**LAKE MICHIGAN CREEL**

**History and Program Overview**

Janel Palla

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**INTRODUCTION**

(adapted from Bence et al. 1995)

The recreational fisheries of the Great Lakes are economically, socially and ecologically important. Management of these fisheries relies on data describing fishery catch and effort. Information on sport fishery harvest, catch per unit effort, and biological information is widely used to make management decisions and to develop a better understanding of ecosystem and population dynamics.

The fisheries of Lake Michigan and the other Great Lakes are intensively managed through stocking, sea lamprey control, and harvest regulations. Management of these fisheries frequently requires coordination across state lines and with tribal authorities and often involves collaboration with stock assessment scientists and population dynamics. The sport fishery has become an increasingly important component of the overall fishery harvest during the past 30 years, especially on Lake Michigan. In 1991, approximately 10% of the total United States angling effort in freshwater was expended on the Great Lakes and nearly one-third of Great Lakes anglers fished Lake Michigan (U.S. Department of the Interior and Commerce 1993).

Sport harvest within Lake Michigan has become increasingly monitored through direct contact creel surveys. Annual creel surveys began in Wisconsin waters of Lake Michigan in 1969, and by 1985 were conducted by all four states bordering the lake (Bence et al. 1995). All four states also began requiring mandatory reporting of charter fishing catch and effort during the 1980s.

As fish respect natural, not political boundaries, management of the Lake Michigan fishery requires coordination across state lines and with tribal authorities. Recognizing this, the Lake Michigan Creel Survey Working group, composed of fisheries managers and researchers from the four states, was formed in 1994 by the Lake Michigan Technical Committee (LMTC) of the Great Lakes Fishery Commission (Great Lakes Fishery Commission created in 1954 to facilitate coordinated, binational fisheries management by the governments of the United States and Canada). The Lake Michigan Creel Survey Working Group is an ad hoc group that first met at the January 1995 Lake Michigan Technical Committee meeting. The original charges were:

(1) to develop a lake-wide database on sport harvest and effort

and

(2) to review and standardize methods for a lake-wide creel survey.

The existence of a database facilitates timely and complete reporting for Lake Michigan meetings and preparation of tailored information from more than one jurisdiction needed for management. A suite of pre-designed computer programs can be applied to such databases to produce standard reports, such as tables and figures on harvest, effort, targeted harvest and effort, and size or age compositions. Appendix A shows the Lake Michigan Creel Survey Work Group creel database design.

A review of existing methods used in Lake Michigan Creel Surveys was completed, and a written report was produced and distributed at the July 1995 Lake Michigan Technical Committee. That report contained both a description of methods and suggestions for changes in field procedures and data analysis. Although changes were suggested to lead to more standardized procedures, one major conclusion was that **identical procedures were neither necessary nor desirable given differences in fisheries and available sampling resources**. The major goal was comparable and appropriate state estimates that could be combined.

**INDIANA’S LAKE MICHIGAN SHORELINE**

*Geographic area of the Indiana Shoreline*

Indiana’s share of Lake Michigan is the smallest of the four states bordering the Lake (roughly 1% of Lake Michigan area), encompassing approximately 43 miles of Lake Michigan 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 (Appendix B).

Boat and pier access is provided along the lakefront by several private and public marinas. These include: 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. Four 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; NIPSCO Dean H. Mitchell Generating Station, Gary, and Dominion State Line plant, Hammond. The NIPSCO Michigan City[[1]](#footnote-1) plant along with State Line provide limited fishing opportunities for pedestrian 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. Dean Mitchell, a highly popular pedestrian/boat fishing location, recently ceased operations, closing fishing access, due to the declining electricity demand and the economic downturn in steel and other Northwest Indiana industries.

Various industries along the shoreline also provide access (some areas restricted to employees only) to pedestrian and/or boat anglers (e.g., Bethlehem Steel, Burns Harbor; Midwest Steel, Burns Harbor; boat-in-beach between Burns Waterway and Port of Indiana, Portage; Amoco Whiting Refinery, Whiting; Hammond Water Filtration Plant; Hammond).

Due to the National Security Strategy of the United States of America, access to private and industrial properties has become increasingly limited since 200x.

Most of the Dunes National Lakeshore beaches are accessible to pedestrian anglers, with fishing allowed outside bathing-beach areas. Areas include, but are not limited to, Mt. Baldy Beach (Michigan City); Central Avenue Beach (Beverly Shores); Kemil Road Beach (Beverly Shores); Lakeview Beach (Beverly Shores) and Burns Harbor boat-in-beach. Several county or city parks also exist for pedestrian/boat angler access (Appendix B).

Two main tributaries, Trail Creek and the Little Calumet River empty into Indiana waters of Lake Michigan. Watershed land-uses range from urban to industrial (wastewater treatment plants; effluents) to agricultural.

*The Southern Lake Michigan Fishery*

The slope of the near-shore lake bottom becomes progressively steeper from south to north, a geographic feature that influences the distribution and success of sport fishing. In general, most angler effort from Michigan City to Hammond has historically been directed at yellow perch *(Perca flavescens)* and salmonids.

Smallmouth bass *(Micropterus dolomieui)*, a near-shore species, have recently increased in popularity for both boat and shore fisheries. The addition of large rocks, glacial boulders and rip-rap to the lake during break wall construction has created ideal smallmouth bass habitat. Smallmouth bass numbers have responded positively to this increase in habitat. As the availability and abundance of smallmouth have increased in southern Lake Michigan, so has the interest by anglers targeting smallmouth bass.

During the months of January, February, and March, fishing activity is limited to the streams and warm-water discharges along the shoreline. Indiana’s boat fishing season typically begins during the months of March and April, with the majority of fishing activity occurring within a two-mile band along the shoreline. Due to annual migration patterns, most of the coho salmon *(Oncorynchus kisutch)* stocked in the Lake by Illinois, Michigan, Wisconsin and Indiana stage in southern Lake Michigan. Thus, coho salmon contribute close to 90% of the Indiana boat and shore salmonid catch during the spring months.

As the near-shore water temperatures begin to increase in late spring, the coho and other trout and salmon species move into deeper, colder, offshore waters. Between May and the end of July, boat anglers in pursuit of salmonids fish the deeper depths of Lake Michigan, concentrating in Illinois and Michigan waters.

Yellow perch move closer to shore during this period to take advantage of warm surface waters.

June through October, shore and boat salmonid-effort increases with the return of steelhead trout *(Oncorynchus mykiss)*, coho salmon *(Oncorynchus kisutch)* and chinook salmon *(Oncorynchus tshawytscha)* during their annual spawning migrations. These species return to the tributary or lake site where they were planted as fingerlings. Chinook and coho salmon die after completion of spawning, whereas steelhead trout are multiple-year spawners. The skamania strain (summer-run) steelhead remain in Indiana streams until they spawn the following spring. Most of the winter-run steelhead enter the tributaries during March and April on their annual spawning migration.

At the close of the boating season during October and/or November, angler effort is again concentrated in the tributaries and warm-water discharges along the Indiana shoreline.

*Stocking History*

Since the late 1960's, salmon and trout have been an important component of the Lake Michigan fish community. Lake trout *(Salvelinus namaycush)* planting began in 1965 and coho salmon and chinook salmon were introduced from the Pacific Northwest in 1966 and 1967 (Eshenroder et al., 1995). Rainbow trout, or steelhead and brown trout *(Salmo trutta)* were also extensively planted. Of the five major salmonids stocked, only lake trout is released with the objective of rehabilitation (i.e., to re-establish reproducing populations). The others are stocked to provide angling opportunities and to utilize the overabundance of nonnative alewives *(Alosa pseudoharengus)*, which entered the Lake Michigan system in 1949 from the Atlantic Ocean via the Welland Canal (The Welland Canal joined Lakes Erie and Ontario to bypass Niagara Falls, a natural barrier for aquatic organisms).

The Indiana Department of Natural Resources (IN DNR), Division of Fish and Wildlife has stocked trout and salmon along the southern shoreline of Lake Michigan since 1969. The area stocked extends from Michigan City to Whiting and includes sites along the St. Joseph River, Trail Creek and the East Branch of the Little Calumet.

**INDIANA’S LAKE MICHIGAN CREEL METHODOLOGY**

HEREThe Indiana Department of Natural Resources (IN DNR) first Lake Michigan creel survey occurred in the spring of 1968 to assess Indiana’s salmonid stocking program. shery Since 1968, the Indiana Department of Natural Resources (IN DNR) has conducted Lake Michigan creel surveys to assess harvest and fishing pressure. This harvest, effort and biological data is used to monitor trends in the Southern Lake Michigan fishery. The following table is a summary of the creel sampling dates from the prior 28-years of Indiana’s Lake Michigan lake/stream creel survey program.

Table 1. Lake Michigan lake/stream creel sampling dates (1974-2001).

|  |  |  |
| --- | --- | --- |
| **YEAR** | **LAKE CREEL** | **STREAM CREEL** |
| 1998 - 2001 | April 1 - October 31 (Hammond Marina not surveyed during April 1998 due to personnel shortages and low angler effort) | March 1 - March 31  July 1 - December 31 |
| 1992 - 1997 | April 1 - October 31 | January 1 - March 31  July 1 - November 30 (December not sampled due to personnel shortages) |

|  |  |  |
| --- | --- | --- |
| 1991 | March 19 to October 31 | January 1 - March 31  July 1 - December 31 |
| 1990 | March 22 to October 31 | January 1 - March 31  July 1 - December 31 |
| 1989 | April 1 to November 12 | January 1 - March 31  July 18 - December 31 |
| 1988 | April 2 to September 26 | January 1 - March 31  July 1 - December 31 |
| 1987 | April 1 to October 31 | August 1 - November 22 |
| 1986 | April 1 to October 31 | August 14 - November 10 |
| 1985 | May 1 to October 27 | July 29 - November 17 |
| 1984 | May 1 to November 10 | July 28 - November 25 |
| 1983 | March 19 - November 13  Discharges: Sept. 10 - Oct. 15 | August 1 - November 24 |
| 1982 | March 22 - November 7  Discharges: Sept. 10-29 | July 24 - November 21 |
| 1981 | March 1 - November 23  Discharges: February - May;  Sept. 3 - Oct. 11 | August 6 - November 15 |
| 1980 | April 1 - November 23  Discharges: January - April | September 2 - November 15 |
| June 1978 -  May 1979 | June 1 - November 25; March 19 - May;  Discharges: July - December 1978  (Sept. omitted)  January - May | September 18- November 19, 1978 |
| 1977 | March 28 - June 30  September 1 - November 13 | October 6 - November 20 |
| 1976 | March 24 - June 30  September 20 - November 14 | October 3 - November 14 |
| 1975 | March 24 - June 30  September 6 - November 19 | October 1 - November 19 |
| 1974 | August to November (lack of funding precluded a survey in April - June) | September 23 - November 30 |

*Fishery Types Surveyed*

*Lake*

Four defined access sites (ports) exist to enter Indiana’s Lake Michigan fishery. Public fishing launches are only available at these four ports, thus, the majority of boat anglers utilize these defined sites to reach the water.

**BOAT**

Sport fishing from boats (including charter boats):

1. Michigan City at Washington Park and Trail Creek Marina (MC)

2. Burns Harbor at numerous private ramps and slips on Burns Waterway (BH)

3. East Chicago at Pastrick marina (EC)

4 Hammond at Hammond marina and the Lake County Parks and Recreation Whihala Beach boat launch in Whiting (HA)

Access along the southern shoreline includes the four main sites (ports), along with limited access to various warm water discharges and private industry (e.g. State Line Energy LLC, Hammond; BP Whiting Refinery; Inland Steel break water, East Chicago; Bethlehem Steel, Burns Harbor; and NIPSCO Michigan City Generating Station). Most of the previously listed discharges allow sunrise to sunset fishing with access limited during adverse weather conditions due to dangers associated with high winds and/or icy conditions. The Bethlehem Steel warm water discharge and the U.S. Steel Inland Wall only allow shoreline access to company employees.

**SHORE**

The Indiana Lake Michigan creel survey monitors shore fishing only at the four fishing ports (MC, BH, EC, and HA).

**STREAM**

The stream fishery is monitored at Trail Creek (TC) in LaPorte County, the East Branch of the Little Calumet River (LC) in Porter County and Salt Creek (SC) in Porter County. This creel design samples the stocked tributaries of Lake Michigan. The only exception is the St. Joseph River, which falls directly under the Fisheries Management District 2 biologist. Thus, the Lake Michigan stream creel design is exclusive of the St. Joseph River project.

The following table summarizes the survey area covered for the prior 28 years of Indiana’s Lake Michigan lake/stream creel survey program.

Table 2. Lake Michigan lake/stream creel survey areas (1974-2001).

|  |  |  |  |
| --- | --- | --- | --- |
| **YEAR** | **BOAT FISHERY SITES** | **SHORE FISHERY**  **SITES** | **STREAM FISHERY**  **SITES** |
| 2001  2000  1999 | MC  BH  EC  HA (addition of Whihala boat ramp in 1999) | MC  BH  EC  HA | TC  LC  SC |
| 1998  1997  1996  1995  1994  1993  1992  1991 | MC  BH  EC  HA | MC  BH  EC  HA | TC  LC  SC |

|  |  |  |  |
| --- | --- | --- | --- |
| 1990 | MC (Wash. Park & Sprague)  EC (Pastrick)  BH (Lefty's Marina) | EC pier  MC pier | TC  LC  SC |
| 1989 | MC (Wash. Park & Sprague)  EC (Pastrick)  BH (Lefty's) | EC pier  MC pier | TC  LC  SC |
| 1988 | MC (MC Yacht Basin)  EC (Jeorse Park)  BH (Lefty's) | EC (Jeorse Park)  MC | TC  LC  SC |
| 1987  1986 | MC (MC Yacht Basin)  EC (Jeorse Park)  BH (Lefty's) | EC (Jeorse Park)  MC  [NIPSCO Generating Stations: MC, Gary  (Jan. - March &  Nov. - Dec.)  State-Line Generating Station  (Jan. - March &  Nov. - Dec.)] | TC  LC  SC |
|  |  |  |  |
| Table 2. Lake Michigan lake/stream creel survey areas (1974-2001), continued. | | | |
| **YEAR** | **BOAT FISHERY SITES** | **SHORE FISHERY SITES** | **STREAM FISHERY SITES** |
| 1985 | MC (MC Yacht Basin)  EC (Jeorse Park)  BH (Lefty's) | EC (Jeorse Park)  MC  [NIPSCO Generating Stations: MC, Gary  (Jan. - April &  December)  State-Line Generating Station  (Jan. - April &  December)] | TC  LC  SC |

|  |  |  |  |
| --- | --- | --- | --- |
| 1984 | MC (MC Yacht Basin)  EC (Jeorse Park)  BH (Lefty's) | EC (Jeorse Park)  MC  [NIPSCO Generating Stations: MC, Gary  (Nov. 5 - Dec.)  State-Line Generating Station  (Nov. 5 - Dec.)] | TC  LC  SC |
| 1983  1982 | MC (MC Yacht Basin)  EC (Jeorse Park)  BH (Lefty's) | EC (Jeorse Park)  MC  NIPSCO Generating Station: Gary, IN  1983: Sept. 10 -  Oct. 15  1982: Sept. 10 - 29 | TC  LC  SC |
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|  |  |  |  |
| Table 2. Lake Michigan lake/stream creel survey areas (1974-2001), continued. | | | |
| **YEAR** | **BOAT FISHERY SITES** | **SHORE FISHERY SITES** | **STREAM FISHERY SITES** |
| 1981  1980  1979  1978 | MC (MC Yacht Basin)  EC (Jeorse Park)  BH (Lefty's) | EC (Jeorse Park)  MC  NIPSCO Generating Stations: MC, Gary  1981: Feb.- May  Sept. 3 - Oct. 11 (only Gary)  1980: Jan. - April  1979/1978: July - Aug.  Oct. - Dec. (MC, Gary)  Jan. - May (MC, Gary)  (MC closed Jan. 14 - Feb. 23, 1979; no creel Feb. 1 - Feb. 10) | TC  LC  SC |
| 1977  1976  1975 | MC (MC Yacht Basin)  EC (Jeorse Park)  BH (Lefty's) | EC (Jeorse Park)  MC | TC  LC  SC |
| 1974 | MC (MC Yacht Basin)  EC (Jeorse Park; ramp excluded from fall due to lack of activity)  BH (Lefty's) | MC | TC  LC  SC |

Since the inception of the Lake Michigan creel program, spatiotemporal sampling frames (i.e. locations sampled or included in the Lake Michigan creel survey and sampling methodology) have all varied. Examples of the types of methodology changes includes anything from the scheduling (e.g. sampling a split (a.m. and p.m. shift or sampling daylight hours to represent fishing for the entire fishing day; aerial flights) to the fishing harvest and effort formulas.

A compilation of creel methodology, more specifically the sampling design and methods utilized for data expansion and computation of projected totals, has not been completed. Several factors, such as personnel work rules/restrictions and budgetary considerations, have all impacted past creel sampling design (methodology).

Thus, only the current lake and stream sampling design can/will be reviewed in this document.

Since 1994, Indiana’s Lake Michigan creel survey objective is to provide an index (monitor trends) of the utilization of Lake Michigan as well as the quality of the fishery. Because a subset (i.e. not all fishing access sites are included in the sampling frame) of all fishing locations are surveyed, the creel survey can not yield estimates of total harvest or effort for the recreational fishery in our waters. In order to do this reliably, “correction” factors need to be estimated in order to expand the surveyed harvest. This is an additional recurring cost to the program for the unsampled angler- effort. Due to the current program objective and budgetary restraints, the Lake Michigan creel survey sampling design has remained unchanged since the early to mid 90’s.

***Lake Creel Survey Sampling Design***

*Survey sites*

Sport fishing from boats is monitored at four main ports (cities) along the Indiana shoreline from April 1 through October 31. The sites include: Washington Park and Trail Creek Marina in Michigan City, Indiana; numerous private ramps and slips on Burns Waterway (i.e. Lefty’s Coho Landing; Portage Marina; Doyne’s Marina; Treasure-Chest Marina, etc.) in Portage, Indiana; Pastrick Marina in East Chicago, Indiana; the Lake County Parks and Recreation Whihala Beach boat launch in Whiting, and Hammond Marina in Hammond, Indiana. The shore fishery is also monitored from April 1 through October 31 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 accuracy of access site estimates of catch and effort depend on a complete and correct site listing (Hayne 1991). Important sites left off the list will result in an underestimation of fishing effort while including outdated and/or unused sites will result in an inefficient survey (Pollock et al. 1994). More precise survey estimates can result with the allocation of sampling effort in proportion to fishing effort associated with those sites. Although discharges receive an unknown amount of fishing pressure, they have not been included in the survey since the mid-80's. Since that time, the objective of the Indiana Lake Michigan creel program has changed from providing total harvest and effort estimates to monitoring trends.

*Scheduling*

The time frame of April 1 through October 31 represents the period when the majority of the population fishing the Lake can be reached. Additionally, funding availability and staff availability determine the sampling time frame.

The open-water creel survey is conducted using a modified-stratified-random sampling design (the survey design does not follow a true stratified random design). The design incorporates a two-stage sampling design for individual sites or areas, with days as the first-stage sampling unit (cluster). Second-stage sampling units are specific time of day (for counts) or individual interviews (for interviews).

The sampled fishing season is stratified by weeks, each of which is again stratified by day type, weekends and weekdays. Holidays are classified as weekend days; however, holidays are not sampled because of administrative restrictions. Sampling effort is allocated so that each site is sampled each weekend. Because one creel clerk samples a single site during a workday/shift, this requires two clerks sample each weekend day. Each of the four areas is sampled once on the weekdays during the week. The order of sampling is selected via random selection without replacement on weekends and weekdays. The traditional one-site-per-day approach to sampling access points is the method of choice when sites are five or fewer for each survey team (Pollock et al. 1994).

The selection of sampling days follows a stratified design with the combination of site and weekend or set of weekdays within an individual week forming the strata. One primary sampling unit (day) is selected within each stratum. Each potential day selected within a stratum has equal probability of being selected. However, this design deviates from a true stratified-random design in that choices of sampling units (days) are dependent across strata (the days individual sites were sampled were not independent because the creel clerk could only sample one location per day).

Sampling without replacement has the advantage in that all sites are sampled evenly throughout the month (Appendix C). Over the course of a month, 20.0% of the weekdays and 50.0% of the weekend days are creeled per site (each site is visited 8 days a month). This scheduling is reasonably consistent with Illinois, Wisconsin and Michigan’s Lake Michigan creel survey design (Bence et al. 1995). Their surveys are conducted every weekend day and on either two or three days during the week, depending upon the month.

Once the monthly schedule has been determined, end dates for the bi-weekly payroll period are added. Creel clerks (Clerical Assistant III) are restricted to working 75-hours biweekly. If the combination of sample days for the bi-weekly pay period is over the 75-hour restriction, schedules are adjusted by either moving a sample day or substituting a full-time employee. If moving the day or substitution of a full-time employee are not feasible, the sample is dropped.

*Day length*

Fishing day lengths are standardized for the entire season for daylight hours (sunrise to sunset) with: 14-hours/day April through September, and 12-hours/day in October.

Typically, creel surveys are stratified by season or month, day-type and time of day (Beard 1994). For the Lake Michigan survey, however, one set sampling shift exists to represent the entire fishing day.

The creel clerk remains at one of the four sites (Michigan City; Burns Waterway (Portage); East Chicago; Whiting/

Hammond) for an approximate 8.5-hour shift (8:00 a.m. - 4:20 p.m.; 8:20 a.m. - 4:40 p.m. or 8:40 a.m. - 5:00 p.m.). Personnel are restricted to 75-hours biweekly; thus, a clerk works two weekdays and two weekend days per week. Due to personal safety, measuring the Lake Michigan night fishery is not practical. Sampling these set daytime shifts assumes fishing activity during the time the clerk is working (between 8:00 a.m. and 5:00 p.m.) is representative of fishing activity for the entire sample day (12 or 14-hour day).

Three types of data are collected for each site: angler and boat counts for effort, angler interviews for harvest rates and biological information on harvested fish.

This survey utilizes a variant of an access site method. Access site creel survey designs assume that during a period a site is sampled, all anglers leaving the access point are interviewed (Pollock et al. 1994). The creel clerk will tour the site and attempt to intercept and interview as many anglers as possible. For the shore/pier fishing, creel clerks sample complete and incomplete trips. Combining complete with uncompleted fishing trips assumes that the catch rate at time of interview will equal the rate for the entire trip (Malvestuto 1983; Phippen and Bergersen 1991).

*Instantaneous counts*

Instantaneous counts are utilized at each port for both the boat and shore/pier fisheries. Boat effort is measured by counting the number of fishing boats returning for a twenty-minute period every other hour. Pier/shore effort is measured utilizing instantaneous angler counts every other hour throughout the day. Three time periods exist within the shore and boat counts. The three times include, first, a count at the top of the hour (00:00) beginning with 8:00 a.m.; second, a count at twenty-minutes after the hour (00:20) beginning with 8:20 a.m., and last, a count at forty-minutes after the hour (00:40) beginning with 8:40 a.m.. The time of the count is designated via random selection. Thus, a count is made every other hour with the time within the first hour selected randomly for a total of five count periods during a survey day (boat and shore counts every other hour). Interviews are collected in-between counts.

See Appendix D for the Lake Michigan survey boat and shore count sheet.

*Interviews*

Launched boat and moored boat-anglers are interviewed at the completion of their fishing trip. Anglers or angler parties (each interview consists of one angling party) are asked what time they started their fishing trip, what they fished for, and the number of fish caught and harvested.

Pedestrian anglers are contacted directly at each site. Data from complete and incomplete fishing trips are collected. Incomplete trip interviews are marked and updated upon the completion of the angler’s trip. Care is taken when interviewing an angler prior to the completion of their fishing trip. Shore/pier anglers are checked every half to three-quarter’s of an hour after the initial interview. While this re-checking may cause anglers to feel pestered and result in resentment for participation in the survey, most anglers are willing to share their experience and the benefits of a completed trip outweigh the cost of many uncompleted trips. Clerks are trained to take as little time as possible (updating if any new fish were caught or released) from this repeated contact. By continually checking and updating ongoing interviews, the design tries to avoid length-of-stay bias [anglers who fish longer or are successful are more likely to fish longer than unsuccessful anglers; avoiding the possibility of interviewing only the successful anglers in greater proportion and biasing mean catch rates for the fishery (Pollock et al. 1994)]. Shore anglers are asked questions similar to boat anglers. Additional information about angler county of residence, species preference and angler satisfaction are also collected. The boat angler interview sheet and shore angler interview sheets are located in Appendix D.

If many boat and/or shore anglers are at the site, the clerk may have to sub-

sample anglers for interviewing. The most common strategy of systematically sub-sampling every kth angler is utilized (Pollock et al. 1994).

Biological sampling of fish to obtain data such as length (total length), weight, fin clips and tag information is collected on harvested fish. See Appendix D for the Lake Michigan biodata sheet.

*Charter boats*

Catch and effort information are submitted by charter-boat operators through a mandatory catch reporting system. This reporting system, enacted in 1987, requires all person’s providing sport fishing for hire on Indiana waters, waters containing state-owned fish or state boundary waters to be licensed and submit accurate catch records on a monthly basis (Palla 2002). Licensees provide catch information on a per trip basis for all trips conducted exclusively in Indiana waters of Lake Michigan. Reports are required to be submitted before the fifteenth day of the following month, as outlined in Administrative Code 312 I.A.C. 9-7-17.

The information obtained from each form includes: reporting period (month), name of licensee, license number, date of fishing trip, total number of anglers, total hours fished, and numbers of fish harvested and released. The objective of the charter-boat catch reporting system is to obtain a continuous annual record of charter fishing effort and the numbers and species of fish harvested in Indiana’s portion of Lake Michigan.

In the Indiana Lake Michigan creel survey, charter operators are included in the program (instantaneous counts and interviews). Since operators are already being intercepted for biological data collection, they are included in the survey. This allows the clerk to collect information on catch as soon as the operator is off the water and allows the IN DNR to collect data about the charter operators’ clientele (e.g. county of residence, species preference and angler satisfaction). While utilizing the information directly from the submitted charter operator report would allow time for additional non-charter interviews, clerks are still required to obtain biological data on charter harvest. By including charter operator’s in the Lake Michigan creel survey, we are potentially avoiding the disadvantage of biased reporting (recall bias).

Compliance is an additional issue with relying upon the mandatory reporting system. During 2000 and 2001, compliance ranged between 94 and 97%. However, timeliness averaged 73% (only 73% of the licensed charter operators were compliant in submitting the required monthly forms by the due date). Of the reports turned in tardy, the average was 71 days late (Palla 2002).

*Fishing effort calculations*

Fishing effort estimates (angler hours) are derived from the instantaneous counts of anglers at pier sites and from counts of fishing boats returning. Counts were made at randomly assigned times at each site during each visit.

Data are classified by site, month and day type (weekend/holiday and weekdays), fishing mode and (from the interviews) by target (salmonids, yellow perch, bass or other) prior to summarization and expansion. Data for each such combination are treated as one sample from that site/month/day type, fishing mode and target (Table 3).

*Boat.* Angling effort from boats for each data stratum (month, site, weekend/

weekday) are summarized, then expanded using:

(1) E (Expanded boat angler hours)=

3 (aB)(bB)(cB)(T)

where

(aB) = mean twenty-minute (1/3 of an hour) boat count\*

(bB) = mean complete trip length for boats

(cB) = the mean number of anglers per boat

1. = possible fishing hours\*\*

\*Further stratified for directed effort calculations by the percent of boats fishing for salmonids, perch, bass, and other, determined from interviews (directed effort).

\*\*Total length of the fishing defined as 14- hours/day April through September, and 12- hours/day in October.

*Pier*. Angling effort from piers for each data stratum are summarized within each

combination of site, month, weekend/weekday, then expanded using the equation:

(2) E (Expanded pier angler hours) = (aSH)(T)

where

(aSH) = mean hourly pier angler count\*

1. = possible fishing hours

\*Further stratified for directed effort calculations by the percent of pier anglers fishing for salmonids, perch, bass and others, as determined from interviews.

*Harvest calculations*

Harvest estimates are extracted from angler interviews by fishery. Each interview reports the number of fish harvested and the hours fished. Harvest and hours are summed over all interviews in a stratum (Table 4).

(1) Expanded harvest =

(E) (e/f)

where

1. = expanded boat or shore angler hours (effort)

(e) = harvest recorded in survey (actual harvest)

(f) = angler hours recorded in survey (actual effort)

Table 3. Daily instantaneous counts of anglers and returning fishing boats for Michigan City during April 2002.

Weekdays (April)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Site | Boat/Shore | Counts | | | | |  |
| MC | B  S | 0  14 | 0  14 | 1  12 | 0  12 | 0  4 |  |
| MC | B  S | 0  11 | 0  3 | 1  7 | 0  5 | 0  5 |  |
| MC | B  S | 0  0 | 0  0 | 0  0 | 0  1 | 0  2 |  |
| MC | B  S | 0  3 | 0  5 | 2  3 | 2  0 | 1  1 |  |
| Mean Boat Count  Mean Shore Count | | 1.05  5.1 | Boat = (7/20) \* 3 (multiplied by 3 since counts are 1/3 of an hour)  Shore = 102/20 = 5.1 | | | | |

Weekend Days (April)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Site | Boat/Shore | Counts | | | | |  |
| MC | B  S | 0  54 | 2  22 | 0  9 | 1  2 | 0  11 |  |
| MC | B  S | 0  40 | 0  34 | 3  33 | 0  14 | 2  20 |  |
| MC | B  S | 0  6 | 0  0 | 0  0 | 0  5 | 0  0 |  |
| MC | B  S | 0  1 | 0  0 | 3  1 | 22  0 | 0  1 |  |
| Mean Boat Count  Mean Shore Count | | 4.95  12.65 | Boat = (33/20) \* 3 (multiplied by 3 since counts are 1/3 of an hour)  Shore = 253/20 = 12.65 | | | | |

Table 4. Angler interview summaries plus estimates of effort and harvest for Michigan City during April 2002, based on design presented in table 3.

Angler interview summaries for Michigan City during April 2002.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | Observed Harvest | | | | |
| Day of week | Boat/Shore | Interview  Hours | coho | chinook | steelhead | brown trout | lake trout |
| WD | B  S | 236.4  204.9 | 148  36 | 26  0 | 14  1 | 0  1 | 2  0 |
| WE | B  S | 717.0  366.7 | 328  29 | 15  0 | 60  0 | 5  1 | 2  0 |
| Following is based upon interviews of anglers  targeting trout and salmon species of coho, chinook, steelhead, brown trout and lake trout. | | | | | | | |
| WD | B  S | Avg. number of anglers/boat = 3.66667  Av. trip length = 4.35333  % (# interviews of anglers targeting trout and salmon/total interviews) =  100.00  Avg. number of anglers fishing for trout/salmon = 1.52830  Avg. trip length = 2.38113  % (# interviews of anglers targeting trout and salmon/total interviews) =  0.98780 | | | | | |
| WE | B  S | Avg. number of anglers/boat = 3.63636  Avg. trip length = 4.35000  % (# interviews of anglers targeting trout and salmon/total interviews) =  100.00  Avg. number of anglers fishing for trout/salmon = 2.08929  Avg. trip length = 3.05714  % (# interviews of anglers targeting trout and salmon/total interviews) =  0.97500 | | | | | |

Expanded effort for Michigan City during April 2002, based on tables 3 and 4.

|  |  |  |  |
| --- | --- | --- | --- |
| Day of Week | Boat/Shore | Effort | Calculation example (WD) |
| WD | B  S | 5,162.18  1,551.64 | Expanded boat angler hours =  Avg. boat count \* Avg. trip length \*  Avg. # anglers \* possible fishing hours \*  % trout and salmon interviews  [1.05 \* 4.35333 \* 3.66667 \* 308 \* 1.0]  Expanded shore angler hours =  Avg. hourly pier angler count \* possible fishing hours \* % trout and salmon interviews  [5.1 \* 308 \* 0.98780] |
| WE | B  S | 8,769.60  1,381.38 |

Table 4. Angler interview summaries plus estimates of effort and harvest for Michigan City during April 2002, based on design presented in table 3 (continued).

Expanded effort and harvest for Michigan City during April 2002, based on estimates in table 4.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | Expanded Harvest | | | | |
| Day of Week | Boat/Shore | coho | chinook | steelhead | brown  trout | lake  trout |
| WD  WE | B  S  B  S | 3,232  273  4,012  109 | 568  0  183  0 | 306  8  734  0 | 0  8  61  4 | 44  0  24  0 |
| Total Harvest in all stratum | | 7,626 | 751 | 1,048 | 73 | 68 |
| Total Effort in all stratum | | 16,865 |  |  |  |  |
| expanded harvest =  total expanded effort for that stratum \* (observed harvest recorded in survey/interview hours) | | | | | | |

***Stream Creel Survey Sampling Design***

*Survey sites*

The stream fishery is monitored at three Lake Michigan tributaries from March 1 through March 31 and July 1 through December 31. The three tributaries include: Trail Creek in LaPorte County, the East Branch of the Little Calumet River in Porter County and Salt Creek in Porter County. This creel design samples the stocked tributaries of Lake Michigan. The only exception is the St. Joseph River (Interstate Anadromous Fish Project). This project was initiated by the Michigan and Indiana Departments of Natural Resources to provide passage of migratory fish into urban areas, providing angling opportunities otherwise unavailable to residents of the communities along the river from the Lake Michigan river mouth through Mishawaka, Indiana. A creel program does exist for the St. Joseph River, however, it falls directly under the Fisheries Management District 2 biologist. Thus, this Lake Michigan stream creel design review is exclusive of the St. Joseph River project.

The stream of Trail Creek is located in LaPorte County and flows into Lake Michigan at Michigan City’s Washington Park Marina. It runs through 14.5 linear miles with a drainage area of approximately 59.1 square miles (Northwest Indiana Regional Planning Commission 1993). The main channel of Trail Creek is divided into two main tributaries: East Branch and West Branch. The East Arm of the Little Calumet River, from the junction with Burns Waterway up to the headwaters (located east of U.S. 421 in Michigan City), is 22 miles long and incorporates 71.5 square miles of drainage area upstream of Salt Creek. Salt Creek is 24.5 miles long with a drainage area of 77.1 square miles. Drainage area of the East Branch of the Little Calumet River and Salt Creek together is 148.6 square miles (Division of Water, personal communication; Appendix B).

Trail Creek has six public fishing sites, including: DNR access site; Robert Peo Public Access; U.S. 35; Trail Creek Forks (U.S. 20); Johnson Road and Creek Ridge Park. The East Branch of the Little Calumet River and Salt Creek provide limited public access sites for fishing opportunities. Salt Creek runs through Imagination Glenn County Park and Haven Hollow Park, both offering angler access. There is one State-managed public fishing site located on Salt Creek, The Chustak Public Fishing Area. Portions of the East Branch of the Little Calumet River flow through the Indiana Dunes National Lakeshore property, which the public can utilize. Since the majority of these tributaries run through private property; public access is mostly restricted to State and County-owned areas.

Due to tributary size and budgetary restrictions, only a subset of fishing locations are surveyed. Thus, the survey can not yield estimates of total harvest or effort for the stream recreational fishery. Sites included in the stream survey are areas that have public access (public fishing sites, state right-of-ways) or have historical popularity and allow public fishing (although many of these areas are not designated public fishing access sites, e.g. Karwick Road on Trail Creek). Sites included in the survey are relatively close to each other and offer fairly easy stream access, providing little disruption in the clerk’s driving and walking progress. Appendix B outlines the stream sampling sites on Trail Creek and the Little Calumet Watershed (E. Branch of the Little Calumet River and Salt Creek).

Accuracy of catch and effort estimates depends upon a complete and correct site listing (Hayne 1991). Including outdated and/or unused sites can result in an inefficient survey while exclusion of high-use areas can result in an underestimation of fishing effort and catch (Pollock et al. 1994). Indiana’s Lake Michigan stream creel survey design focuses on areas where the majority of fishing effort is concentrated. While fishing does occur outside of these stream sections (e.g. upstream, mostly private property), budgetary considerations limit coverage of the entire watershed. Surveys are most efficient (have the least variance) when the distribution of sampling effort coincides with the distribution of fishing effort (Best and Boles 1956).

*Scheduling*

The time frame of March 1 through March 31 and July 1 through December 31 represents the period when a large majority of the population fishing the area tributaries can be reached. Prior to 1998, the stream creel program included the months of January and February in the survey design. Sampling during these months was dropped beginning with the 1998 season due to limited fishing activity (i.e., low angler effort and harvest). Although stream fishing is popular during the months of April, May and June, funding and staff availability ultimately guide the sampling time frame. Additionally, while there is no closed season for taking trout and salmon from Lake Michigan, various sections of the tributary streams are closed to all fishing from April 1 through June 15. These streams are annually stocked with trout and salmon. The closed fishing period provides protection as these fish migrate downstream to the Lake. The closed season applies to the East Branch of Little Calumet River in Porter County from U.S. 12 upstream to U.S. 20, and Trail Creek in LaPorte County from the Franklin Street Bridge in Michigan City upstream to U.S. 35 (Appendix B).

The stream creel survey is conducted using a modified roving sampling design (the survey design does not follow the true stratified roving method). The roving method is utilized to estimate fishing effort and catch rates when access to a fishery occurs at too many points to accommodate a traditional access point design (Pollock et al. 1994). The design incorporates a two-stage sampling design for individual sites or areas (streams), with days as the first-stage sampling unit (cluster). Second-stage sampling units are specific time of day (for counts) or individual interviews (for interviews).

Creel survey schedules are created in a similar fashion as described in the lake creel survey sampling design. The sampled fishing season is stratified by weeks, each of which is again stratified by day type, weekends and weekdays. Holidays are classified as weekend days; however, holidays are not sampled because of administrative restrictions. Sampling effort is allocated so that each creek is sampled a minimum of four weekend days/month and four weekdays/month during the months of November and December. During the month of March and July through October, Trail Creek is sampled four weekday and weekend days per month while the East Branch of the Little Calumet River and Salt Creek are sampled four weekdays and two weekend days. Trail Creek is more heavily fished, thus, sampling is concentrated more upon Trail Creek than upon Little Calumet and Salt Creek. Typically, the stream creel clerk works a total of three to four days/week (one/two weekdays and two weekend days) in March and July through October.

Sites to be sampled each weekend day are determined through random selection (without replacement). Selection of sampling days follows a stratified design with the combination of site and weekend or set of weekdays within an individual week forming the strata. One primary sampling unit (day) is selected from each stratum. Each potential day in a stratum has equal probability of being selected. Again, this design deviates from a true stratified-design in that the choices of sampling days are dependent across strata.

For Trail Creek, 20.0% of the weekdays and 50.0% of the weekend days are creeled each week during March and July through December. East Branch of the Little Calumet River and Salt Creek are each creeled a minimum of 20.0% of the weekdays and 25.0% of the weekend days [however, during November and December these two creeks are combined into the Little Calumet Watershed (LCW); LCW is sampled 4 weekend days or 50.0% of the weekend days).

Once the monthly schedule has been determined, end dates for the bi-weekly payroll period are added. Creel clerks (Clerical Assistant III) are restricted to working 75-hours biweekly. If the combination of sample days for the bi-weekly pay period is over the 75-hour restriction, schedules are adjusted by either moving a sample day or substituting a full-time employee. If moving the day or substitution by a full-time employee is not feasible, the sample is dropped.

*Day length*

Fishing day lengths are standardized for the entire season to represent daylight hours (sunrise to sunset) with: 12-hours/day in March and October, 14-hours/day July through September, and 9-hours/day in November and December.

The Lake Michigan stream survey samples a set day shift [design assumes fishing activity during the time the clerk is working is representative of fishing for the entire sample day (9, 12 or 14-hour day)]. For the months of November and December, a single 7.5-hour shift is used to represent the daylight hours (8:00 a.m. to 3:30 p.m.). A 10-hour sampling shift is used during March, and July through October (7:30 a.m. to 5:30 p.m.). Due to personal safety, measuring the stream effort and harvest from the night fishery is not practical.

Three types of data are collected: angler counts and/or vehicle counts for effort, angler interviews for harvest rates and biological information on harvested fish.

*Counts*

Stream effort is measured by utilizing a progressive count. Not all sampling areas can be traversed quickly or viewed from vantage points. Thus, the clerk drives the entire stream and stops at predetermined sites to count anglers (only at the DNR site on Trail Creek) or angler vehicles. The number of progressive counts performed per day varies depending upon which stream is being sampled.

Trail Creek, due to a smaller survey- area, has three progressive vehicle counts performed each survey day. The number of progressive counts performed on Salt Creek and East branch of the Little Calumet River differ depending upon the time of the year and the day type (weekend days vs. weekdays). Due to low angler-use on the East Branch of the Little Calumet River and Salt Creek during the months of November and December, these creeks are combined into one site for both weekday and weekend surveys (Little Calumet Watershed). Due to the large area encompassed by the Little Calumet Watershed, only two progressive vehicle counts/day can be performed. During the month of March, and July through October, the two-creek combination is only used on weekdays (lower angler-use on weekdays vs. higher angler-use on weekend days). On weekend days, the Little Calumet Watershed is separated into each respective creek (i.e. the East Branch of the Little Calumet River and Salt Creek) utilizing the three progressive vehicle-count design/day. Time of counts are randomly chosen without replacement.

A sample of the stream creel survey schedule for March and November can be found in Appendix C. Stream survey count sheets are presented in Appendix D.

*Interviews*

Stream anglers are interviewed along the designated sampling sections of the tributaries (Appendix B). Data from complete and incomplete fishing trips are collected. Incomplete trip interviews are marked and updated upon the completion of the angler’s trip. Care is taken when interviewing an angler prior to the completion of their fishing trip. Stream anglers are checked every half to three-quarter’s of an hour after the initial interview. While this re-checking may cause anglers to feel pestered and result in resentment for participation in the survey, most anglers are willing to share their experience and the benefits of the completed trip outweigh the cost of many uncompleted trips (i.e. harvest and effort bias). Clerks are trained to take as little time as possible (updating if any new fish were caught or released) from this repeated contact. In roving surveys, anglers are intercepted during the act of fishing and the probability of intercepting them is proportional to the duration of their fishing (Robson 1961, 1991; Lucas 1963; Brown 1971). By continually checking/updating these ongoing interviews, the length-of-stay-bias may be avoided. Length-of-stay bias is common to the roving creel survey because the probability of intercepting an angler fishing is proportional to the length of the angler’s fishing trip (Lucas 1963). Roving clerks can disproportionally interview more anglers that have been fishing longer than average; potentially increasing the overall mean trip length for incomplete trips (determined from the completed trips). By continually cycling/driving the stream route, the clerk is intercepting both types of anglers: anglers fishing for short and long durations.

Anglers or angler parties (each interview consists of one angling party or the total number of anglers fishing per vehicle) are asked what time they started their fishing trip on the tributary being sampled, if they came by car and parked in the vehicle count site, what they fished for, and the number of fish caught and harvested. Additional information about angler county of residence, species preference and angler satisfaction are also collected. See Appendix D for the stream angler interview sheet.

If many stream anglers are encountered along the stream section (at fishing sites), the clerk may have to sub-sample anglers for interviewing. The most common strategy of systematically sub-sampling every kth angler is utilized (Pollock et al. 1994).

Biological sampling of fish to obtain data such as length (total length), weight, fin clips and tag information is collected on harvested fish. Data are recorded on the same sheet utilized for the Lake Michigan creel survey (Appendix D).

*Fishing effort calculations*

Angling effort at streams for each data stratum (month, site, weekend/

weekday) are summarized, then expanded using:

Expanded car angler hours =

(aST)(cST)(d) + (w)(d/e)

where

(aST) = mean vehicle count on streams

(cST) = mean number of anglers/vehicle on streams

1. = possible fishing hours\*
2. = hours from interviews for anglers without vehicles at stream count sites
3. = survey hours

\*Possible fishing hours are defined as 12- hours/day in March, 14-hours/day July through September, 12-hours/day in October and 9-hours/day in November and December.

*Harvest calculations*

Harvest estimates are extracted from the angler interviews. Each interview reports the number of fish harvested and the hours fished. Harvest and hours are summed over all interviews in a stratum (month, stream, weekend/weekday).

Expanded harvest =

(expanded angler hours) (e/f)

where

(e) = harvest recorded in survey (actual harvest)

(f) = angler hours recorded in survey (actual effort)

*Lake Michigan Variance Estimates*

Catch and effort estimates are not presented with confidence intervals (boat, shore/pier and stream).

*Quality Control*

Clerks are initially trained by the Assistant Fisheries Biologist and includes: 1) a review of the Lake Michigan fishery,

2) a review of the survey objectives, 3) a review of the survey design, 4) a review on fish identification, form completion, and biological data collection, 5) a tour of the survey areas, 6) interview techniques, 7) scheduling and 8) rules/quality assurance procedures.

Formal checks (i.e., checking that interviews, counts and biological data collections are performed correctly) are made upon the creel clerks in the field. Frequency of these checks varies, but usually occurs at two-week intervals. The goal is a formal check at least once per month. Periodically, a member of the staff is sent out to informally check on the clerks (i.e., verify clerk is present on site on the proper day); however, creel clerks are often observed by members of the staff when staff are engaged in field activities. Supervisory visits to check a clerk’s technique and answer questions can provide a positive reinforcement of good work habits and assist in sustaining the morale of isolated staff (Pollock et al.1994).

Clerks are required to turn in all their data sheets at the end of the day when returning to the office. All of the field data collected by the clerks is checked within one to two days of their collection. Any problems with the data are identified and immediately brought to the attention of the clerk. Data are entered into a database monthly. The data are verified and corrected in the database prior to processing and report writing.

**RECOMMENDATIONS ON IMPROVING THE INDIANA LAKE MICHIGAN CREEL SURVEY**

**Lake Michigan Survey Sampling Design**

*Scheduling*

Pollock et al. (1994) discuss assigning days and times to the access point survey.

Since Lake Michigan temporal patterns of angling greatly vary, the primary sampling unit (day) should continue to be chosen with surveys conducted on most weekend days and on either two or three days during the week. The fishing day described as 14-hours from April through September and 12-hours in October is longer than the creel clerk’s working day. The day cannot be sampled completely and should be sub-sampled in a legitimate statistical manner (Pollock et al. 1994). Commonly, the fishing day is partitioned into two or more work periods (mornings and afternoons) to be chosen randomly for sampling on each survey day. Shifts should be selected with equal probabilities (p=0.5) if no patterns of within day variance have been evident. Since the fishing day is described as 14-hours in length (6 AM to 8 PM) April through September, the clerks shift would include an hour for travel and scheduling of two non-overlapping 7-hour periods (6 AM to 1 PM and 1 PM to 8 PM) using true stratification (periods chosen independently from among all days). The 12-hour days in October (6 AM to 6 PM) would include an hour for travel and scheduling two non-overlapping 6-hour periods (6 AM to noon and noon to 6 PM).

Based on past use by anglers, weighting of the four sites by probability of expected use is advantageous. Best and Boles (1956) state that creel surveys will be most efficient (have the least variance) when the distribution of sampling effort coincides with the distribution of fishing effort. It may be more informative to sample access sites based on expected use as opposed to sampling them with equal probability (Pollock et al. 1994). Sites with the largest angling effort would more likely be sampled on any given day. Table 5 presents a five-year summary of angler effort at each of the four ports and shows the weighting of these sites. Since Lake Michigan fishing effort is strongly influenced by weather patterns and lake conditions, sampling can not be weighted by month.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 5. Estimated effort (angler hours) by site and weighting by probability of expected use by anglers. | | | | |
|  | Michigan City | Burns Harbor | East Chicago | Hammond |
| 1997 | 126,485 | 81,383 | 66,951 | 14,857 |
| 1998 | 174,075 | 88,035 | 54,002 | 11,558 |
| 1999 | 150,001 | 104,893 | 57,101 | 21,522 |
| 2000 | 150,960 | 92,004 | 72,077 | 37,324 |
| 2001 | 155,120 | 93,413 | 92,295 | 30,874 |
| 5-year avg. | 151,328 | 91,946 | 68,485 | 23,227 |
| Site Probability | 45.2% | 27.4% | 20.4% | 6.9% |

Sampling frequency by site would be chosen based upon site probability, stratified by day type (e.g. Michigan City: 22 weekdays (0.452) = 10 weekdays/month; 9 weekends (0.452) = 4 weekend days/month). One problem, however, results from the low probability of Hammond. If the clerk records a fishing tournament the chosen day for a weekend sample, it would significantly add to the variance for the month (overestimate fishing for that month at Hammond). One solution to decrease this variance is to select a higher probability for Hammond while slightly negatively adjusting the other site probabilities.

|  |  |
| --- | --- |
| Table 6. Example of weighting sites by probability of expected use by anglers. | |
| Primary Sampling Unit (PSU) | Random Number Range |
| Michigan City | 1 - 451 |
| Burns Harbor | 452 - 725 |
| East Chicago | 726 - 929 |
| Hammond | 930 - 999 |

All potential combinations of sites and shifts are listed and their inclusion probabilities are specified. From the cumulative distribution of these probabilities, a corresponding distribution of random numbers is created for selection of secondary sampling units (AM versus PM shift).

|  |  |  |  |
| --- | --- | --- | --- |
| Table 7. Example of weighting sites by probability of expected use by anglers for SSU selection. | | | |
| Secondary Sampling Unit (SSU) | Unit Probability | Cumulative  Probability | Random  number range |
| Michigan City-AM | (0.452 x 0.50) = 0.226 | 0.226 | 000 - 225 |
| Michigan City-PM | (0.452 x 0.50) = 0.226 | 0.452 | 226 - 451 |
| Burns Harbor-AM | (0.274 x 0.50) = 0.137 | 0.589 | 452 - 588 |
| Burns Harbor-PM | (0.274 x 0.50) = 0.137 | 0.726 | 589 - 725 |
| East Chicago-AM | (0.204 x 0.50) = 0.102 | 0.828 | 726 - 827 |
| East Chicago-PM | (0.204 x 0.50) = 0.102 | 0.930 | 828 - 929 |
| Hammond-AM | (0.069 x 0.50) = 0.0345 | 0.965 | 930 - 964 |
| Hammond-PM | (0.060 x 0.50) = 0.0345 | 0.999 | 965 - 999 |

*Reliability of Effort and Harvest Estimates*

(adapted from Bence et al. 1995)

For states that allocate a specified amount of sampling effort to a site or specific area each week: estimate effort and harvest first for each sampled cluster, then expand this to the week, and finally sum up weekly estimates to get estimates over longer time periods. Monthly estimates could be derived by apportioning the appropriate fraction of the harvest or effort for weeks that are split between months. Thus the season should be viewed as stratified into weeks in Indiana. Daily effort (or catch) should be calculated for each site. If a site has been visited more than once, the daily totals for that site are averaged and the average is expanded to estimate angling over the entire sampling period (Pollock et al. 1994).

Harvest for a cluster can be calculated as the product of harvest rate (fish per hour) and angler effort in hours for that cluster. Effort for the cluster can be calculated much the way it is now done by Indiana. The calculations depend on whether counts are instantaneous or interval. For instantaneous counts effort can be estimated as the product of the average count, mean number of anglers per party and number of hours in the cluster. For interval counts it can be estimated as the product of the mean count, mean number of anglers per party, mean trip length and number of hours in the cluster.

The way the cluster harvest rate is calculated should depend upon whether complete or ongoing trips are sampled. When interviews are primarily complete trips, harvest rate should be calculated by first summing harvest and effort over all interviews, then dividing the summed harvest by the summed effort (total ratio). When interviews can be considered a random sample of ongoing fishing trips (Indiana shore/pier fishery), harvest rates should be calculated for each interview and then averaged.

The proposed approach is in better agreement with the existing survey design than current estimation methods that are used in Indiana. **The current practice of pooling data into monthly (or similar time blocks) ignores potential gains from the within month stratification, and when harvest rates are calculated on a monthly basis potential for significant bias is introduced**. Such bias can occur if daily effort is related in some way to daily harvest rate and sampling is not strictly proportional to effort. In general, proportional sampling does not occur in the Lake Michigan creel survey because samplers become “saturated” when effort is high. In other words, the current approach assumes self weighting (e.g., Cochran 1977), which is unlikely.

As states consider redesign of the Lake Michigan Creel surveys, efforts should be made to include as much of the population of interest (the entire fishing day at all fishing sites) within the sampling frame. This would reduce the need for tenuous extrapolations. This need not involve an increase in sampling effort, but may mean that less detailed information about particular sites will be collected. Switching to a more traditional access survey would make calculations of variances (i.e. confidence intervals) easier. With the current Lake Michigan creel design, variance calculations are very complex and consequently not completed.

**Lake Michigan Stream Survey Sampling Design**

*Scheduling*

Pollock et al. (1994) discuss assigning days and times to the roving creel survey.

Since Lake Michigan tributary temporal patterns of angling greatly vary, the primary sampling unit (day) should continue to be chosen with surveys conducted on most weekend days and on either two or three days during the week. The fishing day described as 12-hours in March and October; 14-hours from July through September and 9-hours in November and December is longer than the creel clerk’s working day. The day cannot be sampled completely and should be sub-sampled in a legitimate statistical manner (Pollock et al. 1994). Commonly, the fishing day is partitioned into two or more work periods (mornings and afternoons) to be chosen randomly for sampling on each survey day. Shifts should be selected with equal probabilities (p=0.5) if no patterns of within day variance have been evident. Since the fishing day is described as 14-hours in length (6 AM to 8 PM) July through September, the clerks shift would include an hour for travel and scheduling of two non-overlapping 7-hour periods (6 AM to 1 PM and 1 PM to 8 PM) using true stratification (periods chosen independently from among all days). The 12-hour days in March and October (6 AM to 6 PM) would include an hour for travel and scheduling two non-overlapping 6-hour periods (6 AM to noon and noon to 6 PM). The 9-hour days in November and December (7 AM to 4 PM) would include an hour for travel and scheduling two non-overlapping 4.5-hour periods (7 AM to 11.5 AM and 11.5 AM to 4 PM).

Based on past use by anglers, weighting of the three sites by probability of expected use is advantageous. Best and Boles (1956) state that creel surveys will be most efficient (have the least variance) when the distribution of sampling effort coincides with the distribution of fishing effort. For optimal stratification, prior knowledge of a fishery is necessary. Sites with the largest angling effort would have a higher chance of being sampled on any given day. Table 8 presents a five-year summary of angler effort at each of the three tributaries and shows the weighting of these sites. Since Lake Michigan fishing effort is strongly influenced by weather patterns and stream conditions, sampling can not be weighted by month.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 8. Estimated effort (angler hours) by site and weighting by probability of expected use by anglers. | | | |
|  | Trail Creek | E. Branch of  the Little Calumet River | Salt Creek |
| 1997 | 84,850 | 12,827 | 21,463 |
| 1998 | 77,736 | 12,500 | 16,326 |
| 1999 | 91,824 | 13,110 | 20,507 |
| 2000 | 81,828 | 17,026 | 17,696 |
| 2001 | 76,773 | 13,311 | 15,801 |
| 5-year avg. | 82,602 | 13,755 | 18,359 |
| Site Probability | 72.0% | 11.9% | 16.0% |

Sampling frequency by site would be chosen based upon site probability, stratified by day type (e.g. Trail Creek: 22 weekdays (0.72) = 16 weekdays/month; 9 weekends (0.452) = 4 weekend days/month). One problem, however, results from the low probabilities of the E. Branch of the Little Calumet River and Salt Creek. If the clerk records a fishing tournament the chosen day for a weekend sample, it would significantly add to the variance for the month (overestimate fishing for that month at either creek). One solution to decrease this variance is to select a higher probability for the East Branch of the Little Calumet and Salt Creek while slightly negatively adjusting the other site probabilities.

|  |  |
| --- | --- |
| Table 9. Example of weighting sites by probability of expected use by anglers. | |
| Primary Sampling Unit (PSU) | Random Number Range |
| Trail Creek | 1 - 719 |
| Salt Creek | 720 - 879 |
| E. Branch of Little  Calumet River | 880 - 999 |

All potential combinations of sites and shifts are listed and their inclusion probabilities are specified. From the cumulative distribution of these probabilities, a corresponding distribution of random numbers is created for selection of secondary sampling units (AM versus PM shift).

|  |  |  |  |
| --- | --- | --- | --- |
| Table 10. Example of weighting sites by probability of expected use by anglers for SSU selection. | | | |
| Secondary Sampling Unit (SSU) | Unit Probability | Cumulative  Probability | Random  number range |
| Trail Creek-AM | (0.720 x 0.50) = 0.360 | 0.360 | 000 - 359 |
| Trail Creek-PM | (0.720 x 0.50) = 0.360 | 0.720 | 360 - 719 |
| E. Branch Cal.-AM | (0.119 x 0.50) = 0.059 | 0.779 | 720 - 778 |
| E. Branch Cal.-PM | (0.119 x 0.50) = 0.059 | 0.838 | 779 - 837 |
| Salt Creek-AM | (0.160 x 0.50) = 0.080 | 0.918 | 838 - 917 |
| Salt Creek-PM | (0.160 x 0.50) = 0.080 | 0.999 | 918 - 999 |

*Reliability of Effort and Harvest Estimates*

See page 25 for a review adapted from Bence et al. 1995. Recommendations from this section are valid for the harvest and effort calculations for the Lake Michigan stream creel survey.

An additional change to improve the stream methodology involves the way the progressive count is conducted. Progressive counts are unbiased if the starting point and direction of travel are randomized and no interviews are conducted during the count (Neuhold and Lu 1957). The current stream creel design for conducting the progressive vehicle count is to either begin at the furthest upstream site and count downstream or begin at the furthest downstream site and count upstream.

Lastly, the selection of count times within the sampling day could improve. The workday should be divided into sequential blocks of time which would equal the required time to perform the progressive count (Pollock et al. 1994). The blocks would be numbered and chosen by random draw. The progressive count on Trail Creek takes 45-minutes. The working day of

7.0 hours or 420 minutes (7 a.m. to 1 p.m. shift) consists of nine 45-minute blocks of time:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Period | Time of day |  | Period | Time of day |
| 1 | 06:00-06:44 |  | 6 | 09:45-10:29 |
| 2 | 06:45-07:29 |  | 7 | 10:30-11:14 |
| 3 | 07:30-08:14 |  | 8 | 11:15-11:59 |
| 4 | 08:15-08:59 |  | 9 | 12:00-12:44 |
| 5 | 09:00-09:44 |  |  |  |

Three counts can be performed per survey day, so three random number would be drawn without replacement.

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**APPENDIX A**

Table A.1. Lake Michigan Creel Survey Working Group Database Design.

|  |  |  |
| --- | --- | --- |
| Variables to be included in lake-wide catch/harvest/effort database. | | |
| Variable description | Columns | Legal values |
| Year | 1-4 | four digit number (e.g., 1996) |
| Statistical District or Area | 6-8 | ILL, IND, MM1, MM2, MM3, MM4, MM5, MM6, MM7, MM8, WM1, WM2, WM3, WM4, WM5, WM6  (For biomass database)  MIW (Michigan’s waters), WIW (Wisconsin’s waters), MIS, MIN (Michigan’s waters, southern or northern basin), WIN, WIS |
| Month | 10-12 | JAN, FEB, MAR, APR, MAY, JUN,  JUL, AUG, SEP, OCT, NOV, DEC  (For biomass database)  (Q1, Q2, Q3, Q4, ANN (Annual estimate) |
| Fishing Mode | 14-16 | BOA (Boat)  SHO (Shore, includes ice-fishing)  STR (Stream)  ALL (For biomass databases) |
| Observation Type: this denotes whether observation records catch, harvest, effort, etc. | 17-23 | CATCH (in numbers)  CATCHB (in pounds)  HARV (in numbers)  HARVB (in pounds)  EFFORT (in angler-hours)  TEFFORT (targeted effort, angler-hours)  TCATCH (targeted catch in numbers)  THARV (targeted harvest in numbers) |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Table A.1. Lake Michigan Creel Survey Working Group Database Design (continued). | | |
| Variables to be included in lake-wide catch/harvest/effort database (continued) | | |
| Species: For Observation Types this does not apply to (e.g., EFFORT), use “\*” | 25-27 | BKT (brook trout)  BNT (brown trout)  CHS (chinook salmon)  COH (coho salmon)  LAT (lake trout)  RBT (rainbow trout)  SMB (smallmouth bass)  SPL (splake)  WAE (walleye)  YEP (yellow perch)  SAT (salmon and trout, for targeted info) |
| Amount (of catch, harvest, effort...) | 29-41 | Any non-negative number  yyyyyyyyy.xx |
| Variance (for estimate recorded in Amount field), this is squared standard error | 43-55 | Any non-negative number  yyyyyyyyy.xx |
| Coverage (percentage of estimate based on sampling versus extrapolation) | 57-62 | Number between 0 and 100  xxx.yy |

The database has estimates of harvest (number) and effort (angler hours) by statistical district, month and fishing mode. Harvest and catch estimates are made for 10 major species (smallmouth bass, yellow perch, walleye, lake trout, splake, chinook salmon, coho salmon, rainbow trout/steelhead, brown trout, brook trout). All statistical district x month x fishing mode combinations are filled in, at least for harvest and effort, unless there is simply no basis for an estimate of any sort (i.e., not sampling because effort is low implies a zero value or requires some sort of assumption regarding how much effort and harvest occurs). The database design includes not only harvest, but catch (released fish). Additionally, both targeted harvest and effort are reported.

Records are created for every statistical district, month and fishing mode combination even if harvest (or catch) and effort is always assumed to be zero for that combination. There are at least 33 observations for each such combination. Harvest is reported for each of 10 species. Effort is reported and targeted effort for Salmon and Trout (SAT) and for yellow perch (YEP) is reported. Targeted harvest is reported for all ten species for each of these two targets: [(10 + 1 + 2) + (2 x 10) = 33]. An additional 30 records result when catch information is also reported. These are catch for each of ten species, and targeted catch for each of ten species for the two targets [(10 + (10 x 2) = 30].

Database includes estimates of harvest biomass (and when catch is reported, catch biomass). Estimates can be lake-wide for a given state and can be totals for all fishing modes. A mechanism is provided to allow states to report these by mode and finer spatial and time intervals. For each time-period, location and mode reported, there should be 20 such observations.

**APPENDIX B**

Figure B.1. Shoreline of Lake Michigan.

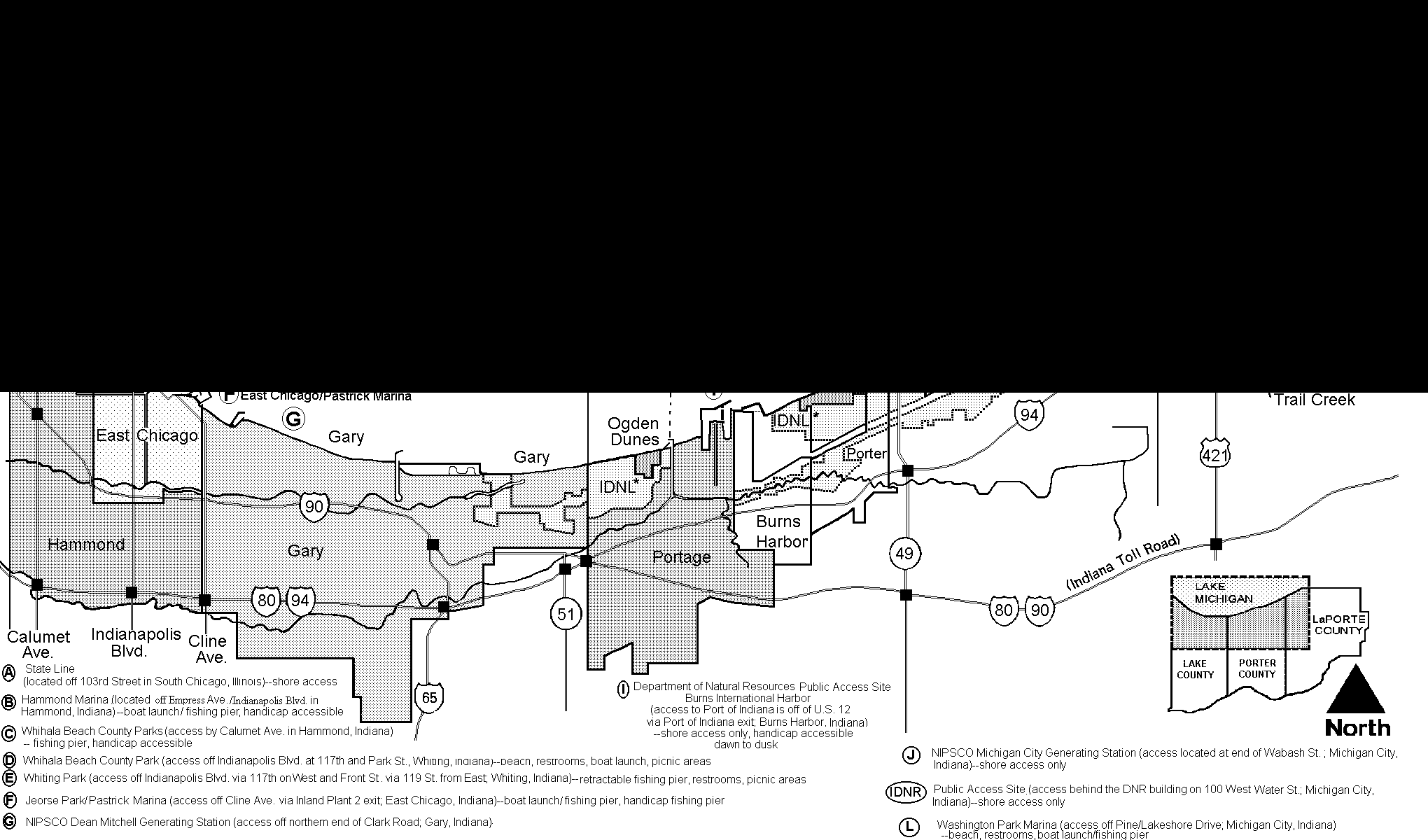


Figure B.2. Trail Creek, Michigan City, Indiana.

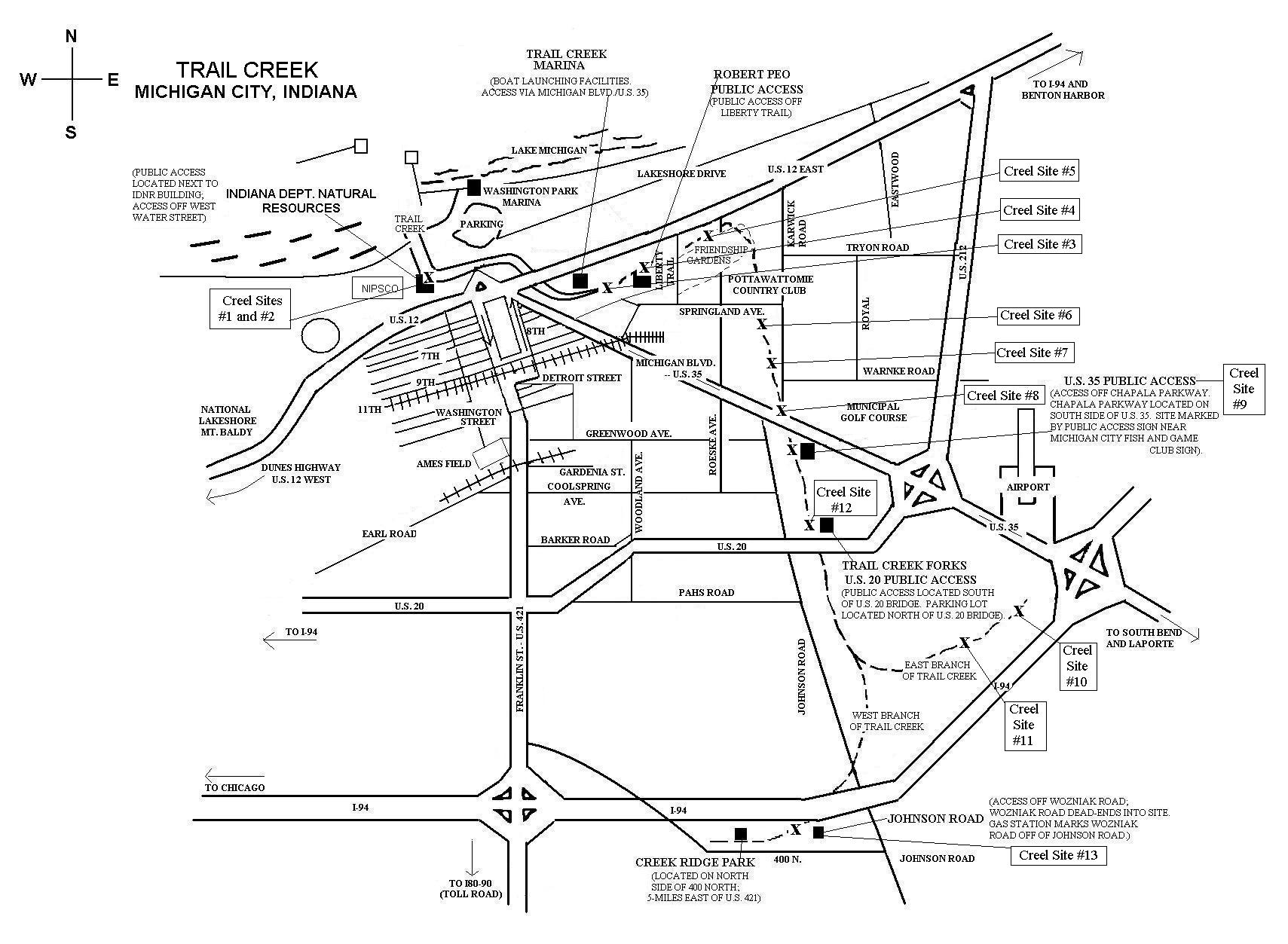
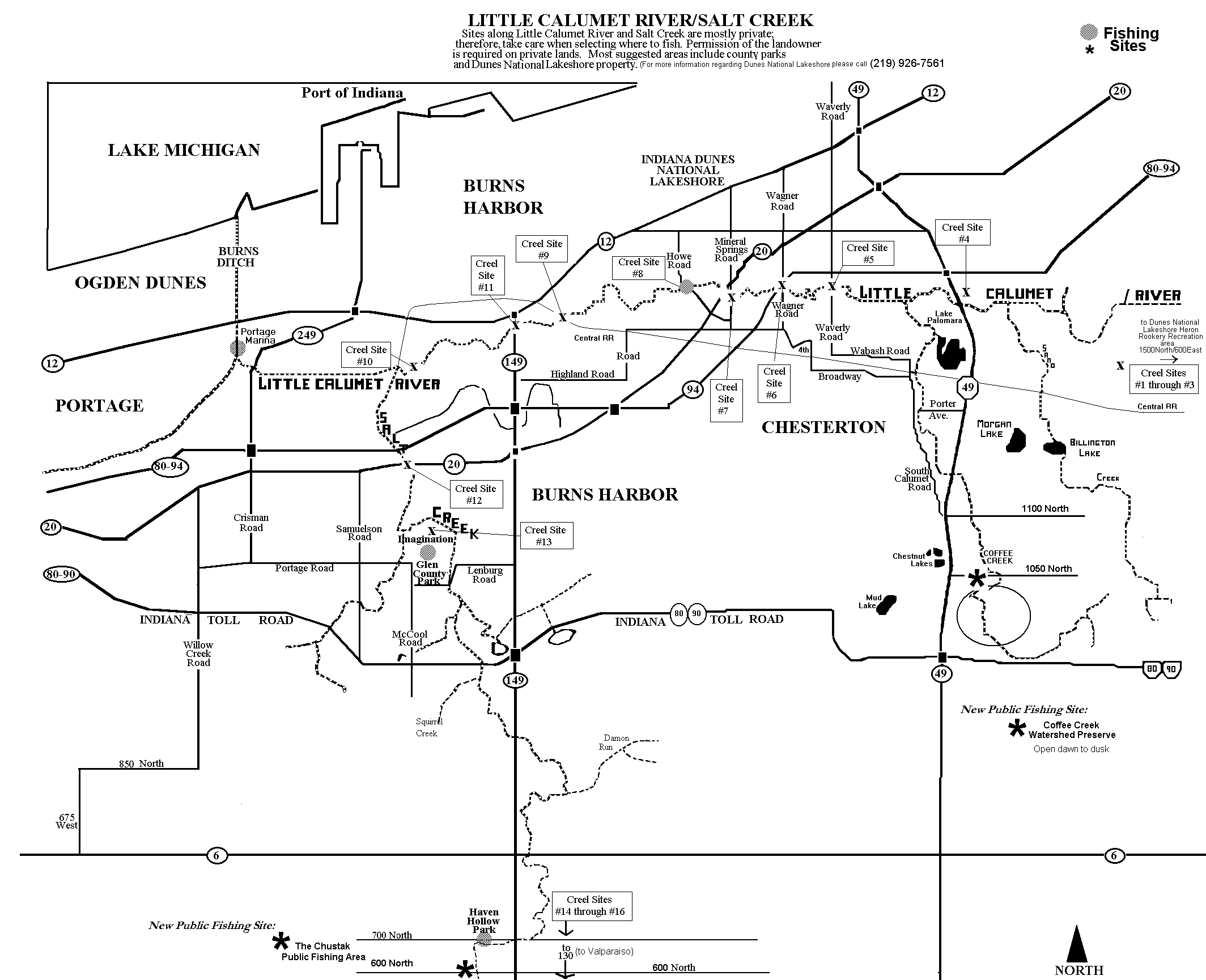


Figure B.3. East Branch of the Little Calumet River and Salt Creek, Porter County, Indiana.



**APPENDIX C**

Figure C.1. Lake Michigan lake creel schedule, April 2002.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
| APRIL 2002  Lake Creel Schedule | | | | |  |  |
|  | 1  25 HA ➂ | 2  24 MC ➂ | 3 | 4  24 EC ➁ | 5  25 BH ➀ | 6  24 HA ➁  25 EC ➀ |
| 7  24 MC ➀  25 BH ➁ | 8  24 EC ➂ | 9 | 10 | 11  25 HA ➀ | 12 | 13  24 HA ➀  25 MC ➀ |
| 14  24 BH ➂  25 EC ➀ | 15 | 16 | 17  24 BH ➁  25 EC ➂ | 18  24 HA ➁  25 MC ➁ | 19 | 20  24 EC ➀  25 HA ➀ |
| 21  24 BH ➁  25 MC ➁ | 22  24 MC ➀  25 EC ➁ | 23  24 HA ➂  25 BH ➂ | 24 | 25 | 26 | 27  24 MC ➀  25 BH ➀ |
| 28  24 EC ➁  25 HA ➀ | 29 | 30  24 BH ➁  25 MC ➀ |  |  |  |  |

MC = Michigan City; BH = Burns Harbor; EC = East Chicago; HA = Hammond/Whihala

1 = counts @ 8.0, 10.0, 12.0, 14.0, 16.0

2 = counts @ 8:20, 10:20, 12:20, 14:20, 16:20

3 = counts @ 8:40, 10:40, 12:40, 14:40, 16:40

Figure C.2. Lake Michigan stream creel schedule, March 2002.

| Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
| --- | --- | --- | --- | --- | --- | --- |
| March 2002 Stream Schedule | | | | | 1 | 2 **SC**  8.0  14.5  17.0 |
| 3 **TC**  8.5  15.0  16.5 | 4 | 5  **LCW**  8.0  13.5 | 6 **TC**  8.0  10.5  15.5 | 7 | 8 | 9 **TC**  10.5  12.5  14.5 |
| 10 **SC**  7.5  11.0  16.0 | 11 | 12 | 13  **LCW**  11.0  15.5 | 14 | 15 **TC**  9.0  11.0  13.0 | 16 **LC**  8.0  12.0  14.0 |
| 17 **TC**  9.5  14.5  17.0 | 18 | 19 | 20 | 21  **LCW**  9.5  14.5 | 22 **TC**  11.0  13.0  15.5 | 23 |
| 24 **TC**  9.0  14.5  17.0 | 25 | 26 | 27  **TC**  12.5  14.0  16.0 | 28  **LCW**  10.0  15.0 | 29  **Good Friday** | 30 **LC**  10.0  13.0  16.0 |
| 31  **Easter** |  |  |  |  |  |  |

TC: Trail Creek WORK TIMES: 7:30 a.m. - 5:30 p.m. LCW/LC/SC: Little Cal. Watershed/Little Cal./Salt Creek WORK TIMES:

7:00 a.m. - 6:00 p.m.

Figure C.3. Lake Michigan stream creel schedule, November 2002.

| Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
| --- | --- | --- | --- | --- | --- | --- |
| STREAM November 2002 | | | |  |  |  |
|  |  |  |  |  | 1 | 2 |
| 3  **LCW**  9.5  14.5 | 4 | 5 | 6 **TC**  9.0  11.0  13.5 | 7 | 8  **LCW**  9.0  14.0 | 9  **LCW**  8.5  14.0 |
| 10 **TC**  9.5  10.5  14.0 | 11 | 12 | 13  **LCW**  9.5  12.5 | 14 **TC**  10.0  11.0  13.0 | 15 | 16 **TC**  8.5  10.5  12.5 |
| 17  **LCW**  8.5  12.0 | 18 | 19  **LCW**  9.0  14.5 | 20 **TC**  9.0  11.0  15.0 | 21 | 22 | 23  **LCW**  10.0  12.5 |
| 24 **TC**  10.0  11.5  14.0 | 25 | 26 **TC**  11.5  13.0  15.0 | 27  **LCW**  9.5  13.5 | 28  **Thanksgiving**  **Day** | 29 | 30 **TC**  10.5  13.0  14.0 |

TC: Trail Creek WORK TIMES: 8:00 a.m. - 3:30 p.m. LCW: Little Cal. Watershed WORK TIMES: 7:30 a.m. - 4:00 p.m.

**APPENDIX D**

Figure D.1. Lake Michigan survey boat and shore count data sheet.

| **IDNR** |  |  | **Lake Michigan Research** | | | |  | **Fishing Effort Counts** | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | |  | |  | | | |  | | |
| Site: BH EC HA MC | | | Date:\_\_\_/\_\_\_/\_\_\_ | | Weekend or Weekday | | | | Clerk:\_\_\_\_\_\_\_\_\_\_\_ | | |
|  | |  |  |  |  |  |  |  |  |  |  |
| **WEATHER:** | |  |  |  |  |  |  |  |  |  |  |
| Average Temperature (F)\_\_\_\_\_ Stormy \_\_.\_\_ hours Foggy \_\_.\_\_ hours  Average sky: sunny hazy p. cloudy m. cloudy overcast  Precipitation (% time it rained): 0 25 50 75 100  Winds mainly out of the: N S E W NE NW SE SW  Wave height: 1 (0-3 ft.) 2 (3-5 ft.) 3 (over 5 ft.) | | | | | | |  |  |  |  |  |
|  | |  |  |  |  |  |  |  |  |  |  |
| **SHORE COUNTS:** | |  |  |  |  |  |  |  |  |  |  |
| Time of Count | | |  |  |  |  |  |  |  |  |  |
| Number of Anglers | | |  |  |  |  |  |  |  |  |  |
|  |  |  | SC1 | SC2 | SC3 | SC4 | SC5 |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| **BOAT COUNTS:** | |  | COUNT PERIOD: 1 ( \_:00 ) 2 ( \_:20 ) 3 ( \_:40 ) | | | | |  |  |  |  |
|  | |  |  | | | | |  |  |  |  |
| 20 Min. Count Starting: | | |  |  |  |  |  |  |  |  |  |
| Fishing Boats Returning | | |  |  |  |  |  |  |  |  |  |
|  |  |  | BC1 | BC2 | BC3 | BC4 | BC5 |  |  |  |  |
| NO. OF BOATS RETURNING THAT WERE CHARTERS: | | | \_\_\_\_\_\_ | \_\_\_\_\_\_ | \_\_\_\_\_\_ | \_\_\_\_\_\_ | \_\_\_\_\_\_ |  |  |  |  |

Figure D.2. Lake Michigan lake creel boat interview sheet (front and back).

| **IN Department of Natural Resources** | | | | | | **Lake Michigan Research** | | | | | | **Lake Creel Survey** | | | **BOAT INTERVIEWS** | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Site: BH EC HA MC | | | | | Date:\_\_\_/\_\_\_/\_\_\_ | | | | | Weekend OR Weekday | | | |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Page\_\_\_\_of\_\_\_\_ | | |  |  |  |  |  |  |  |  |  |  |  |  |  | Clerk\_\_\_\_\_\_\_\_\_\_ | |
| Start Time | Quit Time  (Lines pulled) | Charter Y/N | Number of Anglers | Species Fished For | **FISH HARVESTED (Record the number)** | | | | | | | Undersized Released  (Number and Species) | Legal Released  (Number and Species) | Depth Fished (of LM  in feet) | State Waters Fished | Lure/Bait Used | NOTES  (general area non-charter boats fished for fishing hotline) |
| COHO SALMON | CHINOOK SALMON | STEELHEAD | BROWN TROUT | LAKE TROUT | YELLOW PERCH | OTHER (Number  and Species) |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Back:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **RATE THE FOLLOWING 2 QUESTIONS ON A SCALE OF 1-5 1 IS THE LOWEST 5 IS THE HIGHEST** | | | | | | | | | | | | | | |  |
|  | Rate the **Importance** you place on having *(fill in the blank, read only fish angler fishing for)* in Lake Michigan: | | | | | | | Overall, rate the **satisfaction** of the quality of the  *(fill in using only the fish angler was fishing for)*  fishery in the Lake, not basing your answer just on today’s trip: | | | | | | |  |  |
| County,  State op Residence | COHO SALMON | CHINOOK SALMON | STEELHEAD | BROWN TROUT | LAKE TROUT | YELLOW PERCH | OTHER–list species if  angler is fishing for something  other than trout/salmon/yp | COHO SALMON | CHINOOK SALMON | STEELHEAD | BROWN TROUT | LAKE TROUT | YELLOW PERCH | OTHER–list species if  angler fishing for something  other than trout/salmon/yp etc. | Favorite Lake Michigan  Species to Fish For | COMMENTS |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure D.3. Lake Michigan lake creel shore interview sheet (front and back).

| **IN Department of Natural Resources** | | | | | | **Lake Michigan Research** | | | | | | **Lake Creel Survey** | | **SHORE INTERVIEWS** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Site: BH EC HA MC | | | | | Date:\_\_\_/\_\_\_/\_\_\_ | | | | | Weekend OR Weekday | | | |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Page\_\_\_\_of\_\_\_\_ | | |  |  |  |  |  |  |  |  |  |  |  | Clerk\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | |
| Start Time | Interview  Time | Complete Trip  Y/N | Number of Anglers | Species Fished For | **FISH HARVESTED (Record the number)** | | | | | | | Undersized Released  (Number and Species) | Legal Released  (Number and Species) | Lure/Bait Used | NOTES  (angler identification notes) |
| COHO SALMON | CHINOOK SALMON | STEELHEAD | BROWN TROUT | LAKE TROUT | YELLOW PERCH | OTHER (Number  and Species) |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Back:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **RATE THE FOLLOWING 2 QUESTIONS ON A SCALE OF 1-5 1 IS THE LOWEST 5 IS THE HIGHEST** | | | | | | | | | | | | | | |  |
|  | Rate the **Importance** you place on having *(fill in the blank, read only fish angler fishing for)* in Lake Michigan: | | | | | | | Overall, rate the **satisfaction** of the quality of the  *(fill in using only the fish angler was fishing for)*  fishery in the Lake, not basing your answer just on today’s trip: | | | | | | |  |  |
| County,  State of Residence | COHO SALMON | CHINOOK SALMON | STEELHEAD | BROWN TROUT | LAKE TROUT | YELLOW PERCH | OTHER–list species if  angler is fishing for something  other than trout/salmon/yp | COHO SALMON | CHINOOK SALMON | STEELHEAD | BROWN TROUT | LAKE TROUT | YELLOW PERCH | OTHER–list species if  angler fishing for something  other than trout/salmon/yp etc. | Favorite Lake Michigan  Species to Fish For | COMMENTS |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Figure D.4. Lake Michigan lake and stream creel biodata sheet.

| **IDNR LAKE MICHIGAN RESEARCH BIODATA** | | | | | | | | | | | | |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | **BOAT SHORE STREAM** | | | | | | | |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SITE: BH EC HA MC  LC TC SC | | | | |  | DATE\_\_\_/\_\_\_/\_\_\_ | | | |  | Weekend OR Weekday | | |
| Page \_\_\_\_ of \_\_\_\_\_ | | |  |  |  |  |  |  |  |  |  | Clerk\_\_\_\_\_\_\_\_ | |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Species | Fins  Clipped | Length  (mm) | Weight  (kg) |  | Species | Fins  Clipped | Length  (mm) | Weight  (kg) |  | Species | Fins  Clipped | Length  (mm) | Weight  (kg) |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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Figure D.5. Lake Michigan stream creel count data sheet, Little Calumet Watershed, Salt Creek, East Branch of the Little Calumet.

| **IDNR Lake Michigan Research** | | | | **Clerk\_\_\_\_\_\_\_\_\_\_** |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| **Stream: LC Watershed / SC / LC** | | **Date \_\_\_/\_\_\_/\_\_\_ Weekend OR Weekday** | | |
| WEATHER: |  |  |  |  |
|  | Average temperature \_\_\_\_ Stormy\_\_.\_\_hours  Average sky: sunny hazy p.cloudy m.cloudy overcast  Precipitation (% time that it rained): 0 25 50 75 100  Stream height: flooded high normal low  Stream water clarity: low (muddy) fair high (clear) | | | |
|  |  |  |  |  |
| **Sites** | | **Count 1**  **\_\_\_:\_\_\_ - \_\_\_:\_\_\_** | **Count 2**  **\_\_\_:\_\_\_-\_\_\_:\_\_\_** | **Count 3**  **\_\_\_:\_\_\_-\_\_\_:\_\_\_** |
| **(1) 600** | |  |  |  |
| **(2) 450** | |  |  |  |
| **(3) BR** | |  |  |  |
| **(4) 49** | |  |  |  |
| **(5) WAV** | |  |  |  |
| **(6) WAG** | |  |  |  |
| **(7) 20LC** | |  |  |  |
| **(8) HO** | |  |  |  |
| **(9) 149** | |  |  |  |
| **(10) MC** | |  |  |  |
| **(11) MG** | |  |  |  |
| **(12) 20SC** | |  |  |  |
| **(13) IG** | |  |  |  |
| **(14) 130** | |  |  |  |
| **(15) 400** | |  |  |  |
| **(16) JO** | |  |  |  |
|  | |  |  |  |
| **TOTALS** | |  |  |  |
| Notes: | | | | |

Figure D.6. Lake Michigan stream creel count data sheet, Trail Creek.

| **IDNR Lake Michigan Research** | | | | **Clerk\_\_\_\_\_\_\_\_\_\_** |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| **Stream: TC** | | **Date \_\_\_/\_\_\_/\_\_\_ Weekend OR Weekday** | | |
| WEATHER: |  |  |  |  |
|  | Average temperature \_\_\_\_ Stormy\_\_.\_\_hours  Average sky: sunny hazy p.cloudy m.cloudy overcast  Precipitation (% time that it rained): 0 25 50 75 100  Stream height: flooded high normal low  Stream water clarity: low (muddy) fair high (clear) | | | |
|  |  |  |  |  |
| **Sites** | | **Count 1**  **\_\_\_:\_\_\_ - \_\_\_:\_\_\_** | **Count 2**  **\_\_\_:\_\_\_-\_\_\_:\_\_\_** | **Count 3**  **\_\_\_:\_\_\_-\_\_\_:\_\_\_** |
| **(1) DNRA (anglers\_)** | |  |  |  |
| **(2) DNRB (boats)** | |  |  |  |
| **(3) RR** | |  |  |  |
| **(4) LT** | |  |  |  |
| **(5) FG** | |  |  |  |
| **(6) SP** | |  |  |  |
| **(7) KA** | |  |  |  |
| **(8) 35** | |  |  |  |
| **(9) PA** | |  |  |  |
| **(10) ME** | |  |  |  |
| **(11) DD** | |  |  |  |
| **(12) 20** | |  |  |  |
| **(13) JR** | |  |  |  |
|  | |  |  |  |
| **TOTALS (RR-JR)** | |  |  |  |
|  | |  |  |  |
| Notes: | | | | |

Figure D.7. Lake Michigan stream creel stream interview sheet (front and back).

| **IN Department of Natural Resources** | | | | | | | | **Lake Michigan Research** | | | | | | **STREAM CREEL INTERVIEWS** | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Stream: LCW LC SC TC | | | | | | | Date:\_\_\_/\_\_\_/\_\_\_ | | | | | Weekend OR Weekday | | | | | |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Page\_\_\_\_of\_\_\_\_ | | |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Clerk\_\_\_\_\_\_\_\_\_\_ | |
| Site | Start Time | Interview  Time | Complete Trip Y/N | Come by Car Y/N | Number of Anglers | Species Fished For | **FISH HARVESTED (Record the number)** | | | | | | | | | | Fish On–Not Caught | Lure/Bait Used | NOTES (angler identification notes) |
| BROWN TROUT | NO. RELEASED | STEELHEAD | NO. RELEASED | CHINOOK SALMON | NO. RELEASED | COHO SALMON | NO. RELEASED | OTHER (No. and Species)  SMOLTS (No. of MO) | No. Released  (No. and Species) |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Back:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **RATE THE FOLLOWING 2 QUESTIONS ON A SCALE OF 1-5 1 IS THE LOWEST 5 IS THE HIGHEST** | | | | | | | | | | |  |
|  | Rate the **Importance** you place on having *(fill in the blank, read only fish angler fishing for)* in *(whichever creek angler fishing in)*: | | | | | Overall, rate your **satisfaction** of the quality of the  *(fill in using only the fish angler was fishing for)*  fishery in *(creek)*, not basing your answer just on today’s trip: | | | | |  |  |
| County,  State of Residence | COHO SALMON | CHINOOK SALMON | STEELHEAD | BROWN TROUT | OTHER–list species if  angler is fishing for something  other than trout/salmon | COHO SALMON | CHINOOK SALMON | STEELHEAD | BROWN TROUT | OTHER–list species if  angler fishing for something  other than trout/salmon | Favorite Species to Fish  For in Streams | COMMENTS |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

1. The fishing access at the NIPSCO Michigan City Generating Station closed to pedestrian angler access in June 1999 but has recently been reopened on a limited basis as of March 2002. [↑](#footnote-ref-1)