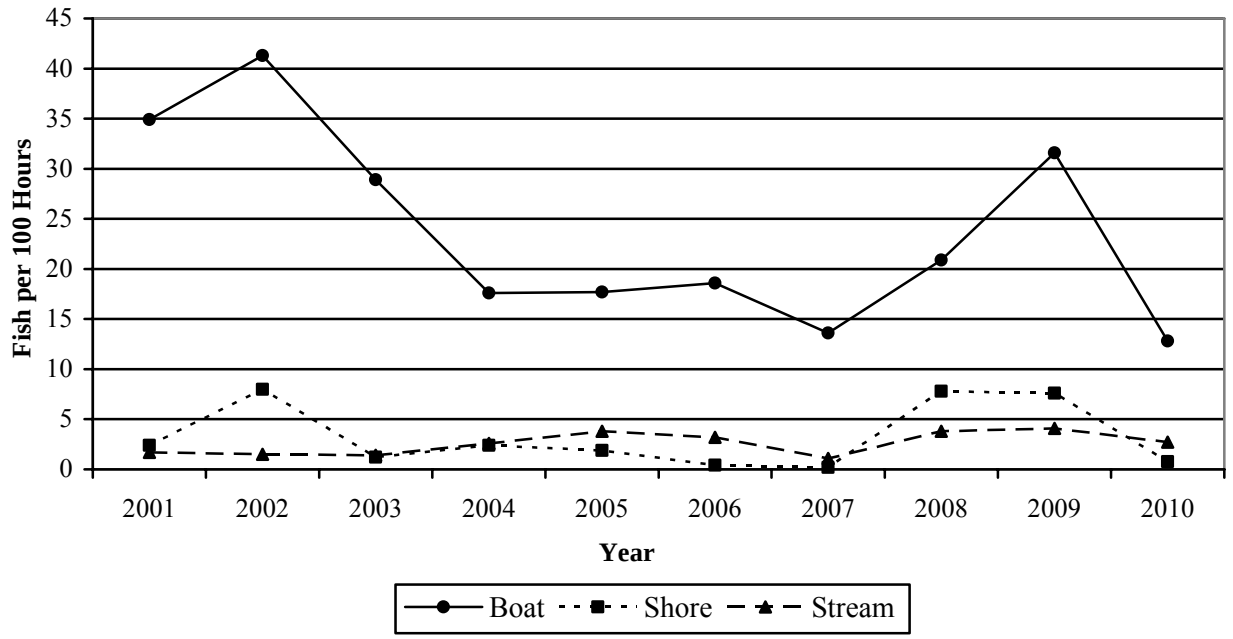


Figure 6. Coho salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for salmonine species were used (directed effort).

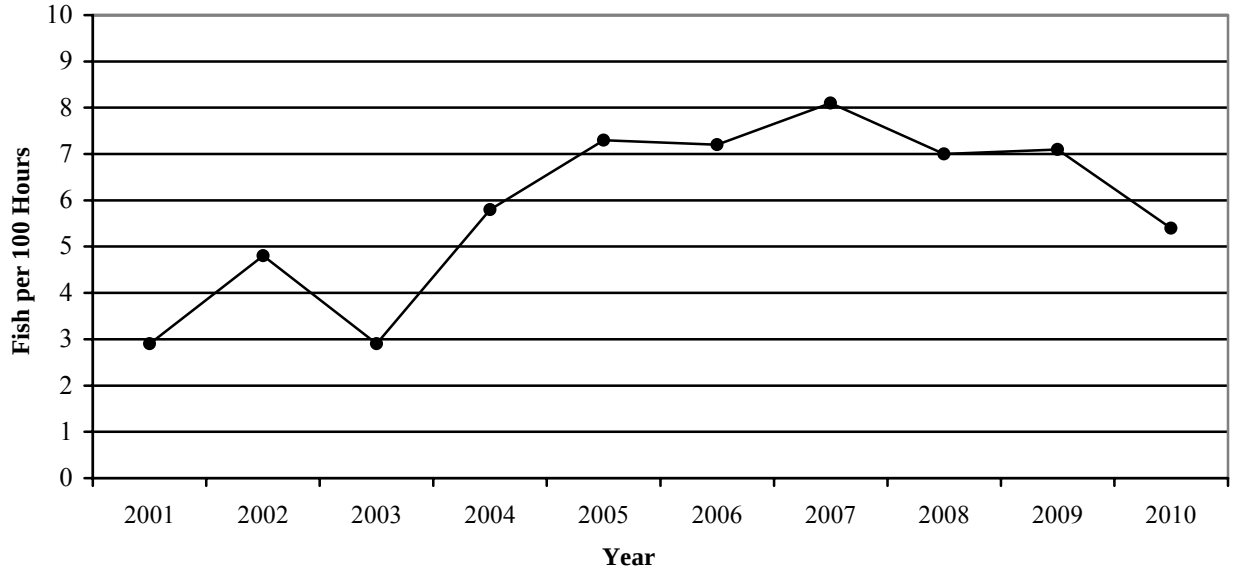


Figure 7. Chinook salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort).

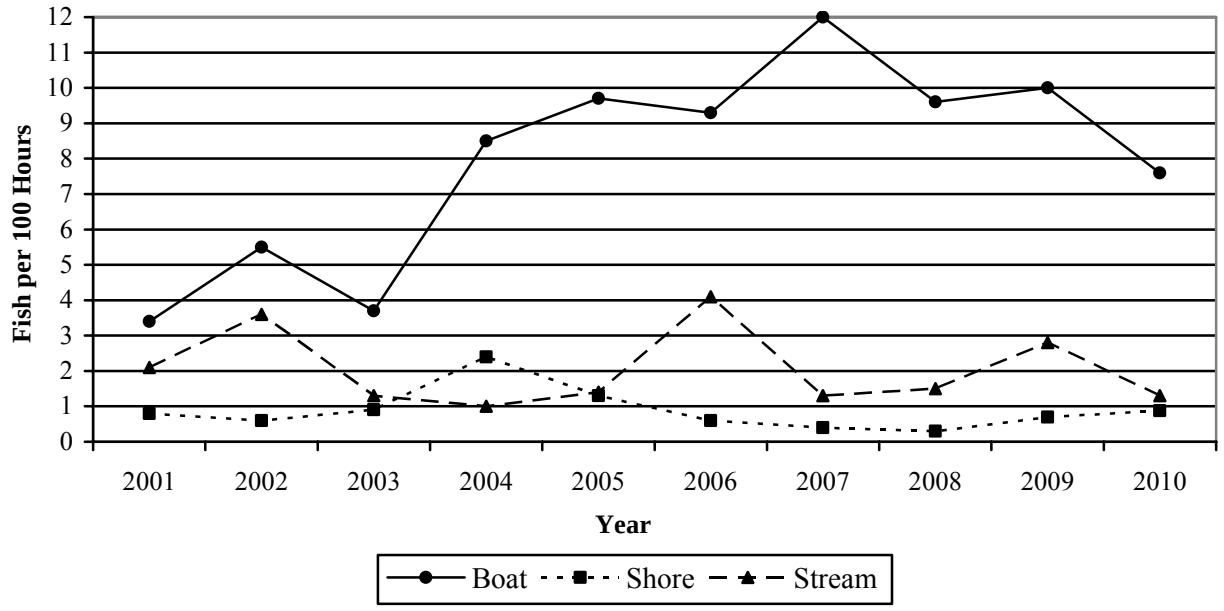


Figure 8. Chinook salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for salmonine species were used (directed effort).

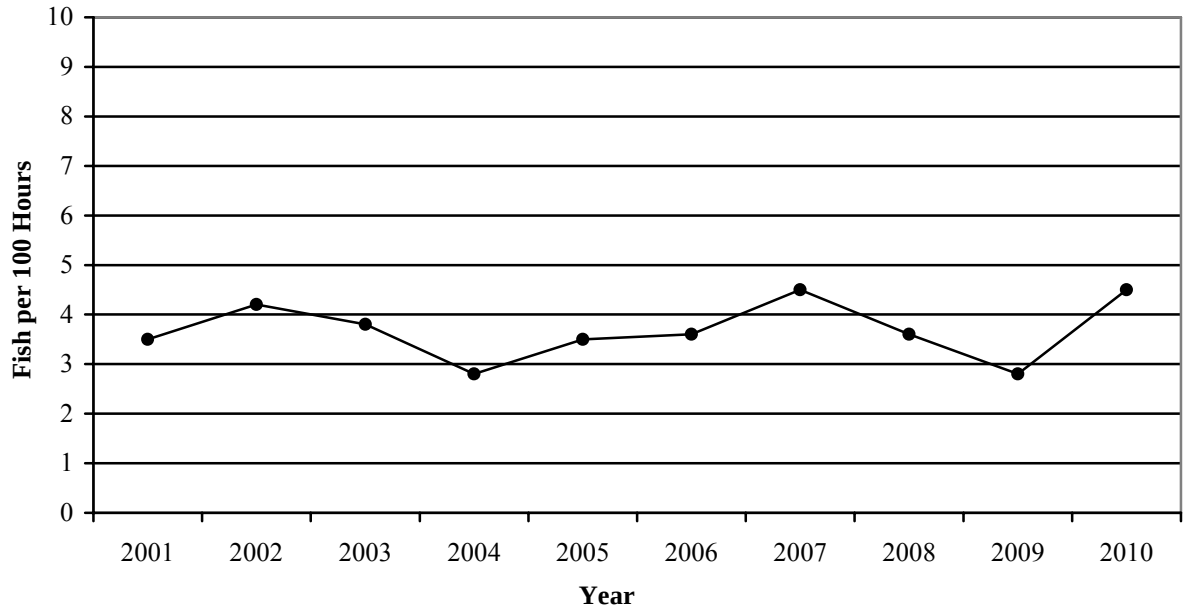


Figure 9. Steelhead trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort).

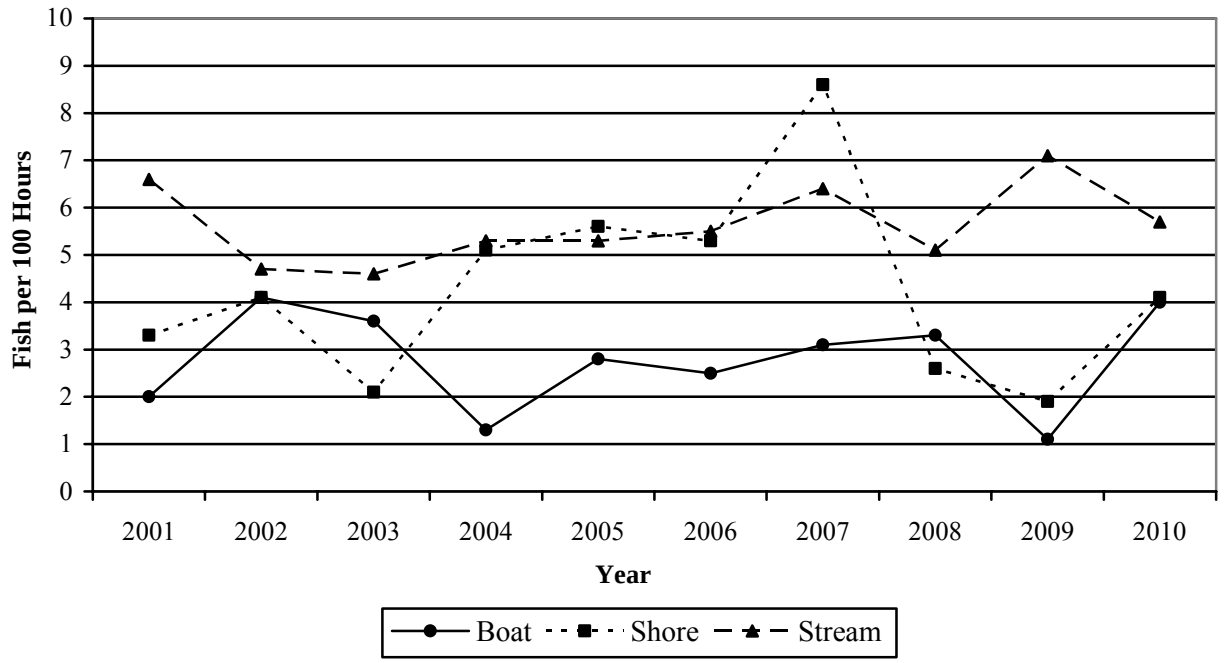


Figure 10. Steelhead trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for salmonine species were used (directed effort).

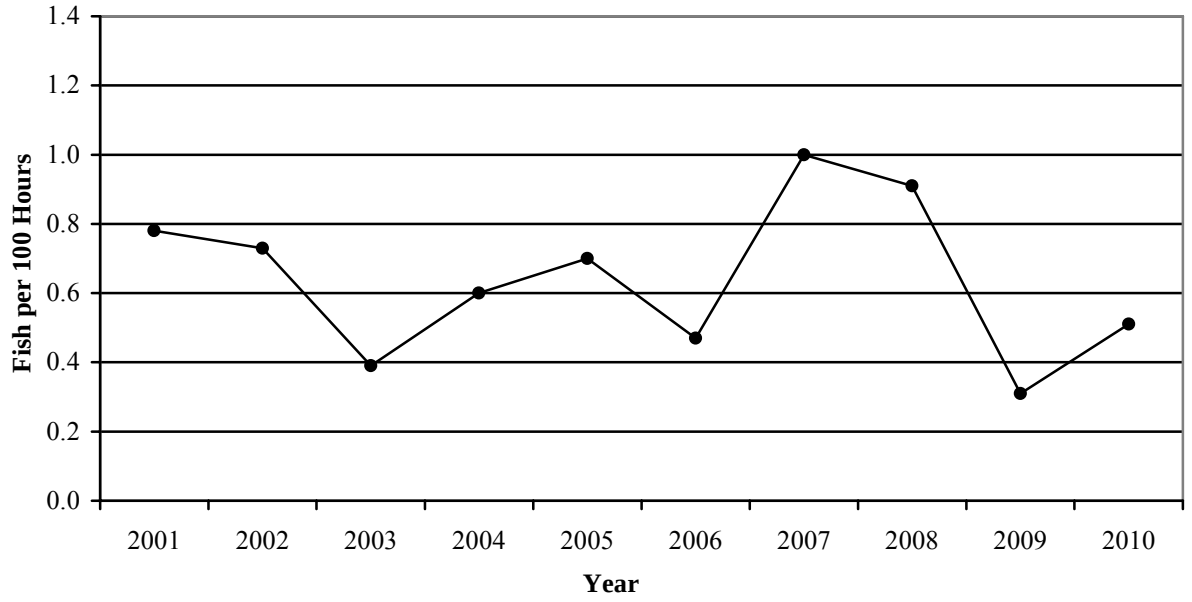


Figure 11. Brown trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort).

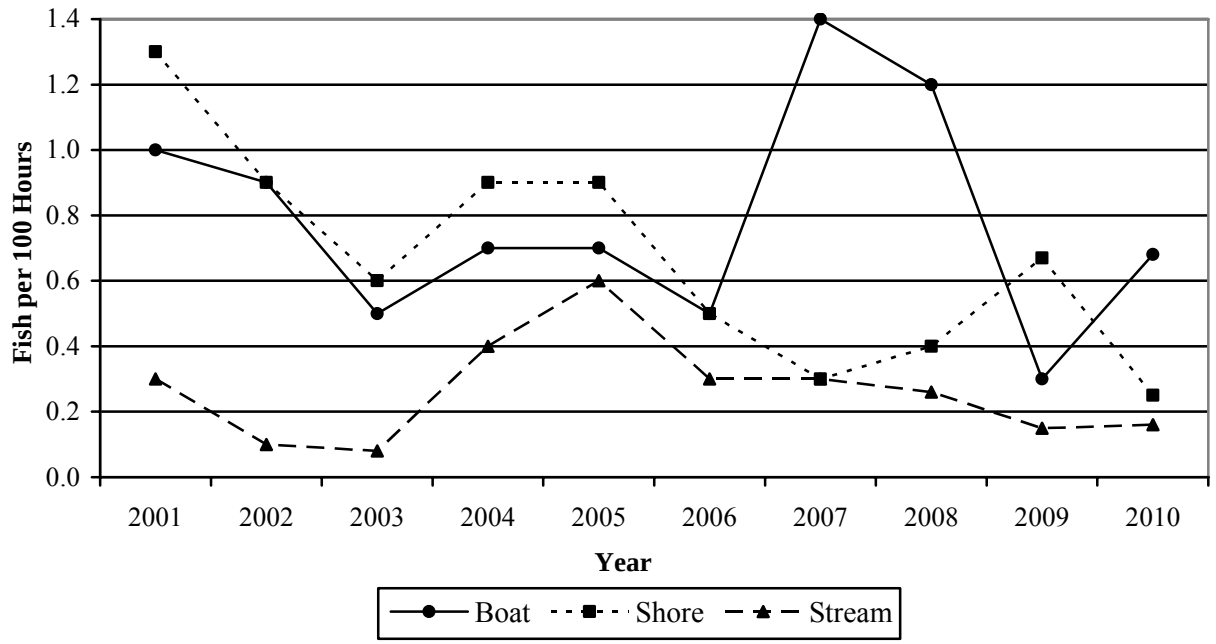


Figure 12. Brown trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for salmonine species were used (directed effort).

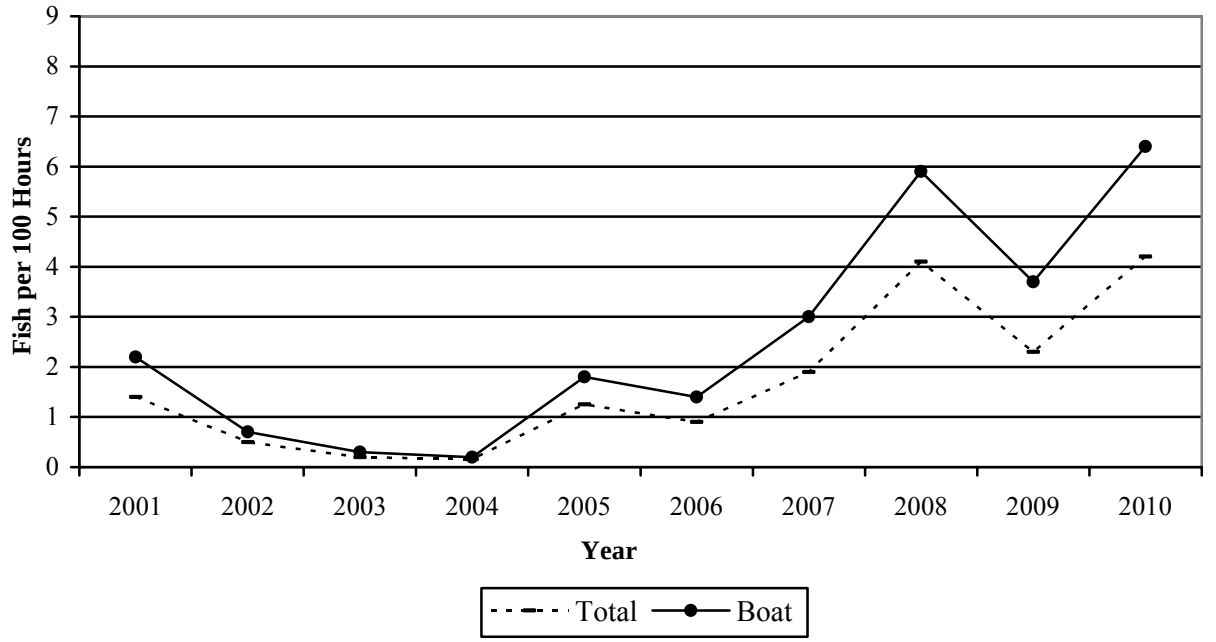


Figure 13. Lake trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for salmonine species were used (directed effort).

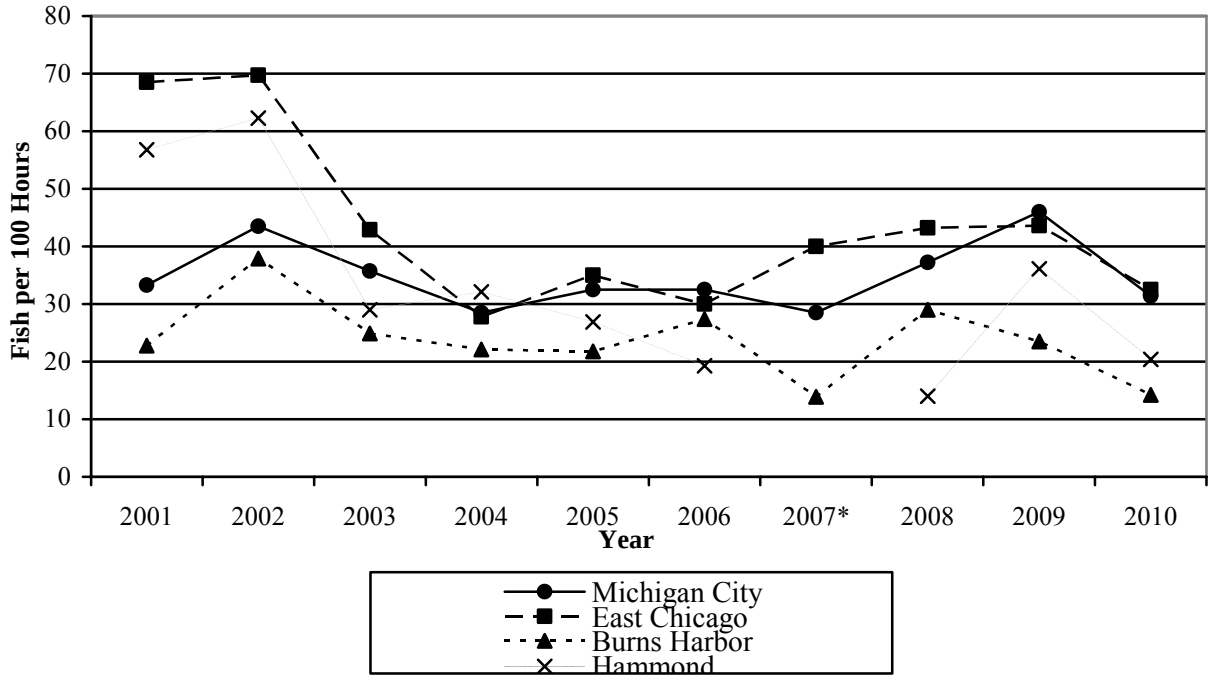


Figure 14. Salmonine CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by port. Only data from anglers fishing for salmonine species were used (directed effort).

*Hammond Marina boat launch closed for construction during the 2007 fishing season; no salmonines were caught from shore.

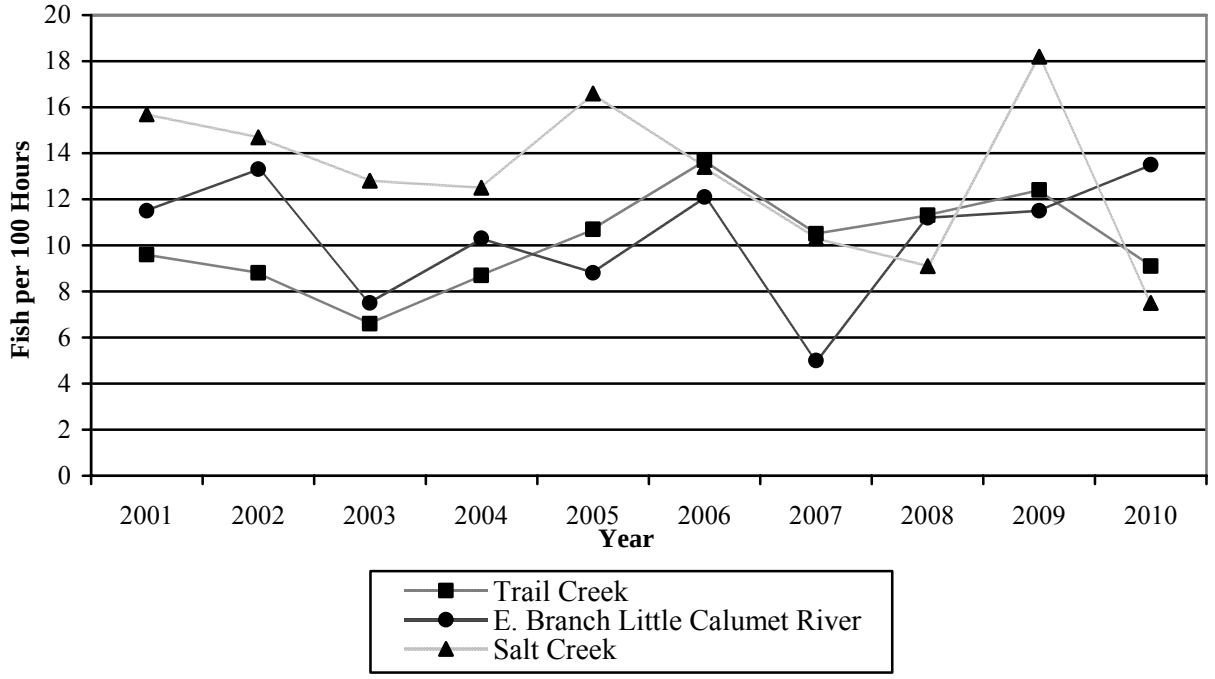


Figure 15. Salmonine CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by stream. Only data from anglers fishing for salmonine species were used (directed effort).

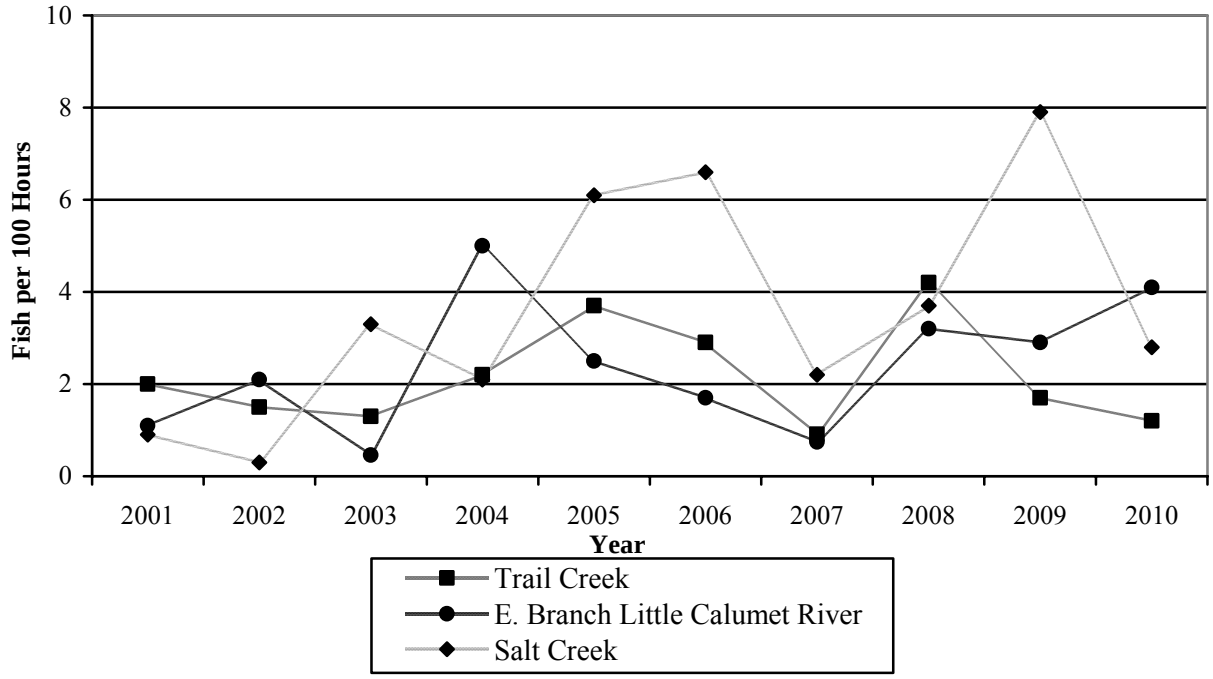


Figure 16. Coho salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by stream. Only data from anglers fishing for salmonine species were used (directed effort).

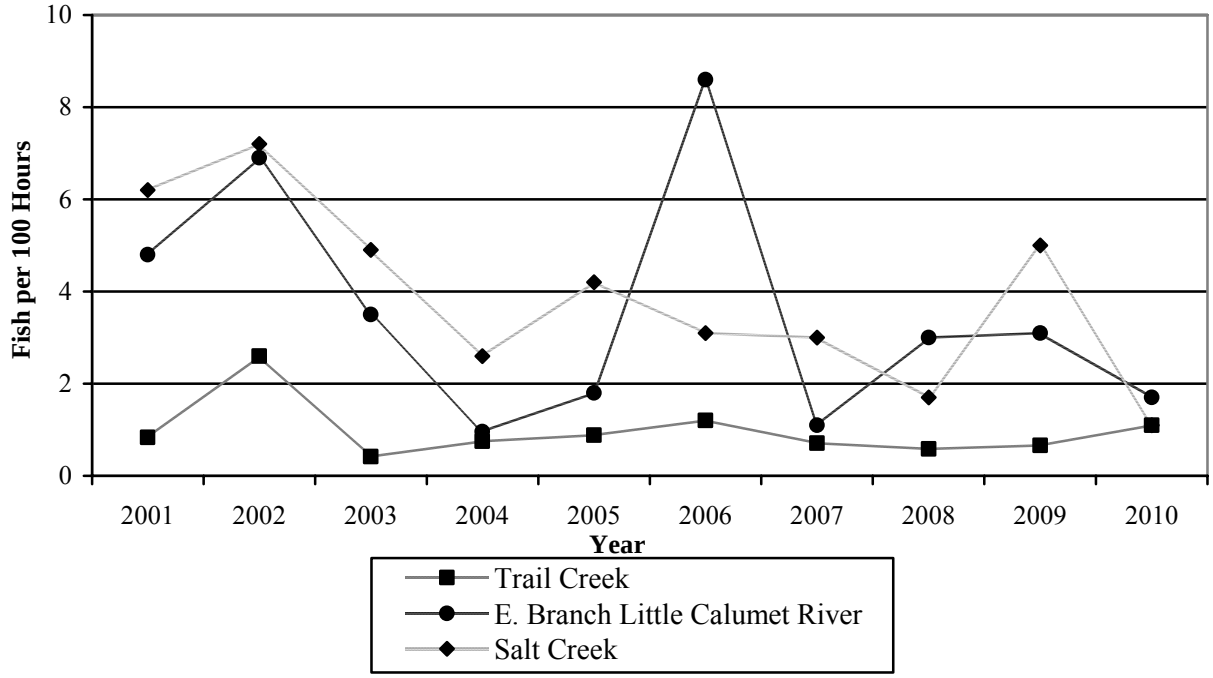


Figure 17. Chinook salmon CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by stream. Only data from anglers fishing for salmonine species were used (directed effort).

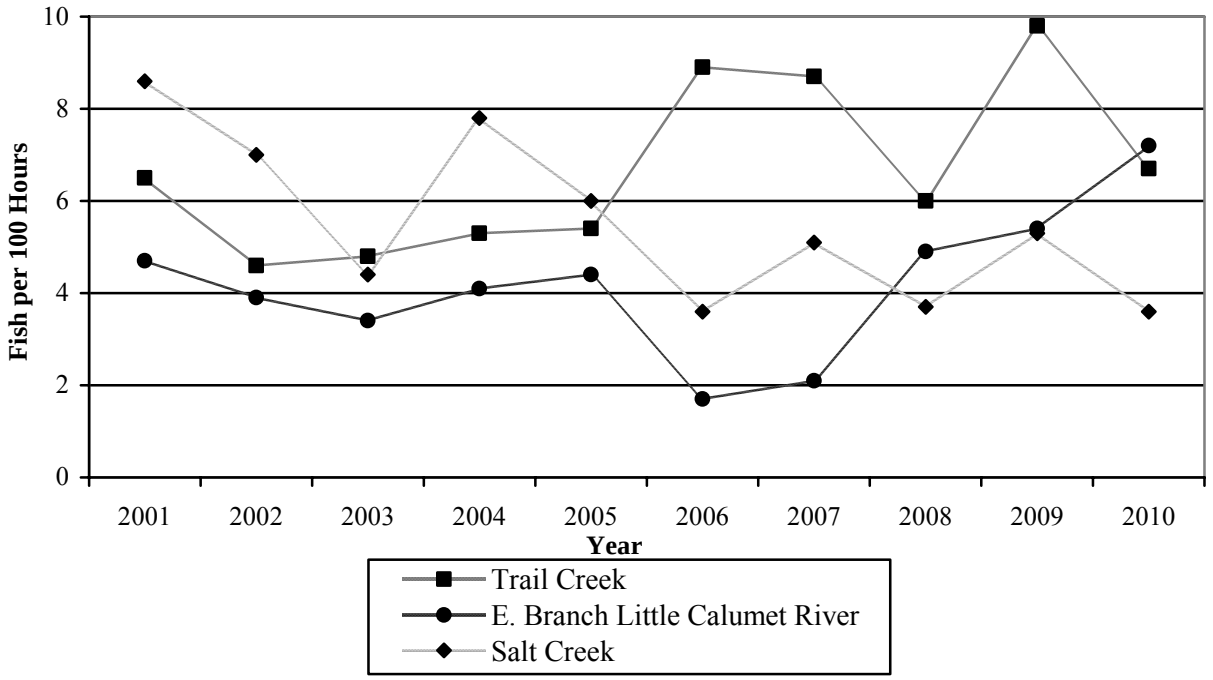


Figure 18. Steelhead trout CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by stream. Only data from anglers fishing for salmonine species were used (directed effort).

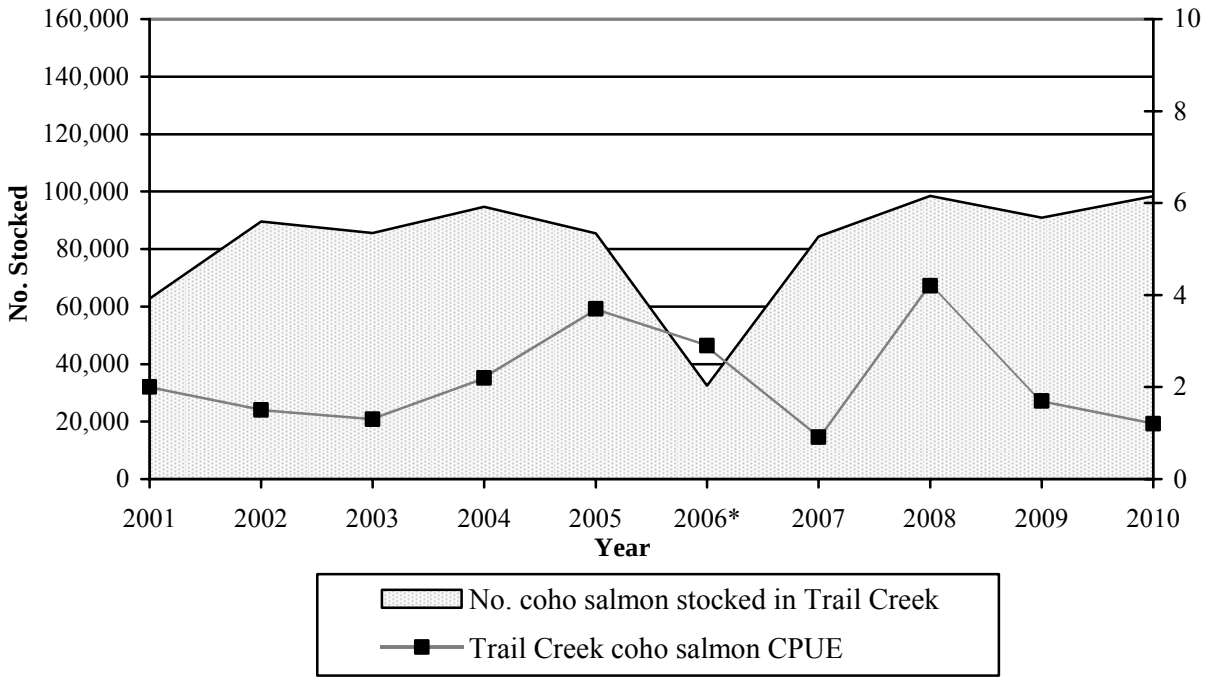


Figure 19. Number of coho salmon stocked in Trail Creek with corresponding coho CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. The primary y-axis portrays number of coho salmon stocked in Trail Creek. Coho salmon CPUE from Trail Creek plotted on secondary y-axis. Only data from anglers fishing for salmonine species were used (directed effort).

*Due to the shut-down/rehabilitation of Mixsawbah Fish Hatchery, coho salmon plantings were reduced by 60%.

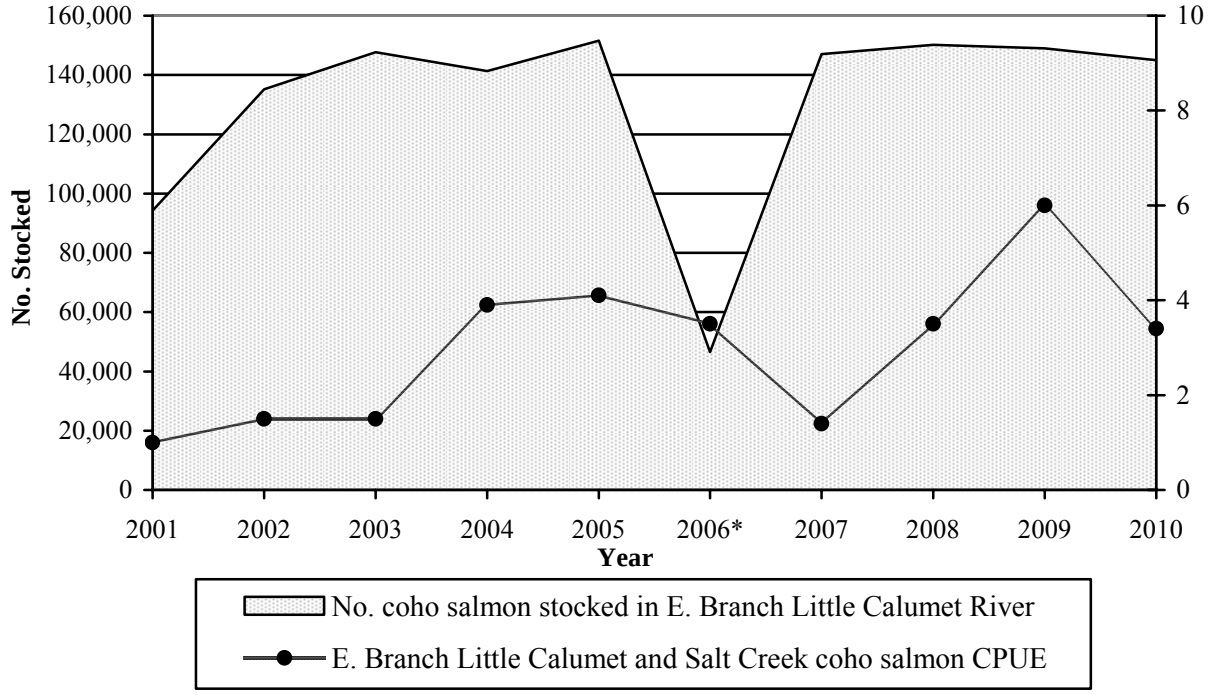


Figure 20. Number of coho salmon stocked in E. Branch Little Calumet River with corresponding coho CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. The primary y-axis portrays number of coho salmon stocked in the East Branch of the Little Calumet River. Coho salmon CPUE from the E. Branch Little Calumet and Salt Creek plotted on secondary y-axis. Only data from anglers fishing for salmonine species were used (directed effort).

*Due to the shut-down/rehabilitation of Mixsawbah Fish Hatchery, coho salmon plantings were reduced by 60%.

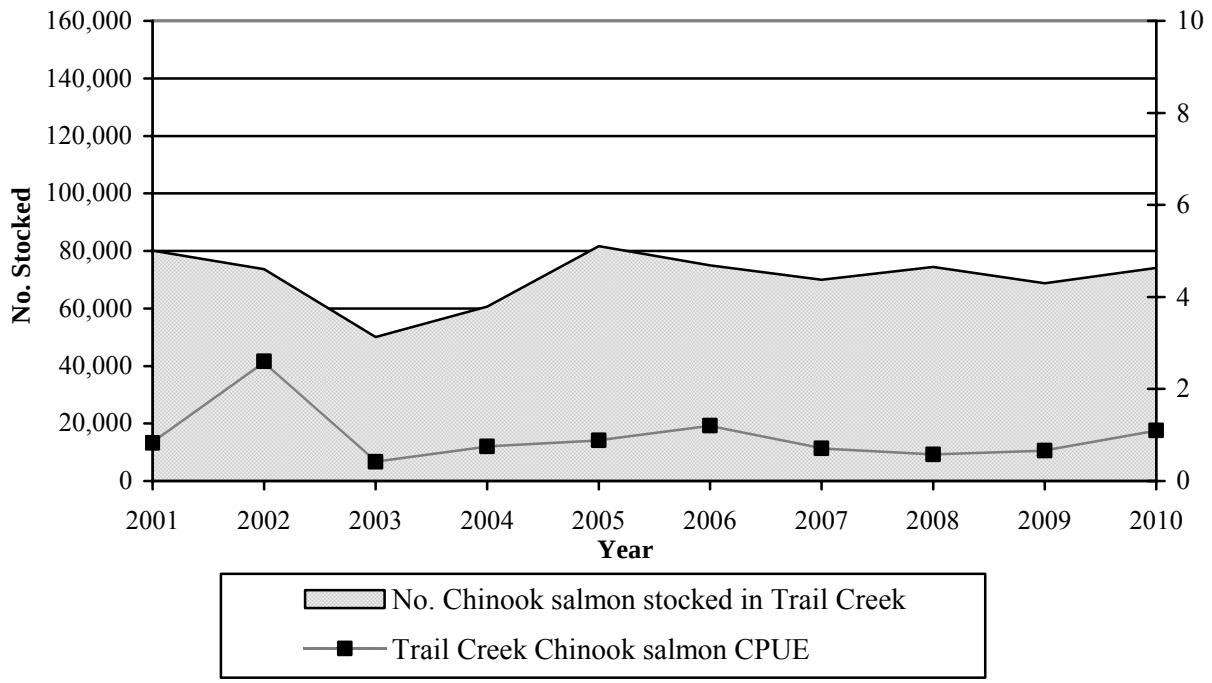


Figure 21. Number of Chinook salmon stocked in Trail Creek with corresponding Chinook CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. The primary y-axis portrays number of Chinook salmon stocked in Trail Creek. Chinook salmon CPUE from Trail Creek plotted on secondary y-axis. Only data from anglers fishing for salmonine species were used (directed effort).

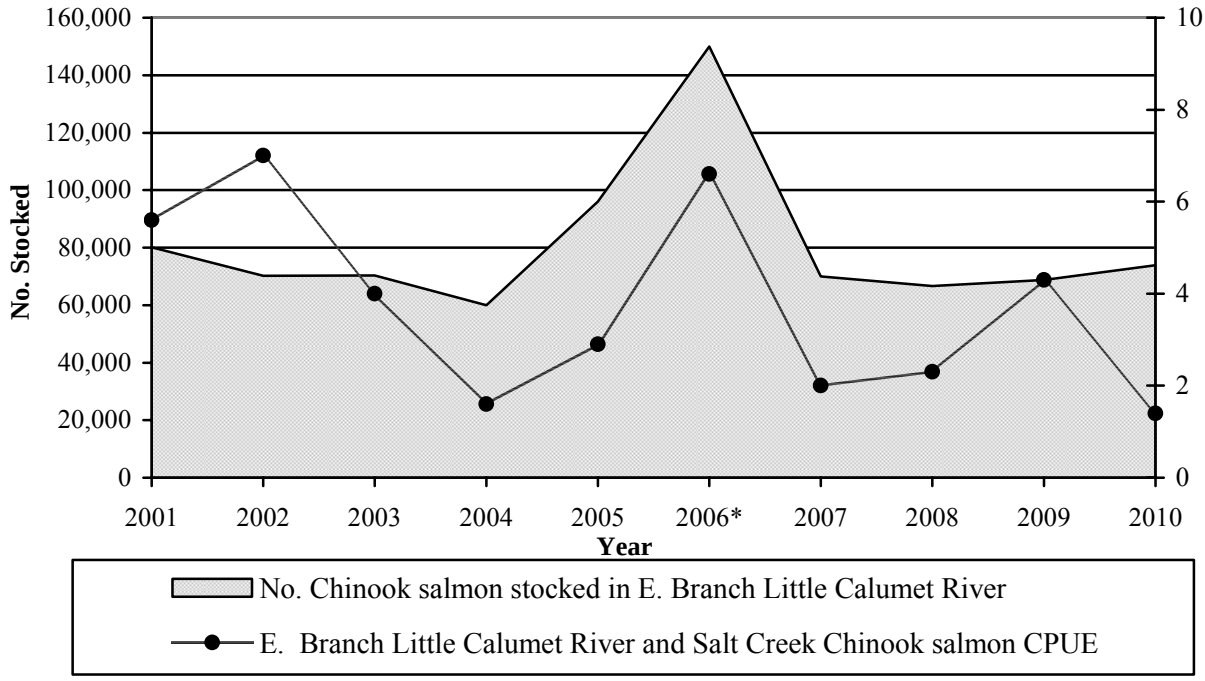


Figure 22. Number of Chinook salmon stocked in E. Branch Little Calumet River with corresponding Chinook CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. The primary y-axis portrays number of Chinook salmon stocked in the East Branch of the Little Calumet River. Chinook salmon CPUE from the E. Branch Little Calumet and Salt Creek plotted on secondary y-axis. Only data from anglers fishing for salmonine species were used (directed effort).

*Due to the shut-down/rehabilitation of Mixsawbah Fish Hatchery, Michigan DNR provided and stocked Chinook salmon for the Indiana DNR. All Chinook were stocked into Trail Creek and E. Branch Little Calumet River. No lakefront stocking occurred.

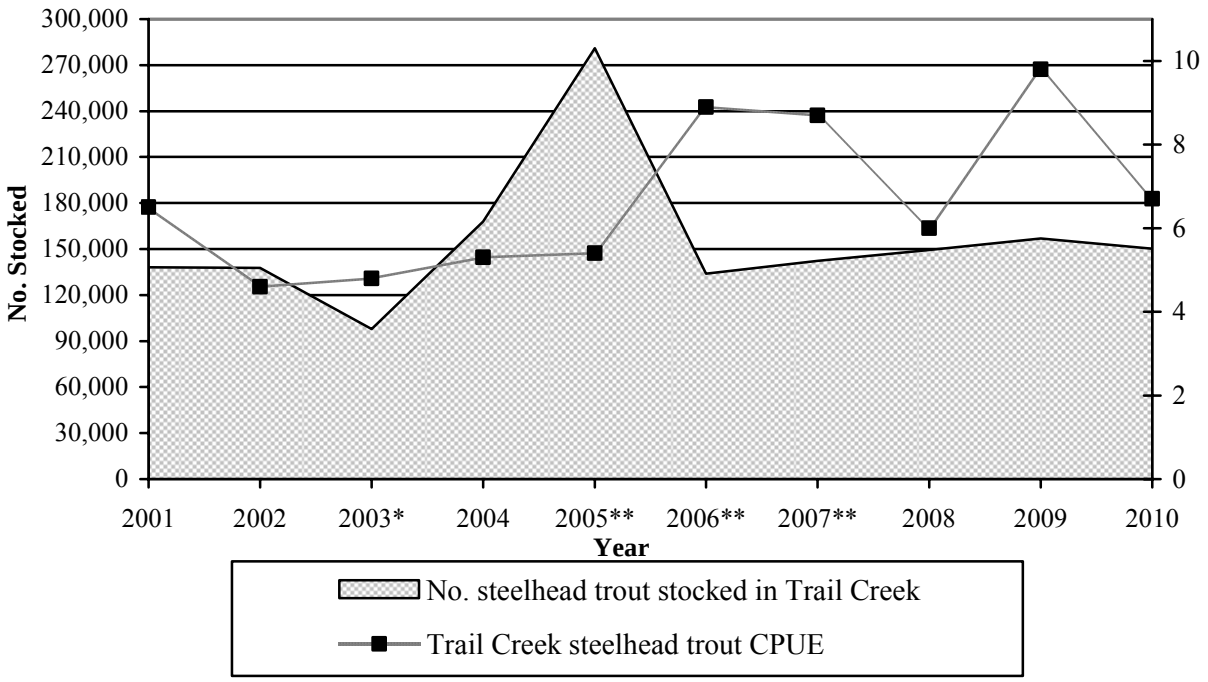


Figure 23. Number of steelhead trout stocked in Trail Creek with corresponding steelhead CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. The primary y-axis portrays number of steelhead trout stocked in Trail Creek. Steelhead trout CPUE from Trail Creek plotted on secondary y-axis. Only data from anglers fishing for salmonine species were used (directed effort).

*Michigan strain steelhead (i.e. winter run steelhead) moved to Little Calumet River due to unknown environmental spill on the day of stocking.

** Due to small size of Michigan strain steelhead and high water temperatures, Salt Creek was stocked instead of Trail Creek to increase survival of fingerling Michigan steelhead (cooler water temperatures). Additionally, due to the shut-down/rehabilitation of Mixsawbah Fish Hatchery, the spring release Skamania strain steelhead were stocked in the fall of 2005 and 2006 as fingerlings and Michigan strain steelhead (winter-run) were stocked in 2007 as yearlings instead of December 2006 as fingerlings.

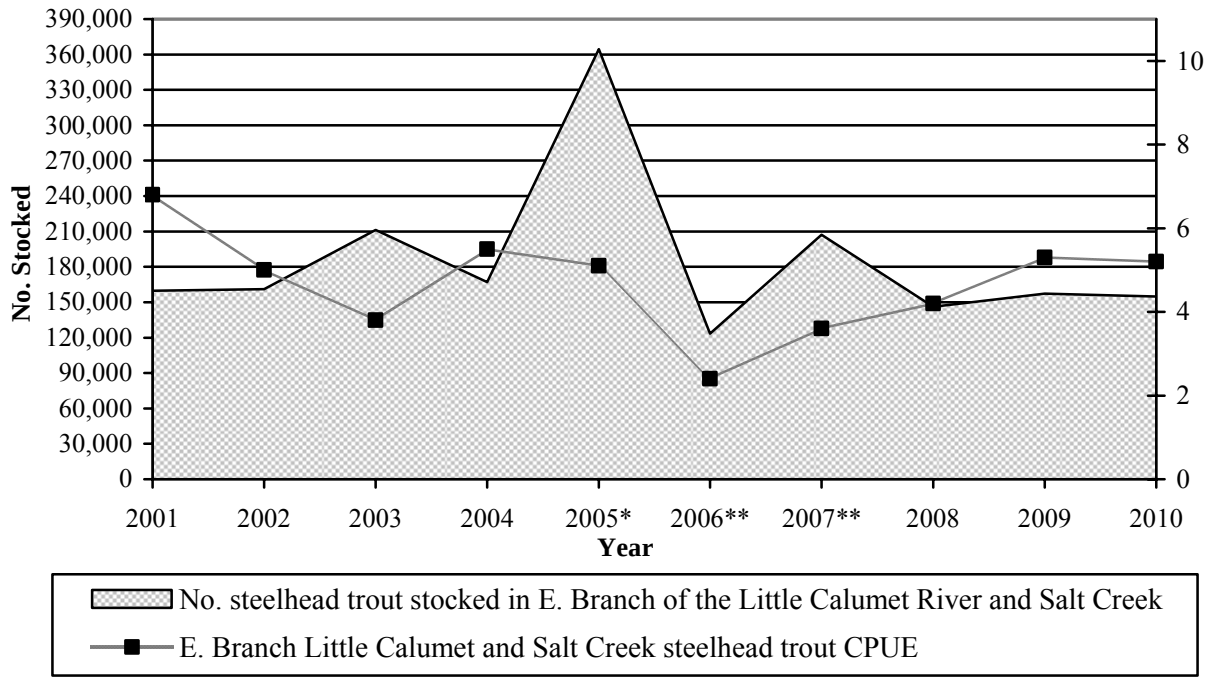


Figure 24. Number of steelhead trout stocked in E. Branch Little Calumet River with corresponding steelhead CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. The primary y-axis portrays number of steelhead stocked in the East Branch of the Little Calumet River. Steelhead trout CPUE from the E. Branch Little Calumet and Salt Creek plotted on secondary y-axis. Only data from anglers fishing for salmonine species were used (directed effort).

*Due to small size of Michigan strain steelhead and high water temperatures, Salt Creek was stocked instead of Trail Creek and the E. Branch of the Little Calumet River to increase survival of fingerling Michigan steelhead (cooler water temperatures).

**Due to the shut-down/rehabilitation of Mixsawbah Fish Hatchery, the spring release skamania steelhead were stocked in the fall of 2005 and 2006 as fingerlings; Michigan strain steelhead (winter-run) were stocked in 2007 as yearlings instead of December 2006 as fingerlings.

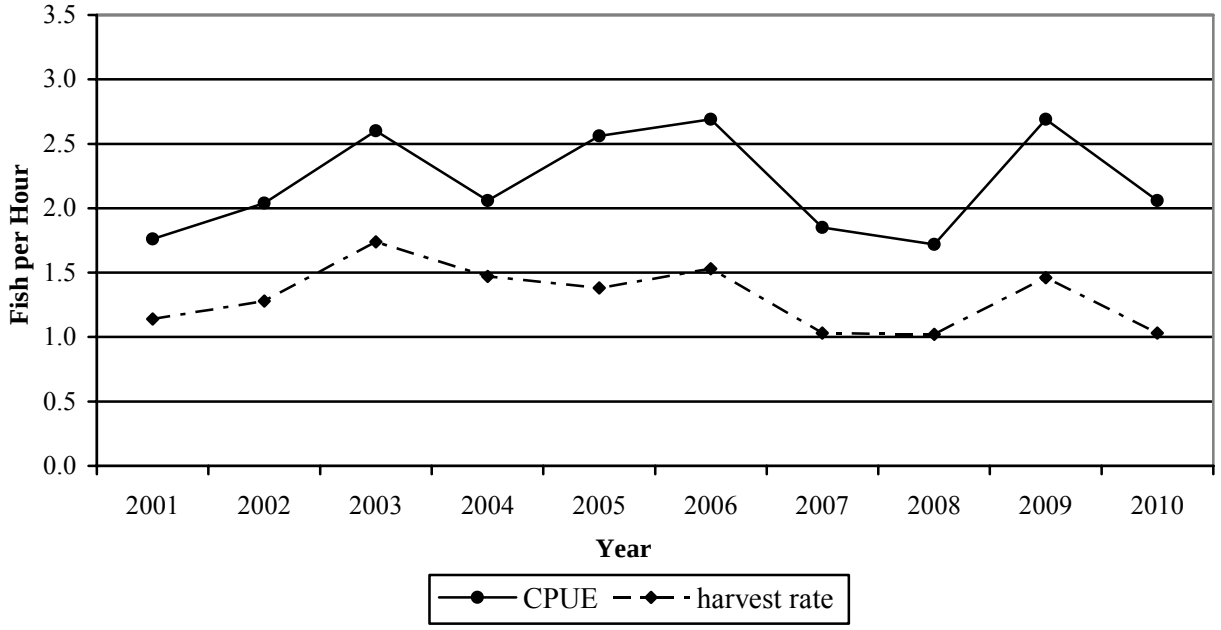


Figure 25. Yellow perch CPUE and harvest-per-unit-effort (harvest rate) from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010. Only data from anglers fishing for yellow perch were used (directed effort).

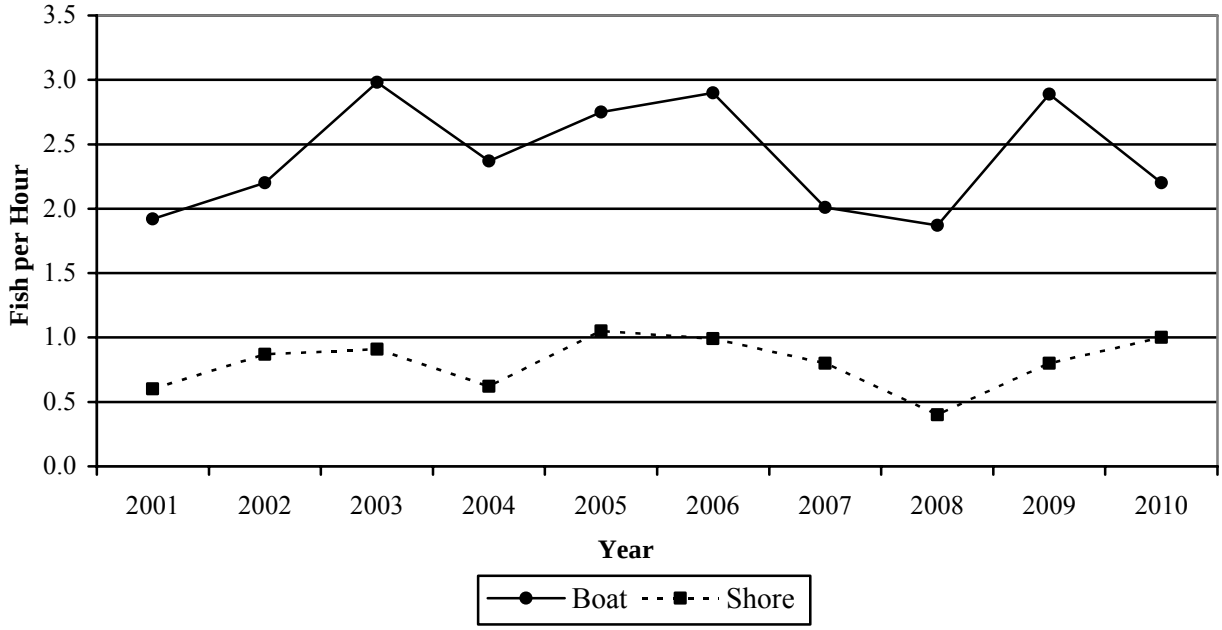


Figure 26. Yellow perch CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for yellow perch were used (directed effort).

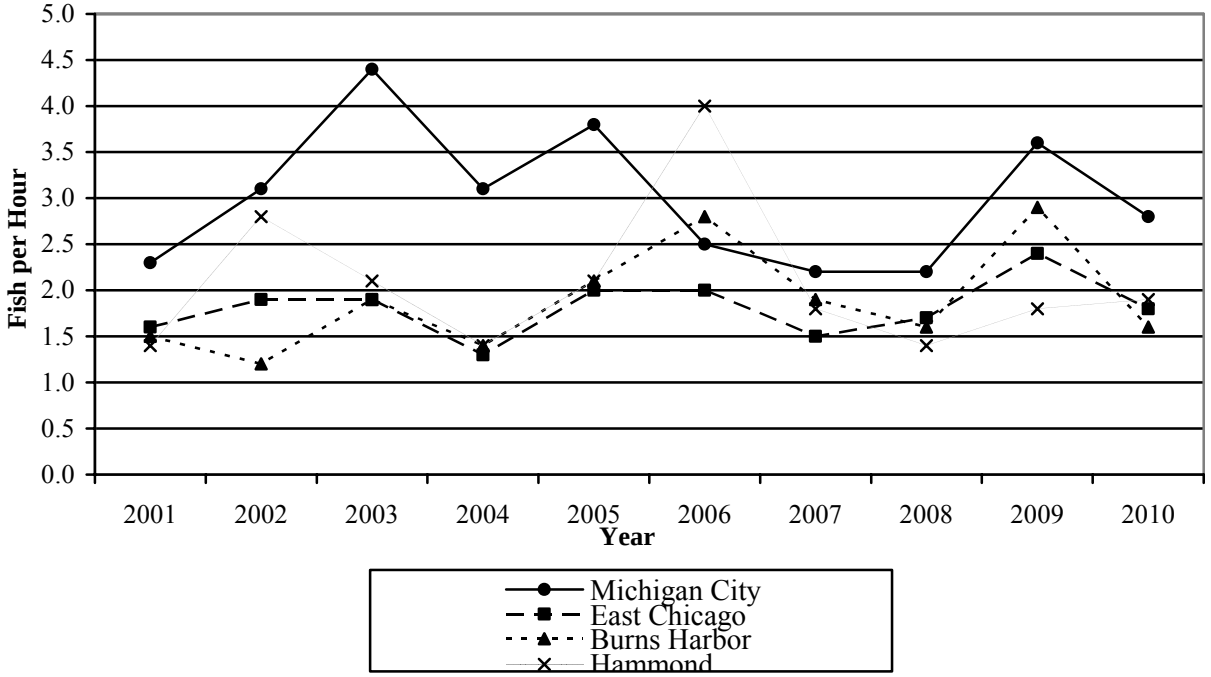


Figure 27. Yellow Perch CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by Port. Only data from anglers fishing for yellow perch were used (directed effort).

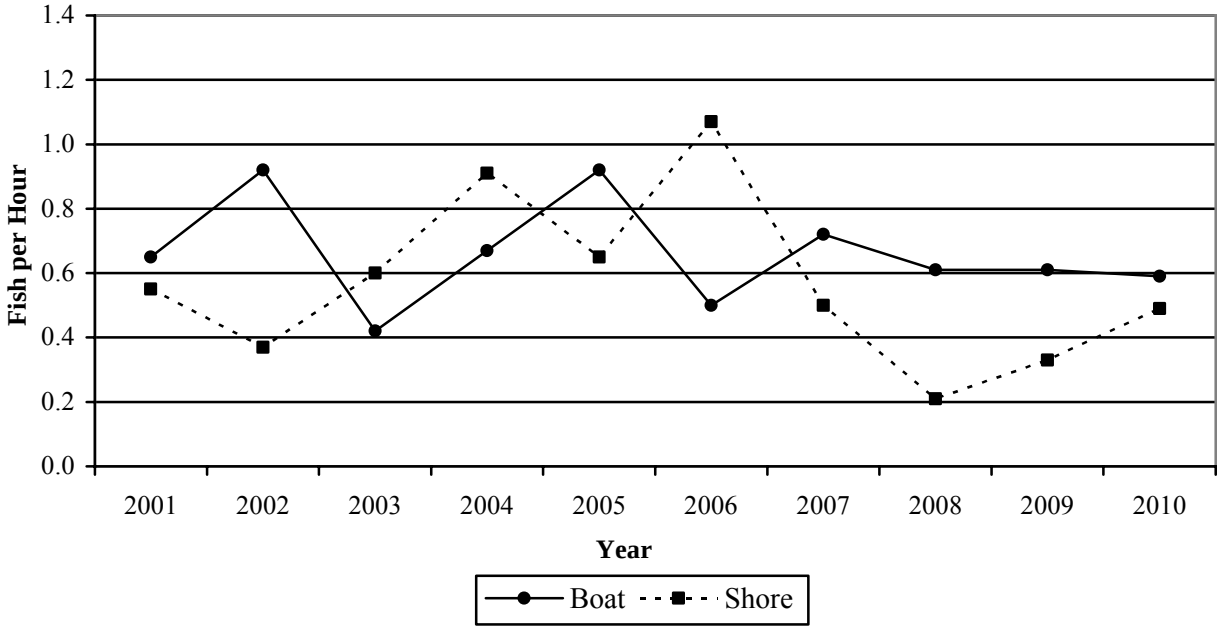


Figure 28. Black bass CPUE from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010, by angler type. Only data from anglers fishing for black bass species were used (directed effort).

Figure 29. County of residence of anglers that were surveyed in the Indiana Department of Natural Resources Lake Michigan creel survey fishing from boat, shore and stream during 2010 (n=2,829).

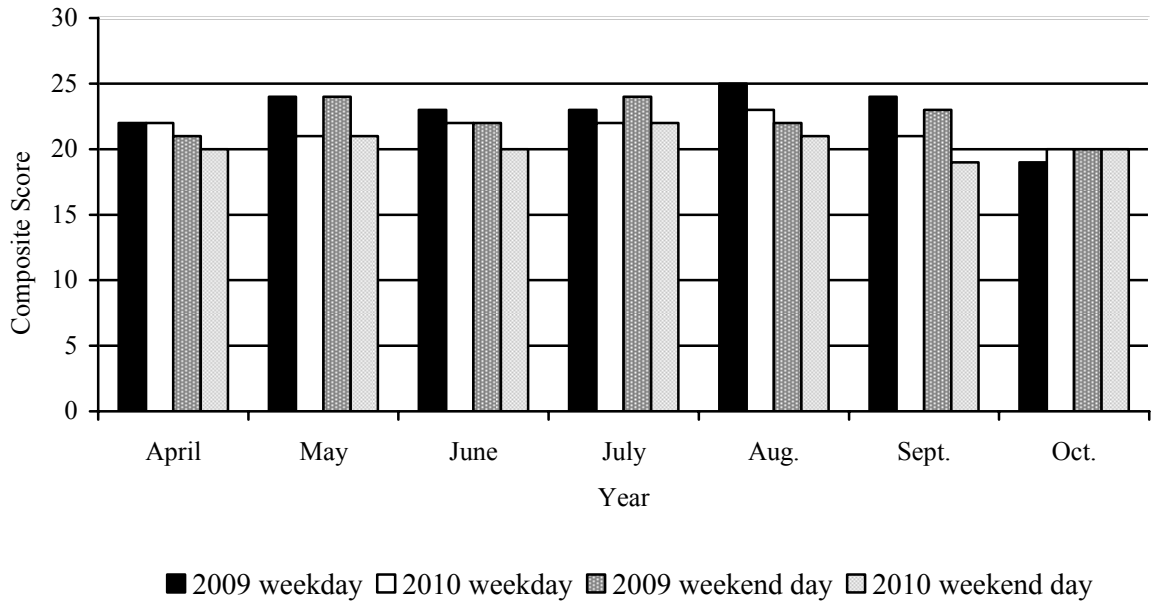
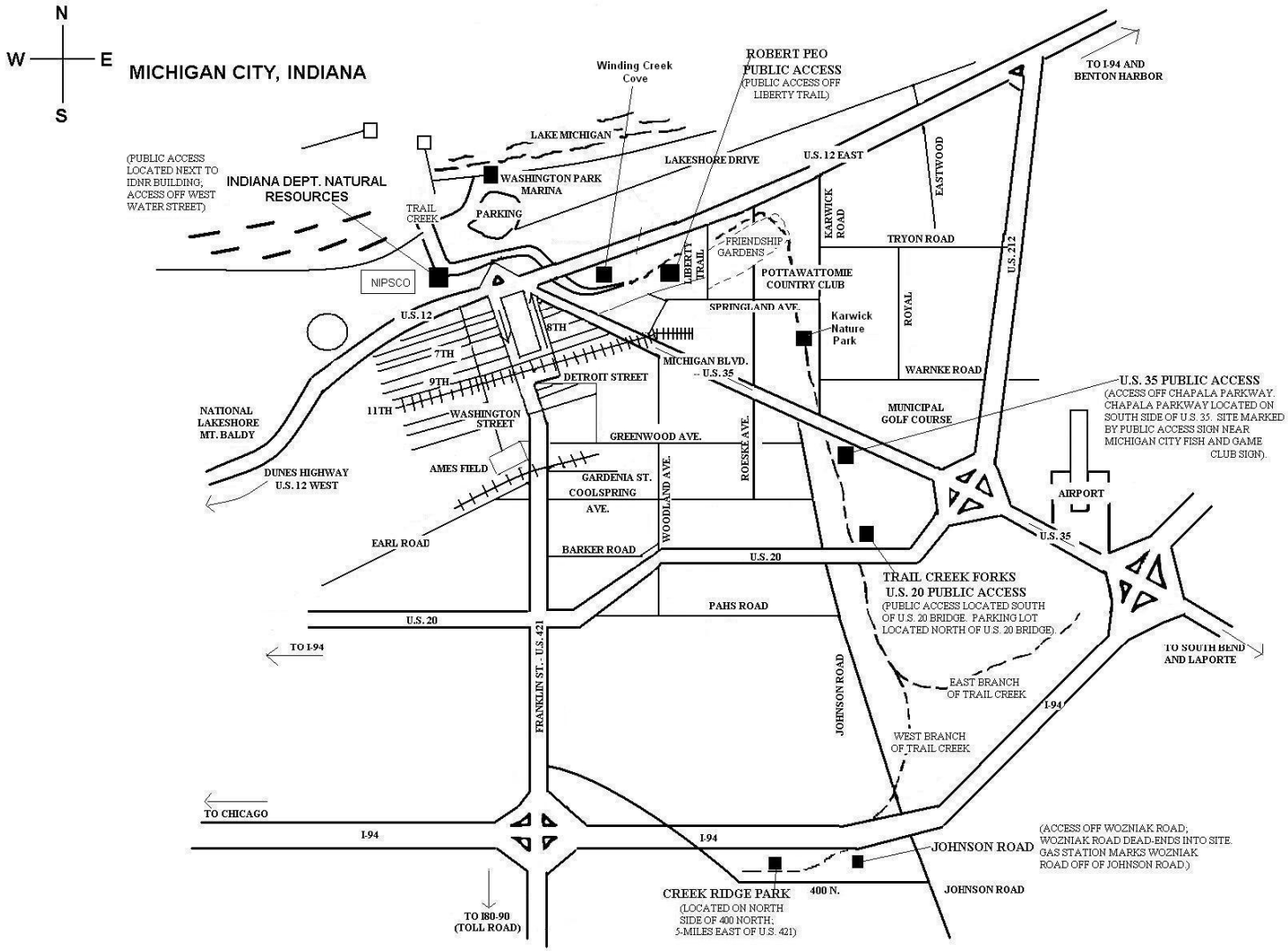
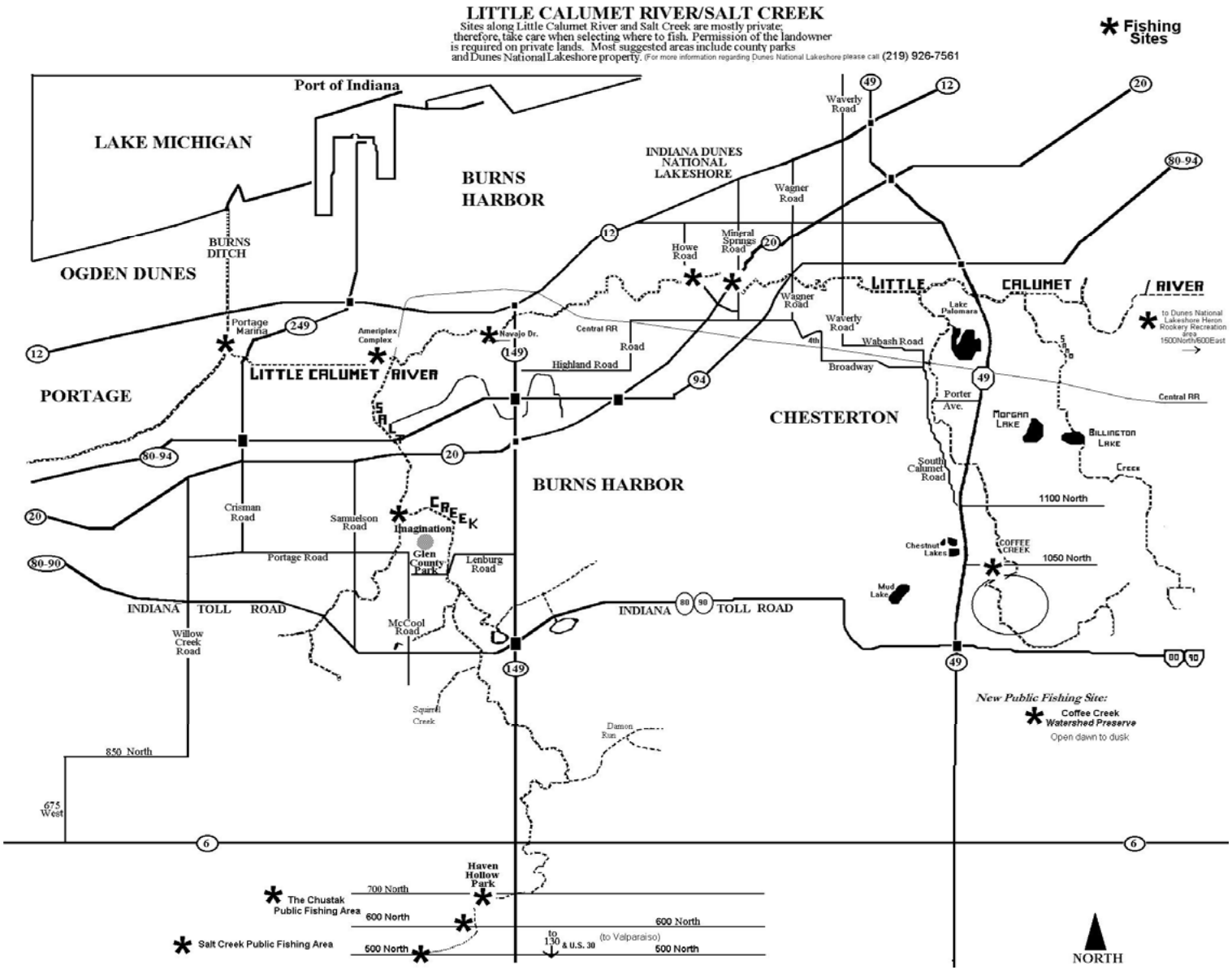


Figure 30. Mean daily weather scores by month from the Indiana Department of Natural Resources Lake Michigan creel survey, 2009 and 2010.



Appendix I (a). Trail Creek public access map.



Appendix I (b). East Branch of the Little Calumet/Salt Creek public access map.

Appendix II. Estimated total catch for species other than salmonines, yellow perch, or black bass species from the Indiana Department of Natural Resources Lake Michigan creel survey during 2010.

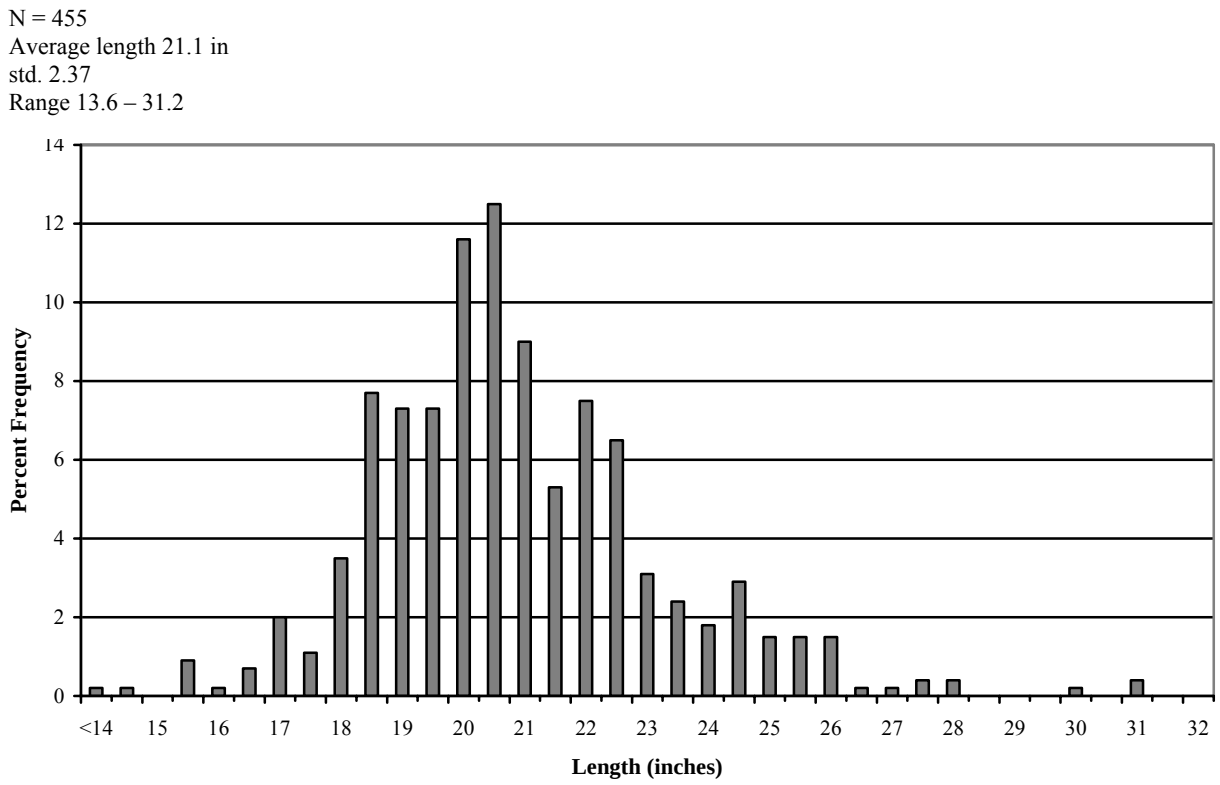
	Catch					
	Boat Fishery		Shore Fishery		Stream Fishery	
	Number Harvested	Total Catch	Number Harvested	Total Catch	Number Harvested	Total Catch
Catfish	64	141	264	520	0	16
Creek Chub	---	---	---	---	0	640
Carp	0	157	16	156	---	---
Crappie	27	27	28	28	---	---
Freshwater Drum	415	1,516	151	330	---	---
Herring Family (Alewife/Gizzard Shad)	0	17	0	5	---	---
Northern Pike	---	---	0	3	---	---
Rock Bass	55	1,076	339	1,498	---	---
Round Goby	1,996	2,450	6,172	6,989	39	115
Suckers	---	---	0	28	20	45
Sunfish (Bluegill/Green Sunfish/Redear Sunfish)	114	230	159	634	0	16
Walleye	---	---	0	20	---	---
TOTAL	2,672	5,614	7,129	10,211	59	832

Appendix III. Average length and weight of salmonine species and yellow perch observed from the Indiana Department of Natural Resources Lake Michigan creel survey during 2001 through 2010. Data from boat, shore, and stream fisheries combined. std. = standard deviation.

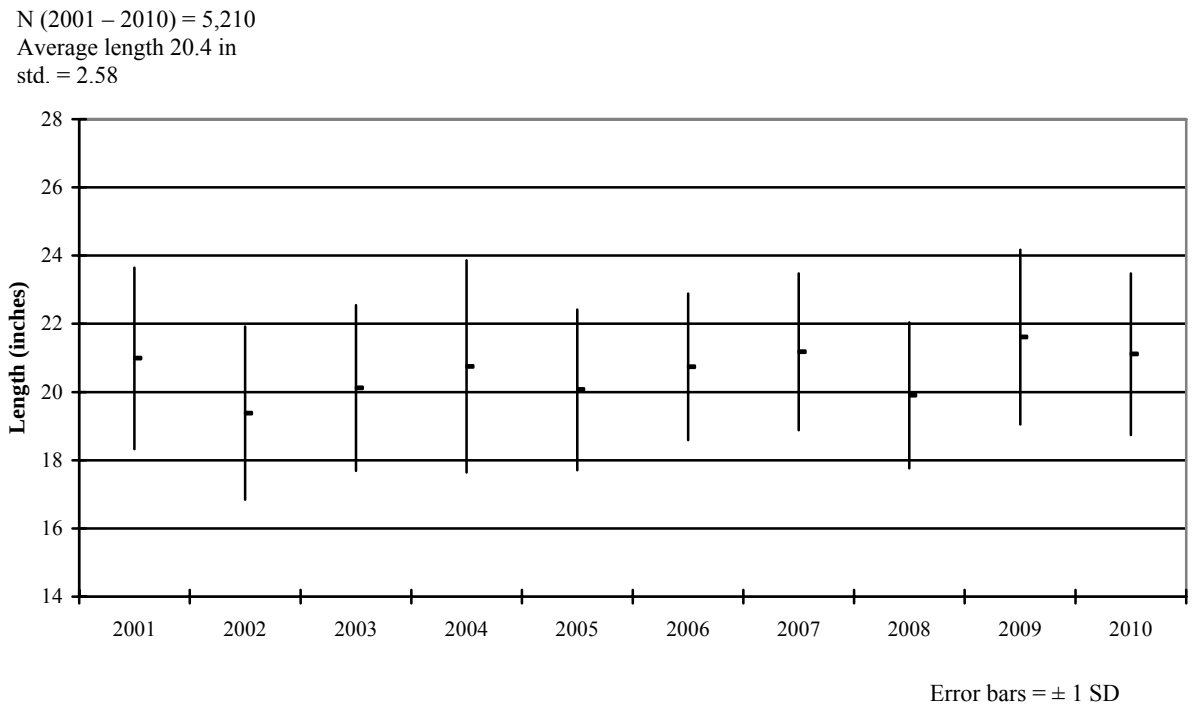
Year	Average length (in)	std.	Average weight (lb)	std.
Brown Trout				
2001	22.3 (n=94)	5.05	5.95 (n=88)	4.10
2002	21.1 (n=102)	4.33	4.83 (n=96)	3.38
2003	20.7 (n=51)	3.78	4.58 (n=51)	3.12
2004	22.9 (n=55)	4.63	6.53 (n=53)	4.07
2005	22.8 (n=68)	4.57	6.05 (n=68)	4.24
2006	23.6 (n=26)	4.65	6.70 (n=26)	4.13
2007	22.0 (n=53)	4.21	5.24 (n=53)	3.30
2008	23.6 (n=24)	4.39	7.47 (n=23)	5.10
2009	23.6 (n=24)	4.49	6.84 (n=23)	3.50
2010	24.0 (n=12)	5.59	7.26 (n=12)	5.41
Coho Salmon				
2001	21.0 (n=513)	2.66	3.59 (n=509)	1.66
2002	19.4 (n=1,008)	2.54	2.66 (n=978)	1.41
2003	20.1 (n=945)	2.43	3.02 (n=940)	1.37
2004	20.7 (n=378)	3.11	3.54 (n=375)	2.01
2005	20.1 (n=516)	2.35	2.69 (n=516)	1.20
2006	20.7 (n=436)	2.15	3.10 (n=436)	1.34
2007	21.2 (n=365)	2.30	3.19 (n=364)	1.31
2008	19.9 (n=249)	2.14	2.58 (n=249)	1.03
2009	21.6 (n=345)	2.56	3.89 (n=330)	1.84
2010	21.1 (n=455)	2.37	3.12 (n=455)	1.28
Chinook Salmon				
2001	30.0 (n=410)	4.45	11.4 (n=405)	4.73
2002	30.7 (n=585)	4.83	11.8 (n=584)	4.82
2003	28.1 (n=218)	4.62	8.87 (n=218)	4.54
2004	29.2 (n=389)	4.27	9.98 (n=389)	3.61
2005	27.7 (n=375)	4.76	7.92 (n=374)	3.61
2006	27.8 (n=285)	4.24	8.39 (n=285)	3.83
2007	28.1 (n=164)	4.86	8.57 (n=164)	3.93
2008	26.7 (n=201)	5.27	7.50 (n=201)	4.13
2009	29.7 (n=502)	3.99	10.5 (n=490)	3.78
2010	26.1 (n=419)	4.67	6.85 (n=419)	3.41

Appendix III *continued*. Average length and weight of salmonine species and yellow perch, observed from the Indiana Department of Natural Resources Lake Michigan creel survey during 2001 through 2010. Data from boat, shore, and stream fisheries combined. std. = standard deviation.

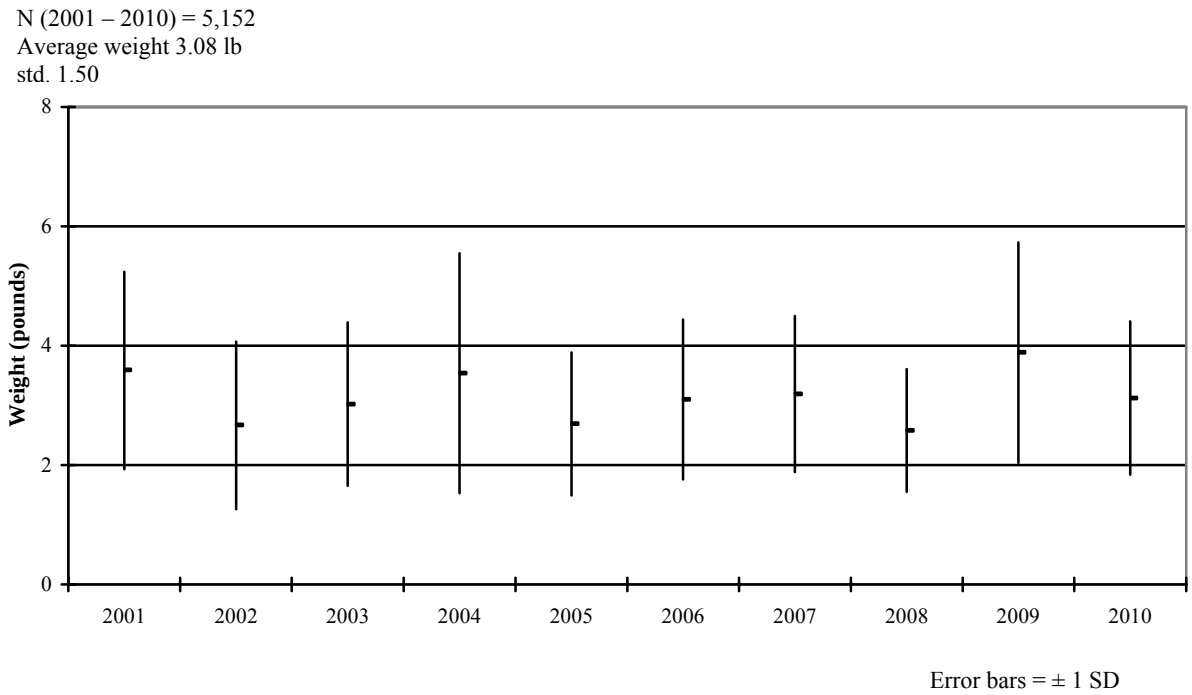
Year	Average length (in)	std.	Average weight (lb)	std.
Lake Trout				
2001	26.3 (n=124)	2.56	7.10 (n=123)	2.35
2002	27.0 (n=65)	3.17	7.57 (n=64)	2.96
2003	26.5 (n=27)	2.14	6.78 (n=27)	1.61
2004	26.8 (n=41)	3.10	7.54 (n=41)	2.92
2005	26.8 (n=79)	3.28	7.75 (n=79)	3.03
2006	25.6 (n=62)	2.43	6.55 (n=62)	2.28
2007	26.9 (n=172)	3.01	7.30 (n=171)	2.54
2008	27.3 (n=187)	2.97	7.64 (n=187)	2.82
2009	28.0 (n=96)	3.33	8.81 (n=96)	3.85
2010	27.6 (n=179)	3.06	7.83 (n=179)	2.67
Steelhead trout				
2001	27.6 (n=503)	3.17	7.76 (n=494)	2.61
2002	29.2 (n=481)	3.39	8.67 (n=477)	2.68
2003	25.6 (n=318)	4.38	6.50 (n=318)	3.16
2004	27.7 (n=278)	3.70	8.16 (n=278)	2.80
2005	26.7 (n=325)	3.75	6.74 (n=324)	2.75
2006	27.6 (n=321)	3.43	7.63 (n=321)	2.66
2007	26.0 (n=266)	4.88	6.77 (n=265)	3.30
2008	25.8 (n=190)	4.43	6.13 (n=190)	2.95
2009	27.7 (n=205)	3.28	7.73 (n=205)	2.33
2010	24.1 (n=191)	4.30	5.08 (n=190)	2.55
Yellow perch				
2001	10.4 (n=891)	2.10	0.50 (n=809)	0.34
2002	9.69 (n=904)	1.74	0.46 (n=894)	0.34
2003	10.0 (n=1,489)	1.67	0.50 (n=1,488)	0.29
2004	9.53 (n=901)	1.75	0.45 (n=889)	0.29
2005	10.4 (n=808)	1.79	0.56 (n=803)	0.32
2006	9.51 (n=878)	1.45	0.42 (n=878)	0.22
2007	10.7 (n=265)	1.48	0.55 (n=265)	0.25
2008	10.5 (n=273)	1.72	0.53 (n=273)	0.29
2009	10.6 (n=391)	1.96	0.60 (n=373)	0.35
2010	9.3 (n=422)	1.73	0.38 (n=422)	0.28



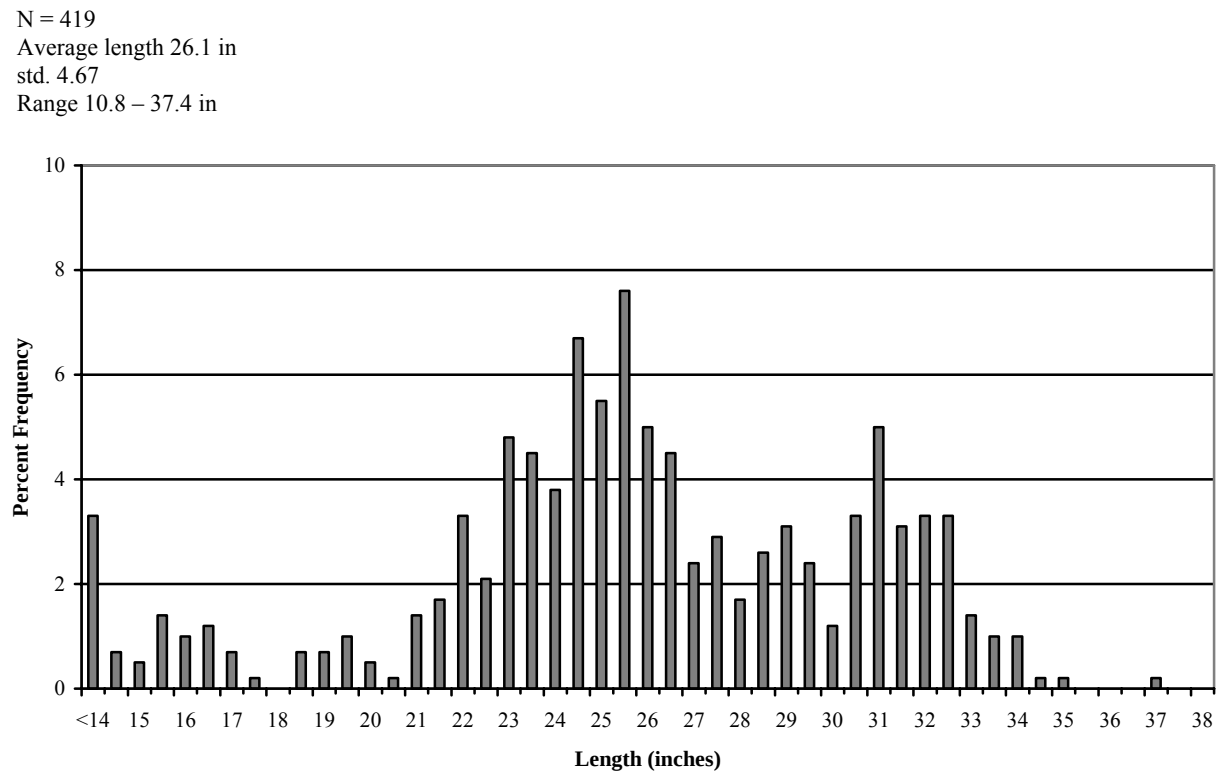
Appendix IV (a). Length frequency of coho salmon observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010.



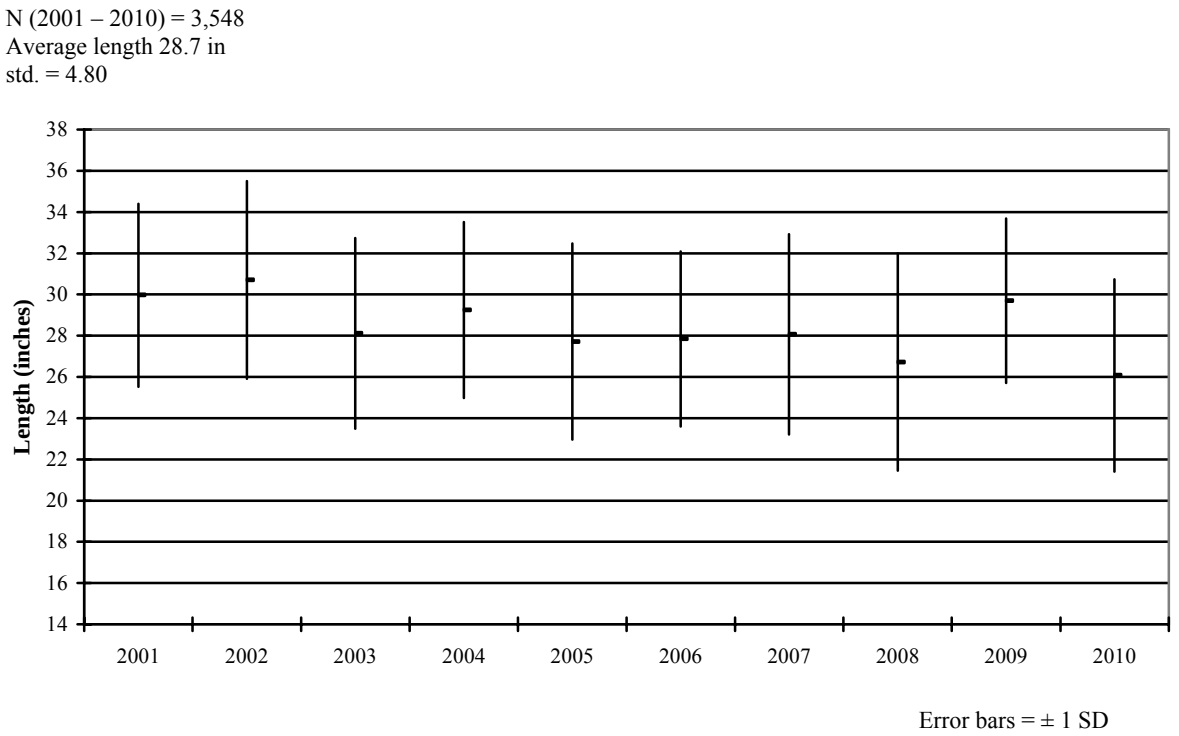
Appendix IV (b). Average total length of creeled coho salmon from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



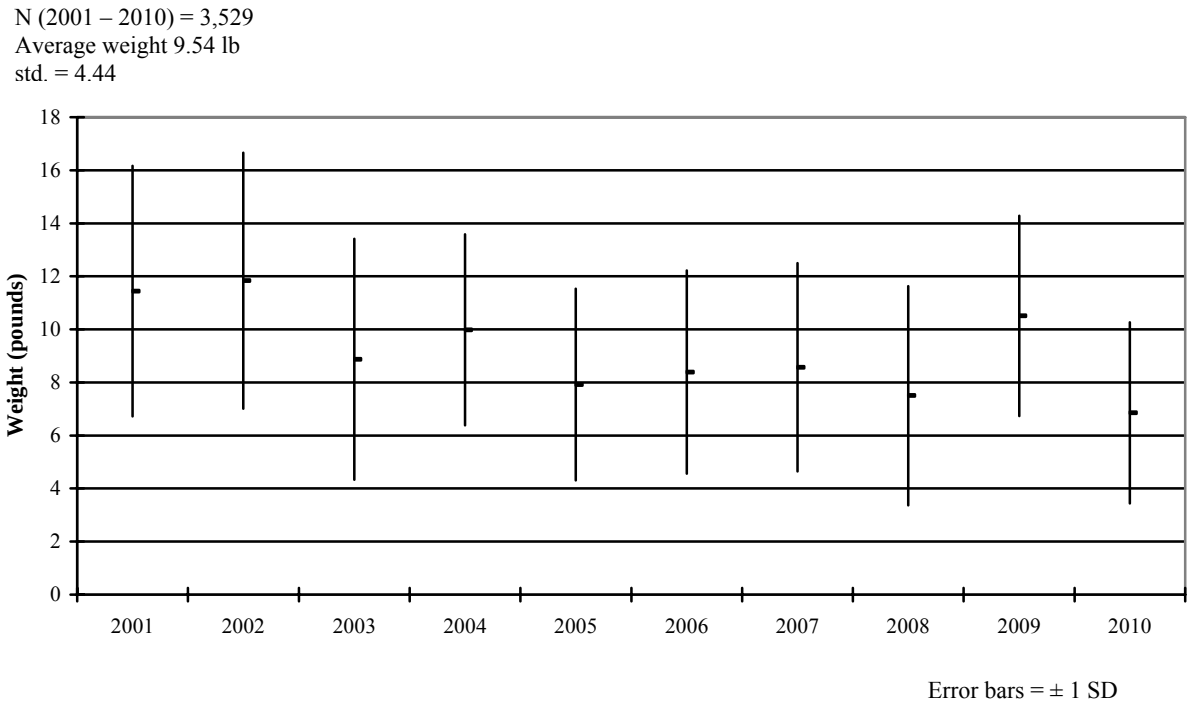
Appendix IV (c). Average weight of creeled coho salmon from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



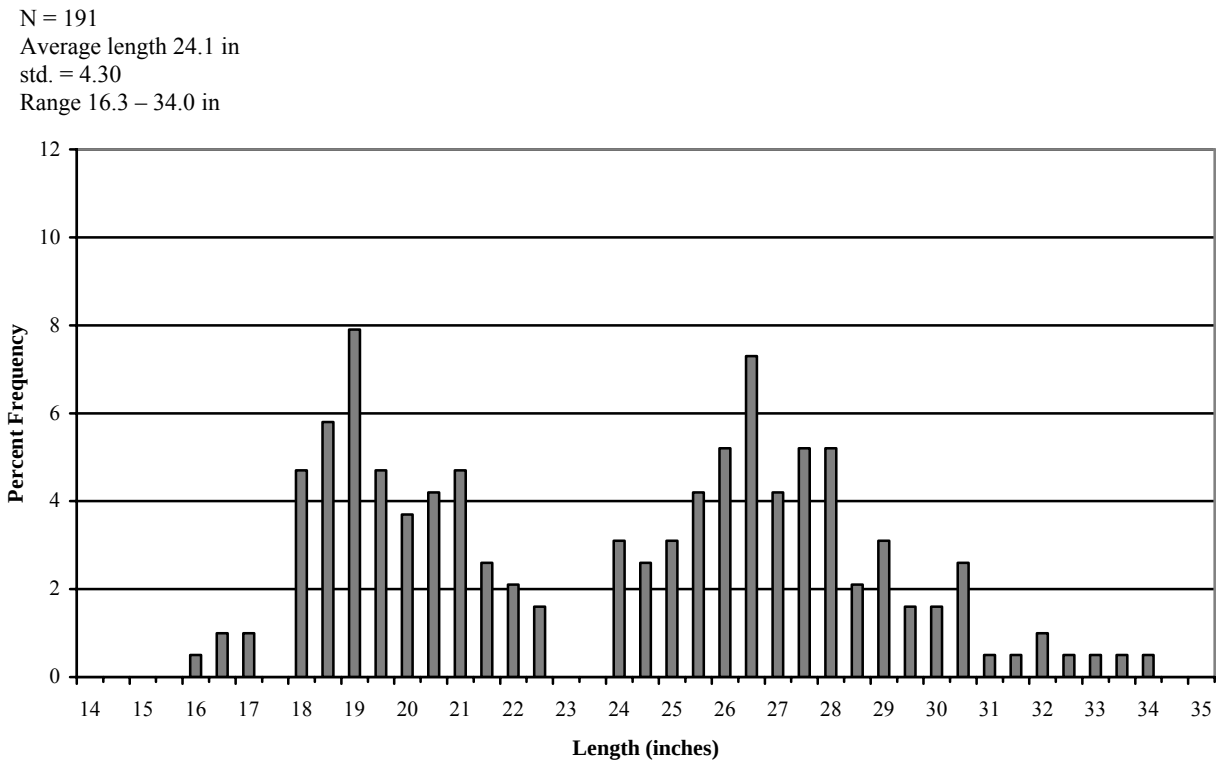
Appendix V (a). Length frequency of Chinook salmon observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010.



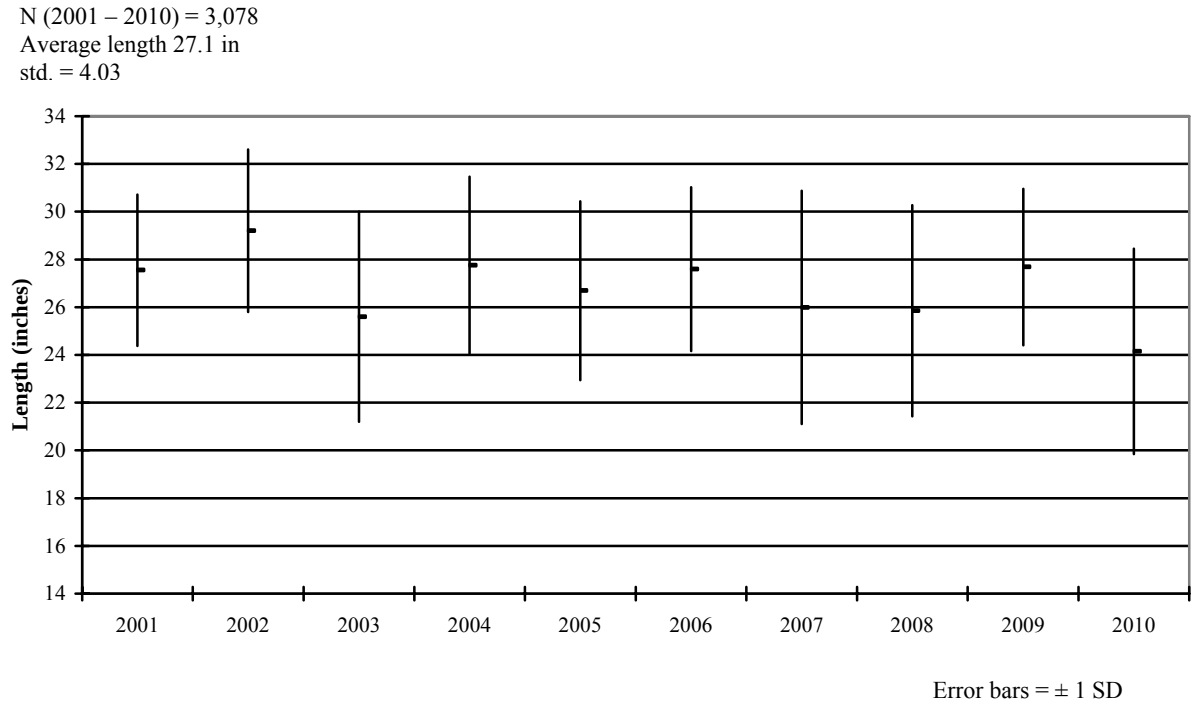
Appendix V (b). Average total length of creeled Chinook salmon from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



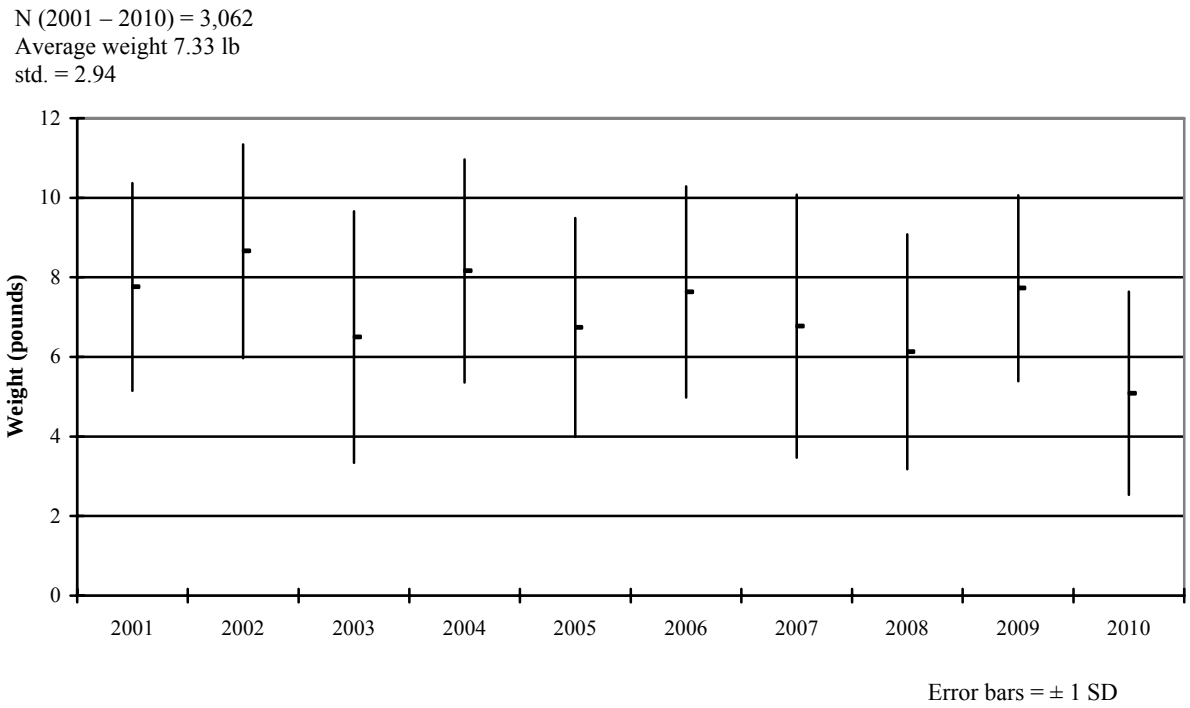
Appendix V (c). Average weight of creeled Chinook salmon from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



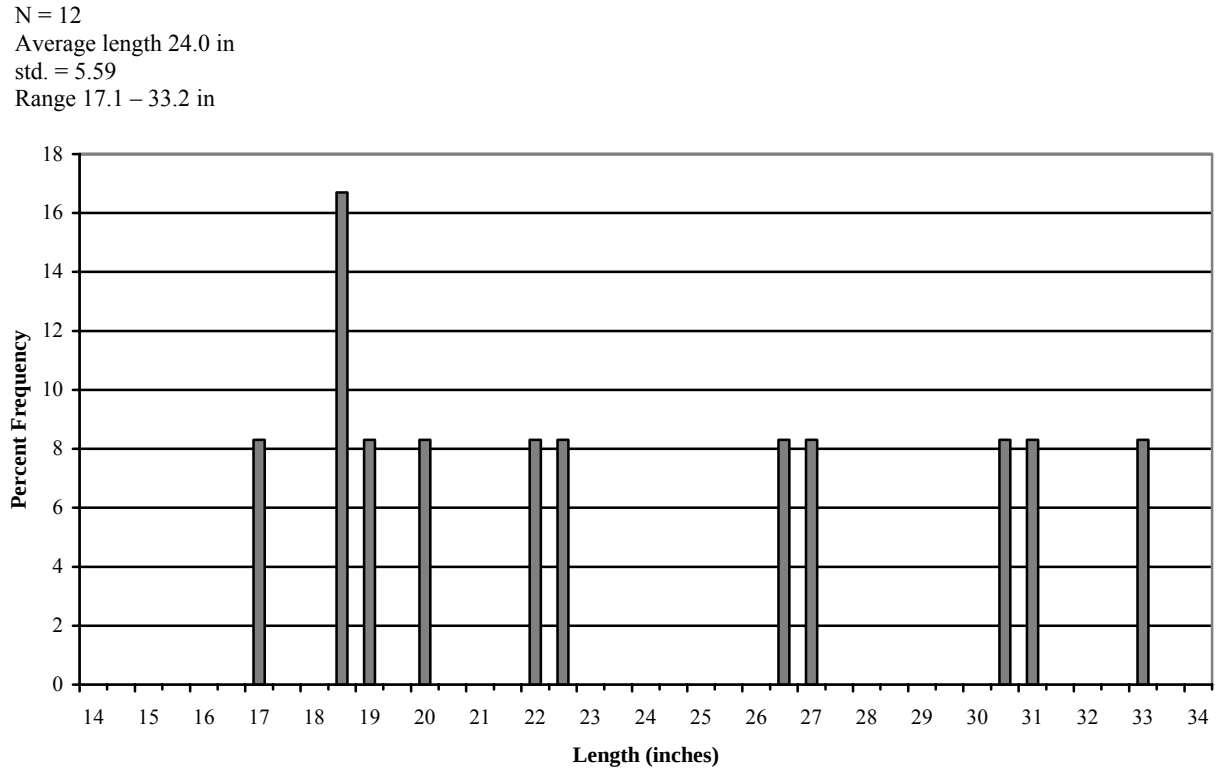
Appendix VI (a). Length frequency of steelhead observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010.



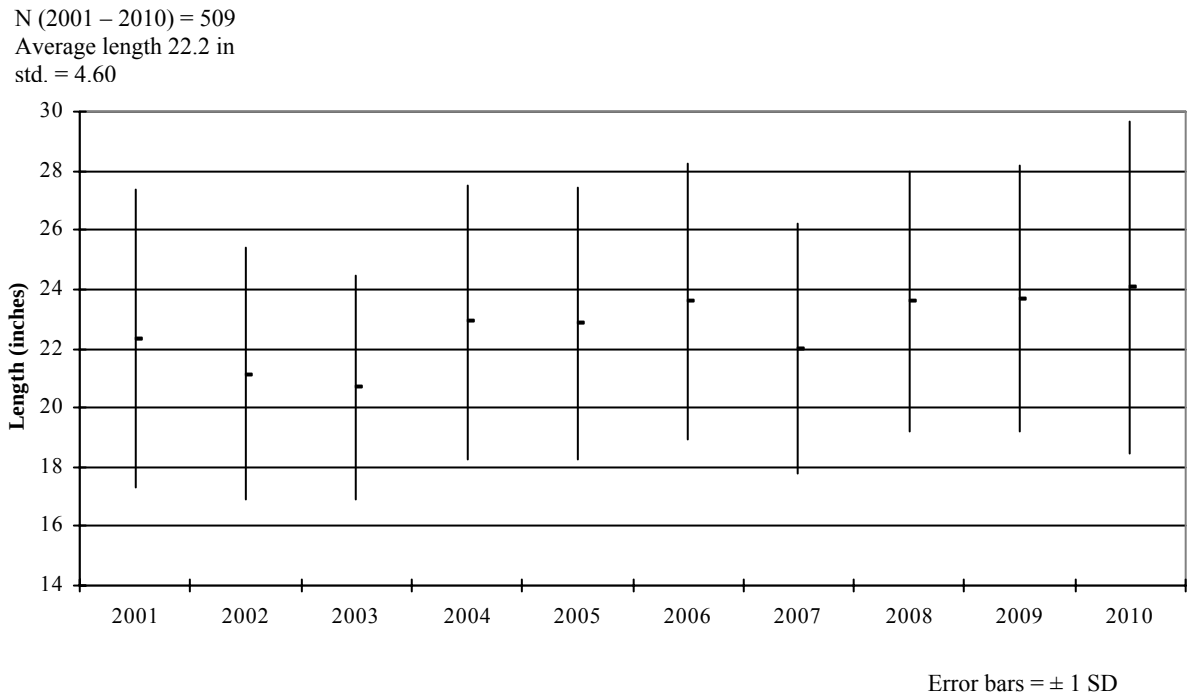
Appendix VI (b). Average total length of creeled steelhead from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



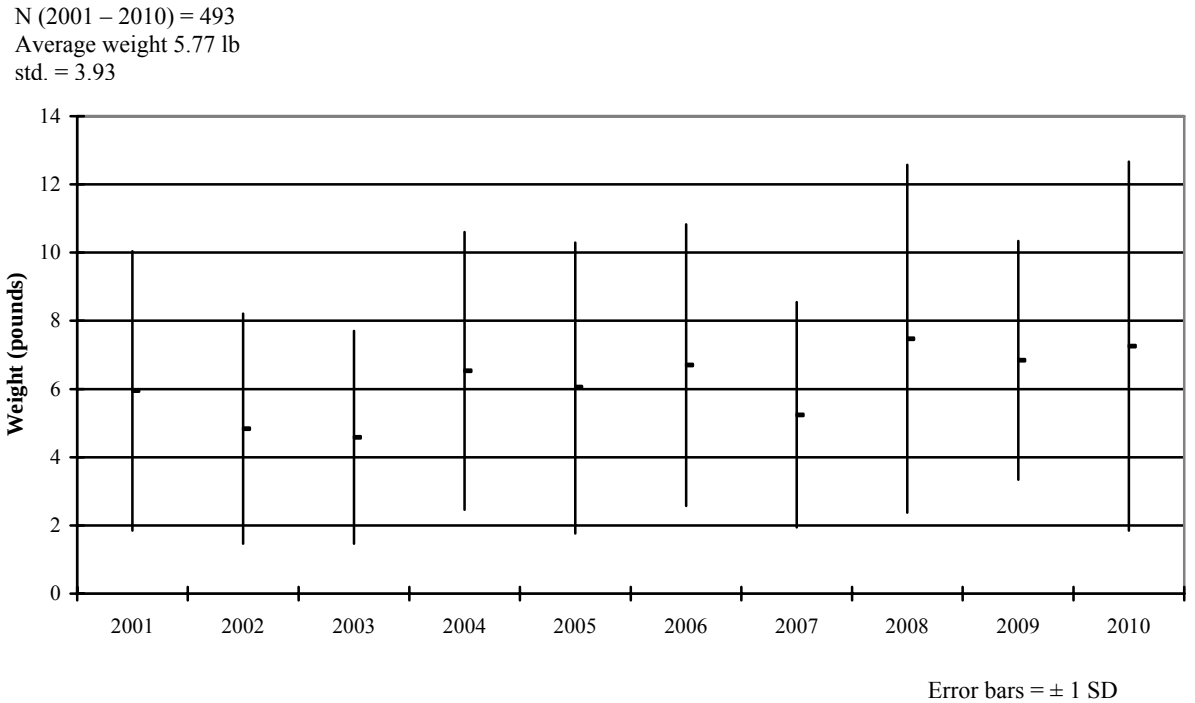
Appendix VI (c). Average weight of creeled steelhead from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



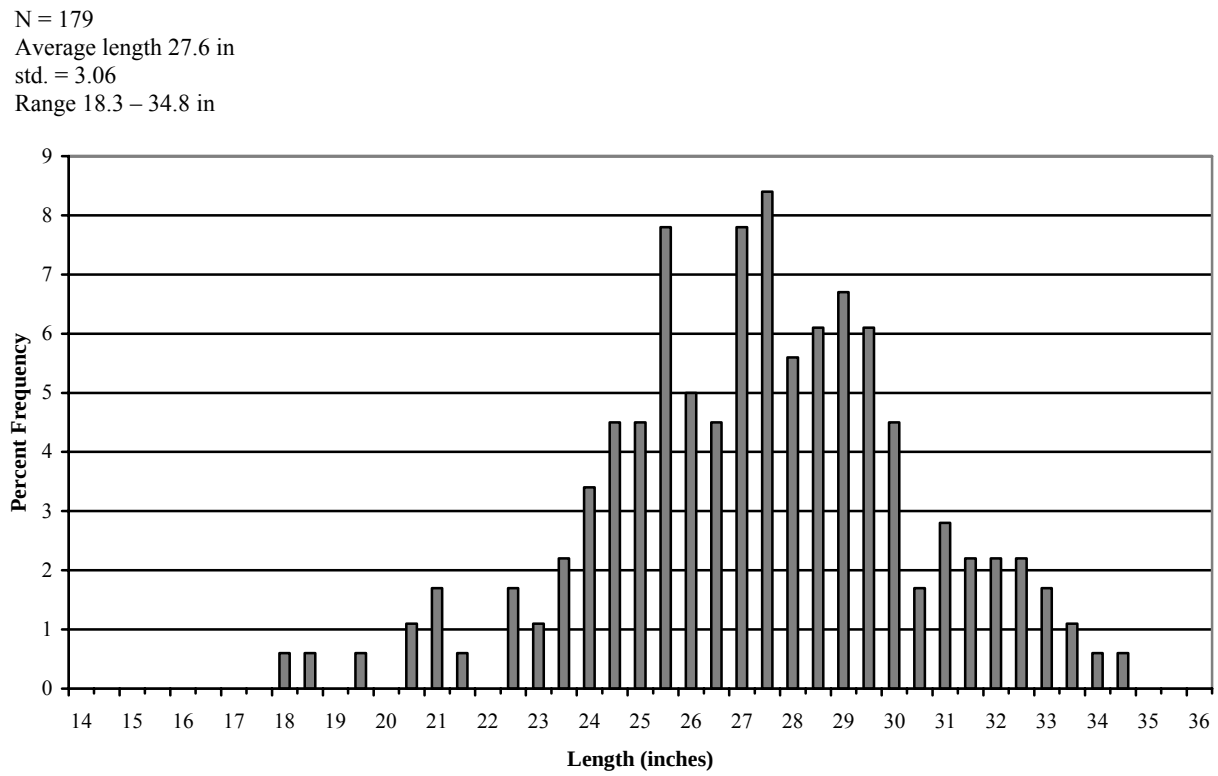
Appendix VII (a). Length frequency of brown trout observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010.



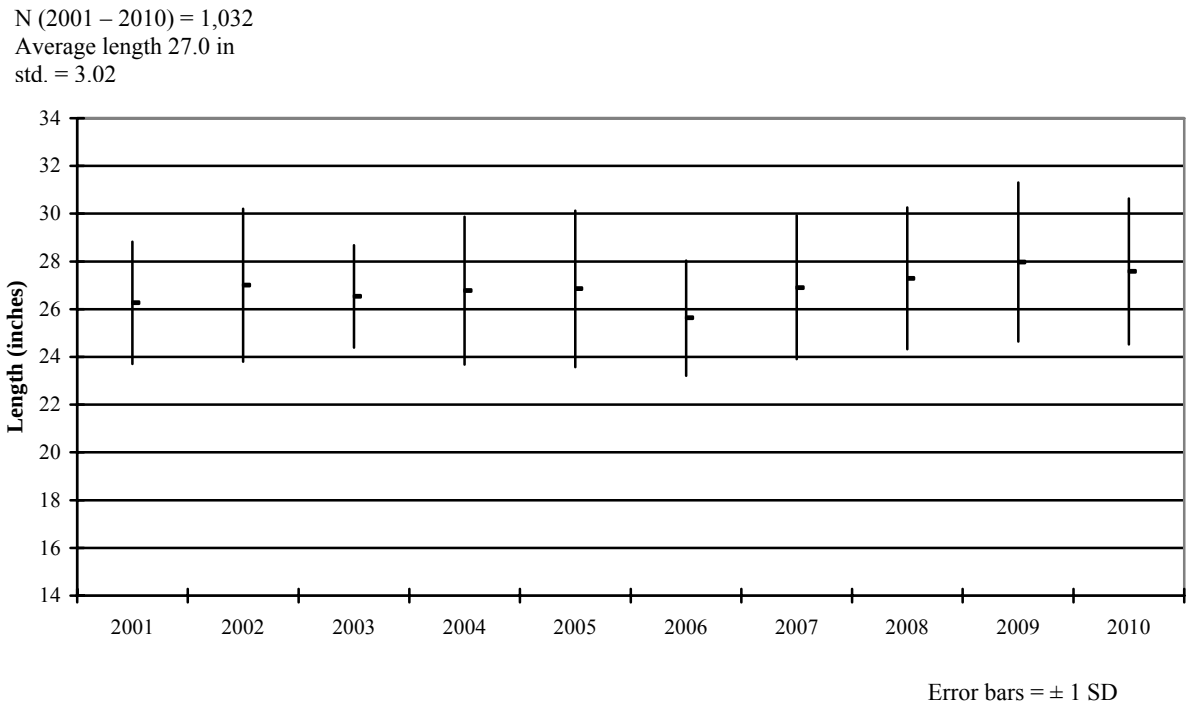
Appendix VII (b). Average total length of creeled brown trout from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



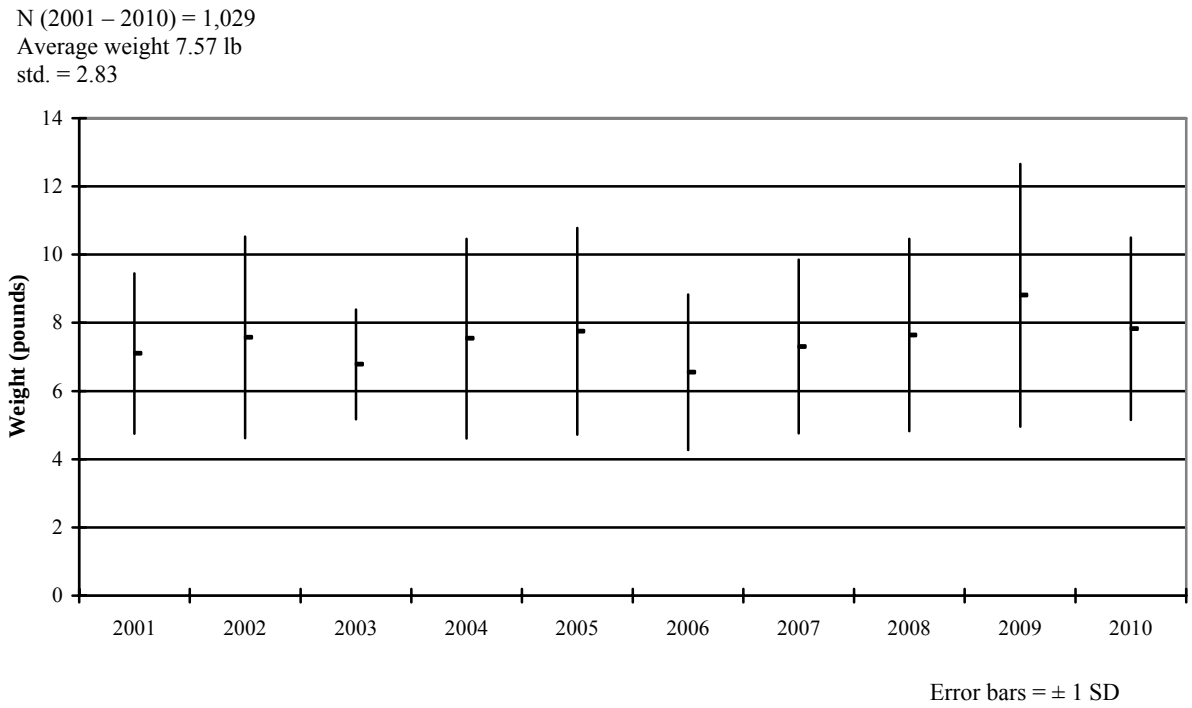
Appendix VII (c). Average weight of creeled brown trout from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



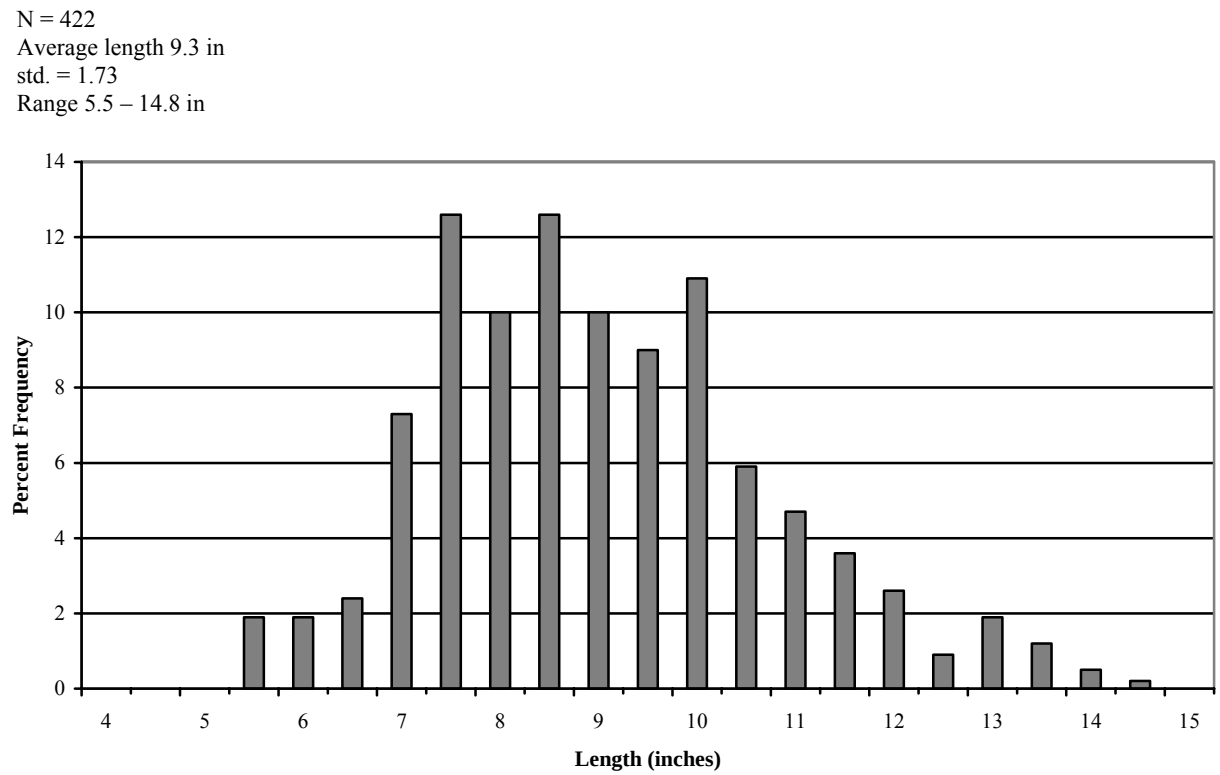
Appendix VIII (a). Length frequency of lake trout observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010.



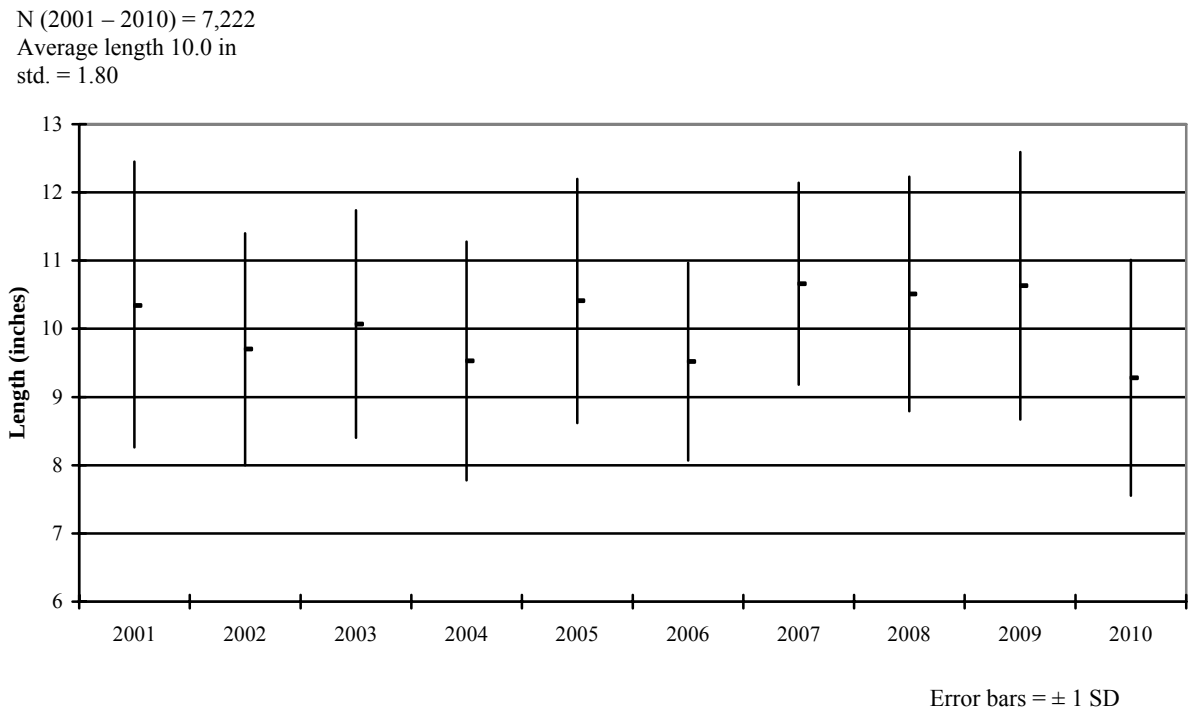
Appendix VIII (b). Average total length of creeled lake trout from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



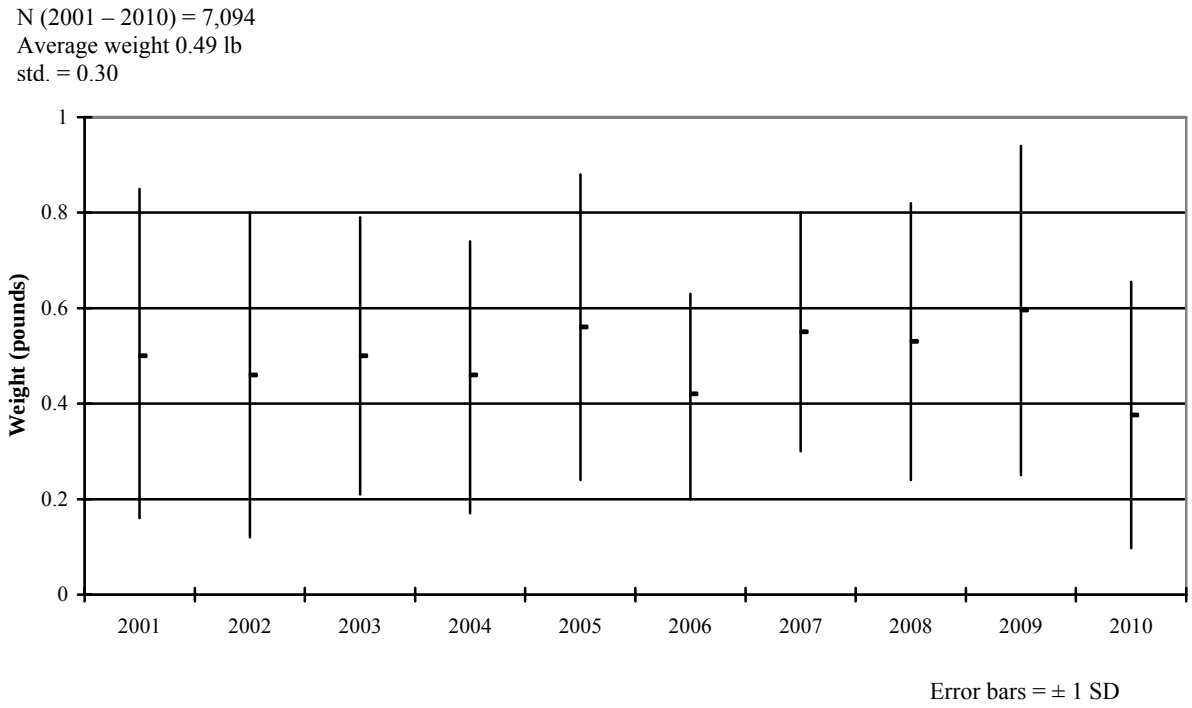
Appendix VIII (c). Average weight of creeled lake trout from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



Appendix IX (a). Length frequency of yellow perch observed in the Indiana Department of Natural Resources Lake Michigan creel survey during 2010.



Appendix IX (b). Average total length of creeled yellow perch from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.



Appendix IX (c). Average weight of creeled yellow perch from the Indiana Department of Natural Resources Lake Michigan creel survey, 2001 through 2010.

Appendix X (a). County of residence of anglers that were surveyed in the Indiana Department of Natural Resources Lake Michigan creel survey fishing from boat during 2010 (n=970).

County	No. Parties	%	County	No. Parties	%
Lake	302	(31.1)	Grant	1	(0.1)
Out-of-State	274	(28.2)	Hancock	1	(0.1)
Porter	168	(17.3)	Harrison	1	(0.1)
LaPorte	114	(11.7)	Hendricks	1	(0.1)
St. Joseph	18	(1.8)	Howard	1	(0.1)
Elkhart	14	(1.4)	Monroe	1	(0.1)
Marion	10	(1.0)	Pulaski	1	(0.1)
Tippecanoe	10	(1.0)	Wabash	1	(0.1)
Newton	7	(0.7)	Wells	1	(0.1)
Marshall	6	(0.6)	Whitley	1	(0.1)
Dekalb	5	(0.5)			
Jasper	5	(0.5)			
Allen	4	(0.4)			
Kosciusko	4	(0.4)			
Boone	3	(0.3)			
Vigo	3	(0.3)			
Fulton	2	(0.2)			
LaGrange	2	(0.2)			
Miami	2	(0.2)			
White	2	(0.2)			
Adams	1	(0.1)			
Bartholomew	1	(0.1)			
Cass	1	(0.1)			
Daviess	1	(0.1)			
Delaware	1	(0.1)			

Appendix X (b). County of residence of anglers that were surveyed in the Indiana Department of Natural Resources Lake Michigan creel survey fishing from shore during 2010 (n=937).

County	No. Parties	%	County	No. Parties	%
Lake	261	(27.8)	Monroe	1	(0.1)
Porter	228	(24.3)	Montgomery	1	(0.1)
LaPorte	214	(22.8)	Morgan	1	(0.1)
Out-of-State	127	(13.5)	Newton	1	(0.1)
St. Joseph	29	(3.1)	Pulaski	1	(0.1)
Elkhart	22	(2.3)	Wabash	1	(0.1)
Marion	12	(1.3)	Warrick	1	(0.1)
Allen	5	(0.5)			
Marshall	5	(0.5)			
Hamilton	3	(0.3)			
Noble	3	(0.3)			
Fulton	2	(0.2)			
Johnson	2	(0.2)			
Miami	2	(0.2)			
Tippecanoe	2	(0.2)			
Wayne	2	(0.2)			
Adams	1	(0.1)			
Brown	1	(0.1)			
Carroll	1	(0.1)			
Cass	1	(0.1)			
Dekalb	1	(0.1)			
Fayette	1	(0.1)			
Hendricks	1	(0.1)			
Huntington	1	(0.1)			
Jasper	1	(0.1)			
Jennings	1	(0.1)			
Madison	1	(0.1)			

Appendix X (c). County of residence of anglers that were surveyed in the Indiana Department of Natural Resources Lake Michigan creel survey fishing from stream during 2010 (n=922).

County	No. Parties	%	County	No. Parties	%
Out-of-State	221	(24.0)	Benton	1	(0.1)
LaPorte	185	(20.0)	Carroll	1	(0.1)
Porter	150	(16.3)	Fayette	1	(0.1)
Lake	145	(15.7)	Franklin	1	(0.1)
St. Joseph	55	(6.0)	Fulton	1	(0.1)
Elkhart	23	(2.5)	Hancock	1	(0.1)
Allen	16	(1.7)	Hendricks	1	(0.1)
Marion	15	(1.6)	Henry	1	(0.1)
Starke	15	(1.6)	Huntington	1	(0.1)
Delaware	8	(0.9)	Johnson	1	(0.1)
Kosciusko	8	(0.9)	LaGrange	1	(0.1)
Jasper	7	(0.7)	Martin	1	(0.1)
Tippecanoe	7	(0.7)	Monroe	1	(0.1)
Hamilton	6	(0.6)	Montgomery	1	(0.1)
Boone	5	(0.5)	Newton	1	(0.1)
Grant	5	(0.5)	White	1	(0.1)
Marshall	4	(0.4)			
Cass	3	(0.3)			
Howard	3	(0.3)			
Morgan	3	(0.3)			
Noble	3	(0.3)			
Wabash	3	(0.3)			
Whitley	3	(0.3)			
Madison	2	(0.2)			
Miami	2	(0.2)			
Pulaski	2	(0.2)			
Warrick	2	(0.2)			
Wayne	2	(0.2)			
Wells	2	(0.2)			
Bartholomew	1	(0.1)			

Appendix XI (a). Boat, shore and stream angler response to the species importance and species satisfaction questions on a scale from 1 to 5, with 5 being the highest degree of importance and/or satisfaction from the Indiana Department of Natural Resources Lake Michigan creel survey, 2010.

	Importance						Satisfaction					
Species	5	4	3	2	1	n/a	5	4	3	2	1	n/a
Coho	774(87%)	63(7%)	27(3%)	6(<1%)	6(<1%)	18(2%)	247(28%)	179(20%)	174(19%)	59(7%)	46(5%)	187(21%)
Chinook	594(88%)	39(6%)	20(3%)	2(<1%)	4(<1%)	15(2%)	145(21%)	134(20%)	132(20%)	46(7%)	70(10%)	147(22%)
Steelhead	1,059(88%)	57(5%)	31(2%)	4(<1%)	2(<1%)	44(4%)	385(32%)	232(19%)	248(21%)	65(5%)	37(3%)	229(19%)
Brown Trout	284(81%)	24(7%)	22(6%)	8(2%)	4(1%)	9(3%)	49(14%)	30(9%)	52(15%)	40(11%)	55(16%)	124(35%)
Lake Trout	114(74%)	7(5%)	17(11%)	10(6%)	5(3%)	2(1%)	47(31%)	17(11%)	25(16%)	12(8%)	11(7%)	42(27%)
Yellow Perch	514(91%)	30(5%)	15(3%)	0	2(<1%)	3(<1%)	162(28%)	124(22%)	122(22%)	43(8%)	34(6%)	77(14%)
Black Bass	199(89%)	11(5%)	8(4%)	0	0	5(2%)	97(43%)	46(21%)	37(17%)	11(5%)	1(<1%)	31(13%)

Appendix XI (b). Boat angler response to the species importance and species satisfaction questions on a scale from 1 to 5, with 5 being the highest degree of importance and/or satisfaction from the Indiana Department of Natural Resources Lake Michigan creel survey, 2010.

	Importance						Satisfaction					
Species	5	4	3	2	1	n/a	5	4	3	2	1	n/a
Coho	317(88%)	23(6%)	12(3%)	2(<1%)	3(<1%)	3(<1%)	106(30%)	98(27%)	72(20%)	35(10%)	13(4%)	34(9%)
Chinook	277(94%)	11(4%)	4(2%)	0	1(<1%)	1(<1%)	80(27%)	87(30%)	61(21%)	24(8%)	20(7%)	22(7%)
Steelhead	152(94%)	3(2%)	6(4%)	0	0	1(<1%)	46(29%)	28(17%)	42(26%)	19(12%)	7(4%)	19(12%)
Brown Trout	80(76%)	9(8%)	11(10%)	3(3%)	2(2%)	1(<1%)	16(15%)	11(10%)	28(26%)	18(17%)	11(10%)	22(21%)
Lake Trout	83(72%)	5(4%)	15(13%)	8(7%)	4(3%)	1(<1%)	41(36%)	14(12%)	21(18%)	10(9%)	8(7%)	21(18%)
Yellow Perch	317(94%)	14(4%)	6(2%)	0	0	1(<1%)	109(32%)	87(26%)	75(22%)	20(6%)	14(4%)	33(10%)
Black Bass	113(95%)	4(3%)	2(2%)	0	0	0	57(48%)	22(19%)	19(16%)	4(3%)	1(<1%)	15(13%)

Appendix XI (c). Shore angler response to the species importance and species satisfaction questions on a scale from 1 to 5, with 5 being the highest degree of importance and/or satisfaction from the Indiana Department of Natural Resources Lake Michigan creel survey, 2010.

	Importance						Satisfaction					
Species	5	4	3	2	1	n/a	5	4	3	2	1	n/a
Coho	142(90%)	6(4%)	5(3%)	2(1%)	1(<1%)	1(<1%)	41(26%)	27(17%)	36(23%)	10(6%)	9(6%)	34(22%)
Chinook	76(86%)	4(5%)	7(8%)	0	1(1%)	0	14(16%)	7(8%)	18(20%)	6(7%)	15(17%)	28(32%)
Steelhead	245(89%)	14(5%)	8(3%)	1(<1%)	0	7(2%)	76(28%)	69(25%)	63(23%)	17(6%)	8(3%)	42(15%)
Brown Trout	45(76%)	5(8%)	4(7%)	4(7%)	0	1(2%)	9(15%)	11(19%)	8(14%)	9(15%)	2(3%)	20(34%)
Lake Trout	31(79%)	2(5%)	2(5%)	2(5%)	1(3%)	1(3%)	6(15%)	3(8%)	4(10%)	2(5%)	3(8%)	21(54%)
Yellow Perch	197(88%)	16(7%)	9(4%)	0	2(<1%)	1(<1%)	53(24%)	37(16%)	47(21%)	23(10%)	20(9%)	44(20%)
Black Bass	86(83%)	7(7%)	6(6%)	0	0	5(4%)	40(39%)	24(23%)	18(17%)	7(7%)	0	15(14%)

Appendix XI (d). Stream angler response to the species importance and species satisfaction questions on a scale from 1 to 5, with 5 being the highest degree of importance and/or satisfaction from the Indiana Department of Natural Resources Lake Michigan creel survey, 2010.

	Importance						Satisfaction					
Species	5	4	3	2	1	n/a	5	4	3	2	1	n/a
Coho	315(84%)	34(9%)	10(3%)	2(<1%)	2 (<1%)	14(4%)	100(27%)	54(14%)	66(17%)	14(4%)	24(6%)	119(32%)
Chinook	241(82%)	24(8%)	9(3%)	2(<1%)	2(<1%)	14(5%)	51(18%)	40(14%)	53(18%)	16(5%)	35(12%)	97(33%)
Steelhead	662(87%)	40(5%)	17(2%)	3(<1%)	2(<1%)	36(5%)	263(34%)	135(18%)	143(19%)	29(4%)	22(3%)	168(22%)
Brown Trout	159(85%)	10(5%)	7(4%)	1(<1%)	2(1%)	7(4%)	24(13%)	8(4%)	16(9%)	13(7%)	42(23%)	82(44%)
Lake Trout	0	0	0	0	0	0	0	0	0	0	0	0
Yellow Perch	0	0	0	0	0	1(100%)	0	0	0	0	0	1(100%)