

## STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-2

Study No.: 646

Title: Inland creel surveys

Period Covered: October 1, 2000 to September 30, 2001

**Study Objective:** To provide a consistent series of guidelines, data collection methods, and timely analysis to fisheries managers and research biologists conducting access point creel surveys on inland waters.

**Summary:** Angler creel surveys were conducted on Burt Lake (Cheboygan County), Crooked and Pickerel lakes (Emmet County), and Higgins and Houghton lakes (Roscommon County) from January 13 through March 31, 2001, and April 28 through September 30, 2001; and on Michigamme Reservoir (Iron County) from April 12 through September 30, 2001. All lakes were surveyed to estimate angling pressure, harvest and catch by species. Michigamme Reservoir and Burt, Crooked, Pickerel, and Houghton lakes were surveyed to evaluate the walleye fishery. Higgins Lake was surveyed to evaluate the trout fishery. Effort and catch estimates were calculated for 3 Au Sable River sections (Alcona and Iosco counties) sampled during summer 1999; Monocle Lake and Tahquamenon River sampled during summer 2000 (Chippewa County); and 10 Southern Michigan trout lakes sampled during summer 2000: Allen and Deep (Lenawee County), Bear and Bird (Hillsdale County), Cary, Gilead, Lavine (Branch County), Farwell and Swains (Jackson County), and Lee (Calhoun County).

### **Job 1. Title: Examine creel survey sites.**

**Findings:** Each site sampled during the current segment was examined to determine appropriate locations for counting and interviewing anglers, and appropriate angler counting and interviewing methods.

Burt Lake was examined from the ground during December 2000 for subsequent 2001 winter and summer survey periods. The lake was stratified into 2 grids for counting and interviewing during winter survey (Figure 1), and 4 grids for counting and interviewing during summer survey (Figure 2).

Crooked and Pickerel lakes were examined from the ground during December 2000 for subsequent 2001 winter and summer survey periods. Each lake represented a single sampling unit. Crooked Lake survey area included lake area only, while Pickerel Lake included lake and channel area to shoreline edge of Crooked Lake (Figure 3).

Higgins and Houghton lakes were examined from the ground during December 2000 for subsequent 2001 winter survey. Higgins Lake was divided into 2 counting and interviewing grids (Figure 4). Houghton Lake was divided into 4 counting and interviewing grids (Figure 5).

Higgins and Houghton lakes were examined by aircraft during March 2001 for subsequent 2001 summer survey. Higgins Lake was divided into 4 counting and interviewing grids (Figure 6). Houghton Lake was divided into 5 counting and interviewing grids (Figure 7).

Michigamme Reservoir was initially examined by aircraft. The reservoir was stratified into 5 grids for counting and interviewing. Grids and boundary locations used for interviewing are given in Figure 7. Air flight path for counting, way points, and site codes for counting and interviewing are given in Figure 8.

**Job 2. Title: Sampling intensity, techniques, and proposed level of statistical significance.**

**Findings:** Statistical significance of 75% or greater was considered appropriate by all unit managers conducting surveys. Error bounds (2 SE) were calculated for each estimate and provided statistical significance, depending on distribution shape and  $N \geq 10$ , of 75% to 95% (Dixon and Massey 1957). Rates of precision (mean/2 SE) were not predetermined for any of the surveys. Unless otherwise noted, all estimates in this report were  $\pm 2$  SE.

Design and estimation methods used for surveys given in this report followed the multiple-day period (Lockwood et al. 1999) or proportional method (Lockwood 2000c). Survey planning in each instance followed general funding and supervisory procedures given in Lockwood (2000a).

*Burt Lake, winter 2001*—Survey followed a roving-roving (counts-interviews) design. All funding was provided through Fisheries Division. One clerk working from a snowmobile collected angler-creel data. Both weekend days and 3 randomly selected weekdays were selected for sampling during each week of the survey season. No holidays were sampled. Clerk followed a randomized count and interview schedule. One of two shifts was selected each sample day (Table 1). Either Section 201 or Section 202 was sampled each day (Figure 1). Starting location within a section and direction of travel were randomized for both counting and interviewing. Instantaneous counts of open-ice anglers and occupied shanties were made once per day. Survey period was January 13 through March 31. Months were estimated separately.

All harvest data were collected by angler rather than by angler party. Most open-ice-angler interviews were of incomplete fishing trips (733 incomplete trip, 30 complete trip), as were shanty-angler interviews (553 incomplete trip, 27 complete trip). Catch rates were estimated using the mean-of-ratios estimator regardless of interview type.

*Crooked and Pickerel lakes, winter 2001*—Survey followed a roving-roving design. All funding was provided through Fisheries Division. One clerk working from a snowmobile collected angler-creel data. Both weekend days and 3 randomly selected weekdays were selected for sampling during each week of the survey season. No holidays were sampled. Clerk followed a randomized count and interview schedule. One of two shifts was selected each sample day (Table 1). Clerk's time was split between Crooked and Pickerel lakes, and only 1 lake was selected for sampling each day. Starting location within a lake and direction of travel were randomized for both counting and interviewing. Instantaneous counts of open-ice anglers and occupied shanties were made once per day. Survey period was January 13 through March 31. Months were estimated separately.

All harvest data were collected by angler rather than by angler party. On Crooked Lake, most open-ice-angler interviews were of incomplete fishing trips (244 incomplete trips, 9 complete trips), as were shanty-angler interviews (298 incomplete trips, 20 complete trips). Similarly, on Pickerel Lake most open-ice-angler interviews were of incomplete fishing trips (126 incomplete trips, 8 complete trips), as were shanty-angler interviews (121 incomplete trips, 2 complete trips). Catch rates for both lakes were estimated using the mean-of-ratios estimator regardless of interview type.

*Higgins Lake, winter 2001*—Survey followed a roving-roving design. All funding was provided through Fisheries Division. One clerk working from a snowmobile collected angler-creel data. Both weekend days and 3 randomly selected weekdays were selected for sampling during each week of the survey season. No holidays were sampled. Clerk followed a randomized count and interview schedule. One of two shifts was selected each sample day (Table 1). Either Section 270 or Section 271 was sampled each day (Figure 4). Starting location within a section and direction of travel were randomized for both counting and interviewing. Instantaneous counts of open-ice anglers and occupied shanties were made once per day. Survey period was January 13 through March 31. Months were estimated separately.

All harvest data were collected by angler rather than by angler party. Most open-ice-angler interviews were of incomplete fishing trips (1,243 incomplete trips, 23 complete trips), as were shanty-angler interviews (1,479 incomplete trips, 26 complete trips). Catch rates were estimated using the mean-of-ratios estimator regardless of interview type.

*Houghton Lake, winter 2001*—Survey followed a roving-roving design. All funding was provided through Fisheries Division. One clerk working from a snowmobile collected angler-creel data. Both weekend days and 3 randomly selected weekdays were selected for sampling during each week of the survey season. No holidays were sampled. Clerk followed a randomized count and interview schedule. One of two shifts was selected each sample day (Table 1). One of the lake's 4 sections was sampled each day (Figure 5). Starting location within a section and direction of travel were randomized for both counting and interviewing. Instantaneous counts of open-ice anglers and occupied shanties were made once per day. Survey period was January 13 through March 31. From January 13 through February 28 was considered a single period with weekdays pooled and weekend days pooled.

All harvest data were collected by angler rather than by angler party. Most open-ice-angler interviews were of incomplete fishing trips (1,205 incomplete trips, 12 complete trips), as were shanty-angler interviews (765 incomplete trips, 17 complete trips). Catch rates were estimated using the mean-of-ratios estimator regardless of interview type.

*Tahquamenon River and Monocle Lake, 2000*—Tahquamenon River followed a progressive-access design and Monocle Lake a roving-access design. Partial funding for this project was provided by the U.S. Forest Service and the Bay Mills Indian Community. This funding covered data collection (creel clerks), transportation, and supervision of clerks. Fisheries Division provided survey design, scheduling, data processing, and final estimates. Survey period was from May 16 through September 6, 2000. One of 2 shifts was selected each sample day (Table 2). August and September were considered a single period.

One clerk covered both river and lake sites. Three randomly selected weekdays and both weekend days were selected for sampling during the survey period. Approximately equal numbers of days were spent at each site.

One progressive count of vehicles was made at the Tahquamenon River each sample day. Direction of counts varied randomly. Three instantaneous counts of fishing craft and shore anglers were made at Monocle Lake each day.

All catch and harvest data were collected by angler rather than by angler party. On Tahquamenon River, most shore/wading angler interviews were of complete fishing trips (4 incomplete trips, 50 complete trips). Catch rates were estimated using the ratio-of-means estimator regardless of interview type.

On Monocle Lake, most boat-angler interviews were of complete fishing trips (12 incomplete trips, 180 complete trips) as were shore-angler interviews (8 incomplete trips, 109 complete trips).

When 80% or more of interviews within a time period (weekday or weekend day within a multiple-day period) were of single interview type, the appropriate catch-rate estimator for that interview type was used on all interviews. When less than 80% were of a single interview type, a weighted average  $R_w$  was used:

$$R_w = \frac{(\hat{R} \cdot n_1) \bullet (\bar{R} \cdot n_2)}{(n_1 + n_2)}, \quad (1)$$

where,  $\hat{R}$  is the ratio-of-means estimator for  $n_1$  interviews and  $\bar{R}$  the mean-of-ratios estimator for  $n_2$  interviews. Estimated variance  $s_w^2$  was calculated as:

$$s_w^2 = \frac{(s_{\hat{R}}^2 \cdot n_1^2) \bullet (s_{\bar{R}}^2 \cdot n_2^2)}{(n_1 + n_2)^2}, \quad (2)$$

where,  $s_{\hat{R}}^2$  is the estimated variance of  $\hat{R}$  and  $s_{\bar{R}}^2$  is the estimated variance of  $\bar{R}$ .

*Southern Michigan trout lakes, 2000*—Survey followed a proportional-access design. Sampling intensity, techniques, and clerk effort used for these surveys follow those given in appendices 1, 4, 8, 12, 16, 19, 26, and 39 of Lockwood (2000c). Survey period covered night fishing on Friday and Saturday nights from June 9 through August 12, for a total of 20 d. Hourly coverages by lake are given in Table 3.

*Au Sable River, Sections 255, 256, and 257 – Loud Impoundment*—Sections 255 and 256 followed a progressive-roving design for fishing activity. Section 257 – Loud Impoundment followed a roving-access design. Partial funding for this project was provided through a grant from Michigan Habitat Improvement Fund. Huron Pines R. C. & D. Council (Grayling, MI) was employed to collect creel data (creel clerks), data processing, transportation, and supervision of clerks. Fisheries Division provided survey design, scheduling and final estimates. Two clerks were used to collect angler-creel data at these three sections. Survey period was from May 20 through September 30, 2000. More complete section descriptions are given in Lockwood (2000b).

Both weekend days and three randomly selected weekdays were selected for sampling each week of the survey season. One of 2 shifts was selected each sample day and period of the day sampled varied with the season (Table 4).

Only one section was selected for counting each workday. Two counts per sample day were made in sections 255 and 257 – Loud Impoundment, and one count per sample day in Section 256. Progressive counts of fishing crafts and shore anglers were made in sections 255 and 256 as the clerks canoed through the sections. In addition, instantaneous counts of non-fishing crafts were also made at sections 255 and 256 (Lockwood 2000b). Instantaneous counts of fishing crafts, shore anglers, and non-fishing crafts were made at Section 257 – Loud Impoundment. Counts in Section 257 – Loud Impoundment were made from numerous vantage points around the impoundment.

While canoeing through sections 255 and 256, the clerks interviewed any anglers they encountered. Interviews were made as quickly and efficiently as possible to minimize shadowing bias (Wade et al. 1991).

When Section 257 – Loud Impoundment was selected for sampling, one clerk made the counts and interviewed, while the second clerk drove along the river in sections 255 and 256 interviewing anglers.

When not counting, the clerks interviewed shore and boating anglers. Number and species of fish caught and released, as well as harvested, were recorded by angler. Both complete-trip angler interviews and incomplete-trip angler interviews were collected. In Section 255, most boat-angler interviews were incomplete trip (56%), while shore-angler interviews were mostly complete trip (52%). In Section 256, most boat (56%) and most shore-angler interviews (87%) were incomplete trip. In Section 257 – Loud Impoundment, most boat-angler interviews were complete trip (98%), while most shore-angler interviews were incomplete trip (78%). For each section, estimation of catch rate followed procedures given for Tahquamenon River and Monocle Lake – 2000 using equations (1) and (2).

*Burt Lake, summer 2001*—Survey followed an aerial-roving design. All funding was provided through Fisheries Division. One clerk working from a boat collected angler interview data. Counts of fishing boats were made on Burt, Crooked, and Pickerel lakes. Counts progressed from Burt to Crooked to Pickerel or from Pickerel to Crooked to Burt. This sequence was randomized. Both weekend days and 3 randomly selected weekdays were selected for counting and interviewing during each week of the survey season. No holidays were sampled. Counting and interviewing were done on the same days, and one instantaneous count of fishing boats was made per day. One of two shifts was selected each sample day for interviewing (Table 5). Interview starting location (north or south end of lake) and direction of travel (clockwise or counter-clockwise) was randomized daily. Time of count was randomized to cover daylight times within the sample period. Survey period is from April 28 through September 30, 2001. Survey is ongoing and no estimates have been calculated.

*Crooked and Pickerel lakes, summer 2001*—Survey followed an aerial-roving design. All funding was provided through Fisheries Division. One clerk working from a boat collected angler interview data. Clerk's time was split between Crooked and Pickerel lakes, and only 1 lake was selected for sampling each day. Counts of fishing boats were made on Burt, Crooked, and Pickerel lakes. Counts progressed from Burt to Crooked to Pickerel or from Pickerel to Crooked to Burt. This sequence was randomized. Both weekend days and 3 randomly selected weekdays were selected for counting and interviewing during each week of the survey season. No holidays were sampled. Counting and interviewing were done on the same days, and one instantaneous count of fishing boats was made per day. One of two shifts was selected each sample day for interviewing (Table 5). Interview starting location (area within a lake) and direction of travel (clockwise or counter-clockwise) was randomized daily. Time of count was randomized to cover daylight times within the sample period. Survey period is from April 28 through September 30, 2001. Survey is ongoing and no estimates have been calculated.

*Higgins Lake, summer 2001*—Survey followed an aerial-roving design. All funding was provided through Fisheries Division. One clerk working from a boat collected angler interview data. Counts of fishing boats were made on Higgins and Houghton lakes. Counts progressed from Higgins to Houghton or from Houghton to Higgins. This sequence was randomized. Both weekend days and 3 randomly selected weekdays were selected for counting and interviewing during each week of the survey season. No holidays were sampled. Counting and interviewing were done on the same days,

and one instantaneous count of fishing boats was made per day. One of two shifts was selected each sample day for interviewing (Table 5). Interview starting location (area within Higgins Lake) and direction of travel (clockwise or counter-clockwise) was randomized daily. Time of count was randomized to cover daylight times within the sample period. Survey period is from April 28 through September 30, 2001. Survey is ongoing and no estimates have been calculated.

*Houghton Lake, summer 2001*—Survey followed an aerial-roving design. All funding was provided through Fisheries Division. One clerk working from a boat collected angler interview data. Counts of fishing boats were made on Higgins and Houghton lakes. Counts progressed from Higgins to Houghton or from Houghton to Higgins. This sequence was randomized. Both weekend days and 3 randomly selected weekdays were selected for counting and interviewing during each week of the survey season. No holidays were sampled. Counting and interviewing were done on the same days, and 1 instantaneous count of fishing boats was made per day. One of two shifts was selected each sample day for interviewing (Table 5). Interview starting location (area within Houghton Lake) and direction of travel (clockwise or counter-clockwise) was randomized daily. Time of count was randomized to cover daylight times within the sample period. Survey period is from April 28 through September 30, 2001. Survey is ongoing and no estimates have been calculated.

*Michigamme Reservoir, summer 2001*—Survey followed an aerial-roving design. Partial funding for this project was provided by Wisconsin Electric. This funding covered data collection (creel clerk), transportation, and air flights. Fisheries Division provided survey design, scheduling, data processing and clerk guidelines. One clerk working from a boat collected angler interview data. Count starting location was randomized and count took approximately 12 min to complete. Both weekend days and 3 randomly selected weekdays were selected for counting and interviewing during each week of the survey season. No holidays were sampled. Counting and interviewing were done on the same days, and one instantaneous count of fishing boats was made per day. One of two shifts was selected each sample day for interviewing (Table 5). Interview starting location (grid within reservoir) and direction of travel (grid order) was randomized daily. Time of count was randomized to cover daylight times within the sample period. Survey period is from April 28 through September 30, 2001. Survey is ongoing and no estimates have been calculated.

**Job 3. Title: Prepare stratified-random schedules.**

**Findings:** Schedules were prepared and distributed to appropriate personnel. Random numbers used in schedule preparation were derived from the dBase IV (software) random number function or tables of random numbers found in Arkin and Colton (1962).

**Job 4. Title: Train creel clerks.**

**Findings:** Written instructions were prepared for all surveys conducted during the current segment. Management Unit personnel provided additional on-site training for clerks. Training descriptions for surveys conducted during previous segments are given in Lockwood (2000b).

**Job 5. Title: Supervise count and interview data processing, and quality control.**

**Findings:** Count and interview data from current segment surveys were processed at the Institute for Fisheries Research. Count and interview data processing from the 1999 Au Sable River survey sections was done by Huron Pines R. C. & D. Council. Tahquamenon River and Monocle Lake data were processed at the Institute for Fisheries Research. The Southern Michigan trout lakes data

were processed by Southern Lake Michigan Management Unit personnel. Additional range checking of all data was done at the Institute for Fisheries Research.

**Job 6. Title: Calculate and distribute catch and pressure estimates.**

**Findings:** The 10 Southern Michigan trout lake surveys used proportional count estimation methods given in Lockwood (2000c). For all other surveys described here, multiple-day estimates were calculated using the expansion methods given in Lockwood et al. (2000).

*Burt Lake, winter 2001*—Anglers fished a total of 42,391±10,060 hours (Table 6). A total of 38,483±9,640 fish were harvested. Yellow perch were the predominant fish harvested (36,064±9,612). Anglers harvested 1,670±664 walleye.

*Crooked Lake, winter 2001*—Anglers fished a total of 5,503±2,227 hours (Table 7). A total of 2,201±971 fish were harvested. Yellow perch were the predominant fish harvested (2,022±963). Anglers harvested 139±117 walleye.

*Pickereel Lake, winter 2001*—Anglers fished a total of 3,258±1,408 hours (Table 8). A total of 2,051±961 fish were harvested. Yellow perch were the predominant fish harvested (2,020±961). Anglers harvested 22±29 walleye.

*Higgins Lake, winter 2001*—Anglers fished a total of 189,305±26,326 hours (Table 9). A total of 669,428±88,462 fish were harvested. Yellow perch were the predominant fish harvested (468,911±63,971). Anglers harvested 7,094±2,025 lake trout and 1,050±650 rainbow trout.

*Houghton Lake, winter 2001*—Anglers fished a total of 85,650±14,788 hours (Table 10). A total of 50,801±10,954 fish were harvested. Bluegill were the predominant fish harvested (20,768±9,389), followed by yellow perch (16,560±4,790). Anglers harvested 3,644±1,826 walleye.

*Tahquamenon River, summer 2000*—Anglers fished a total of 1,197±828 hours (Table 11). A total of 188±174 brook trout were harvested and 587±728 brook trout were caught and released.

*Monocle Lake, summer 2000*—Anglers fished a total of 1,685±489 hours (Table 12). A total of 68±41 fish were harvested, and 661±263 fish were caught and released. Smallmouth bass were the predominant fish harvested (37±29). Anglers harvested 21±24 walleye. Yellow perch were the predominant fish caught and released (409±224; Table 13). Anglers caught and released 79±110 walleye.

*Southern Michigan trout lakes, summer 2000*—Angling effort varied from 150±167 hours at Lavine Lake to 1,447±779 hours at Allens Lake (Table 14). No harvested rainbow trout were reported for Allens and Lee lakes. Greatest harvest and harvest rate of rainbow trout were recorded for Farwell Lake (1,226±1,091 and 1.1405±1.2354, respectively). No released rainbow trout were reported for Cary, Deep, Lavine, or Lee lakes. Greatest estimated catch and release and catch rate of rainbow trout were at Swains Lake (708±667 and 0.9316±0.9763, respectively).

*Au Sable River, Section 255, summer 1999*—Anglers fished a total of 13,095±3,133 hours (Table 15). A total of 7,010±2,297 fish were harvested. Rainbow trout were the predominant fish harvested (3,801±1,847). Anglers caught and released 14,690±3,434 fish (Table 16). Smallmouth bass were the predominant fish caught and released (6,693±2,689). Anglers also caught and released 978±516 rainbow trout.

*Au Sable River, Section 256, summer 1999*—Anglers fished a total of 2,428±1,126 hours (Table 17). A total of 37±76 walleye were harvested. Anglers caught and released 367±437 fish (Table 18). Anglers caught and released 214±373 walleye and 153±228 smallmouth bass.

*Au Sable River, Section 257 – Loud Impoundment, summer 1999*—Anglers fished a total of 12,217±2,903 hours (Table 19). A total of 5,595±2,213 fish were harvested. Bluegill were the predominant fish harvested (3,828±2,113). Anglers caught and released 7,747±2,549 fish (Table 20). Anglers caught and released 3,552±2,293 bluegill.

**Job 7. Title: Prepare annual report.**

**Findings:** This report was prepared on schedule.

**Literature Cited:**

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Wade, D.L., C.M. Jones, D.S. Robson, and K.H. Pollock. 1991. Computer simulation techniques to assess bias in the roving-creel-survey estimator. American Fisheries Society Symposium 12:40-46.

**Prepared by:** Roger N. Lockwood

**Date:** September 30, 2001



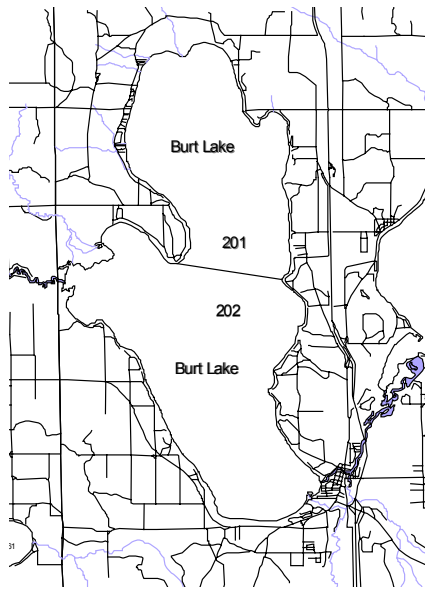


Figure 1.-Burt Lake count and interview grids used during winter 2001 angler survey.

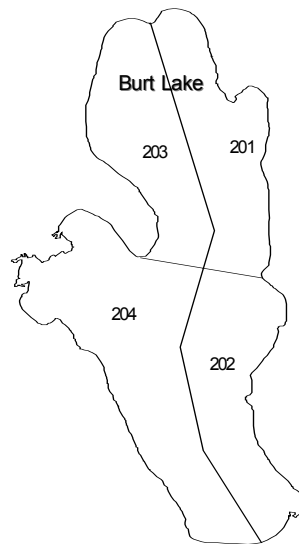


Figure 2.-Burt Lake count and interview grids used during summer 2001 angler survey.

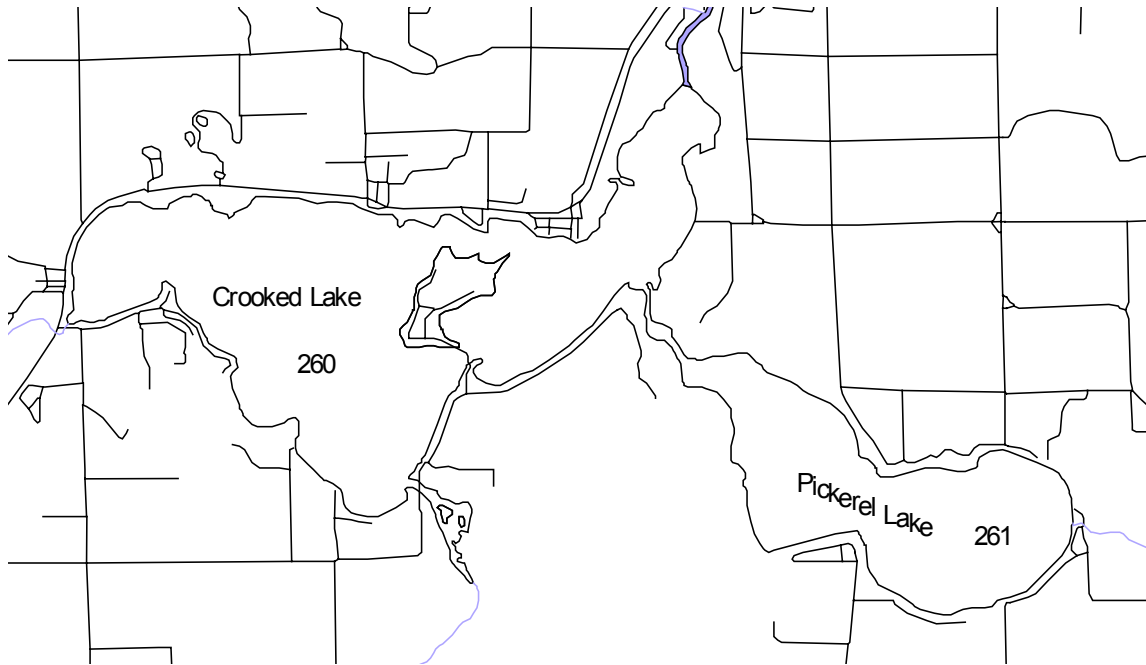


Figure 3.—Crooked and Pickerel lakes. Site codes and boundaries remained the same during winter and summer surveys. Crooked Lake survey area included lake area only, while Pickerel Lake included lake and channel area to shoreline edge of Crooked Lake.

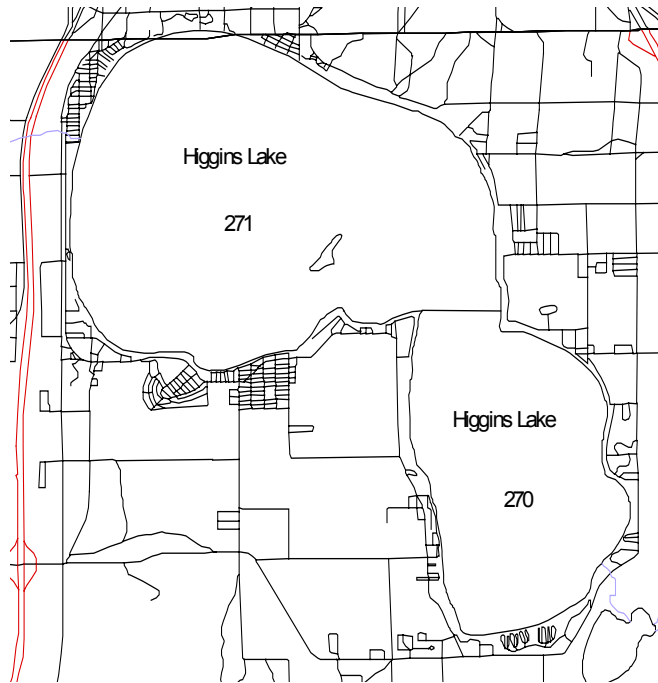


Figure 4.—Higgins Lake count and interview grids used during winter 2001 angler survey.

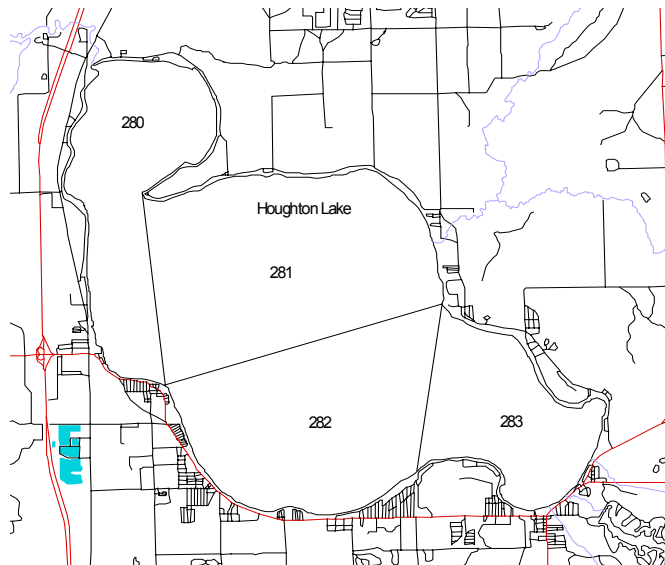


Figure 5.—Houghton Lake count and interview grids used during winter 2001 angler survey.

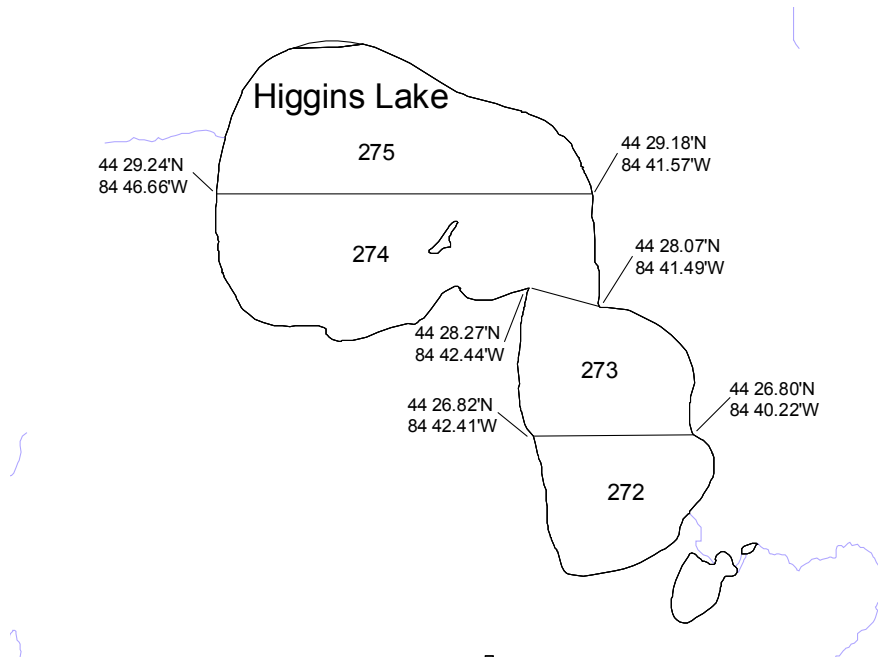


Figure 6.—Higgins Lake count and interview grids used during summer 2001 angler survey. Included are GPS coordinates indicating grid boundaries.

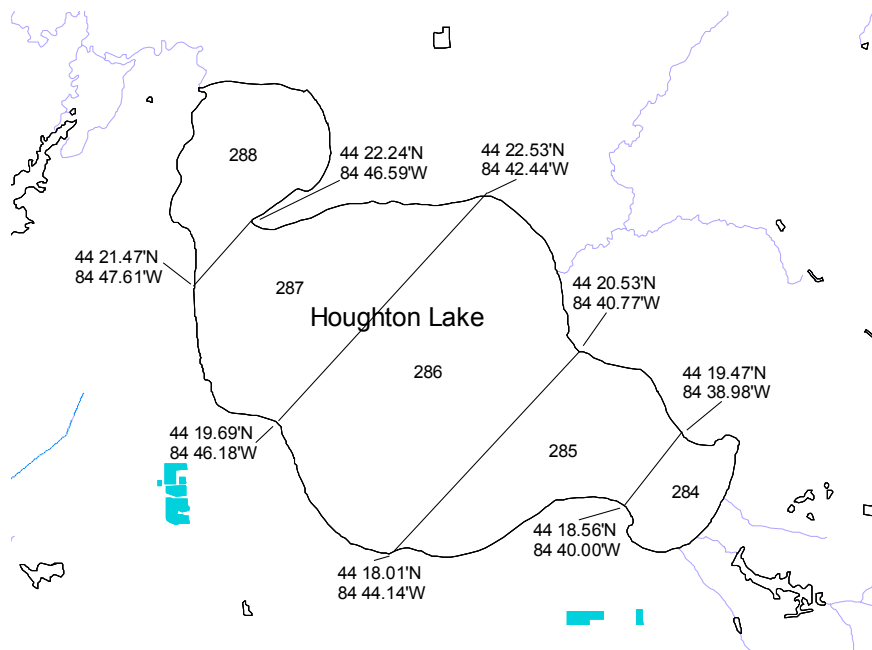
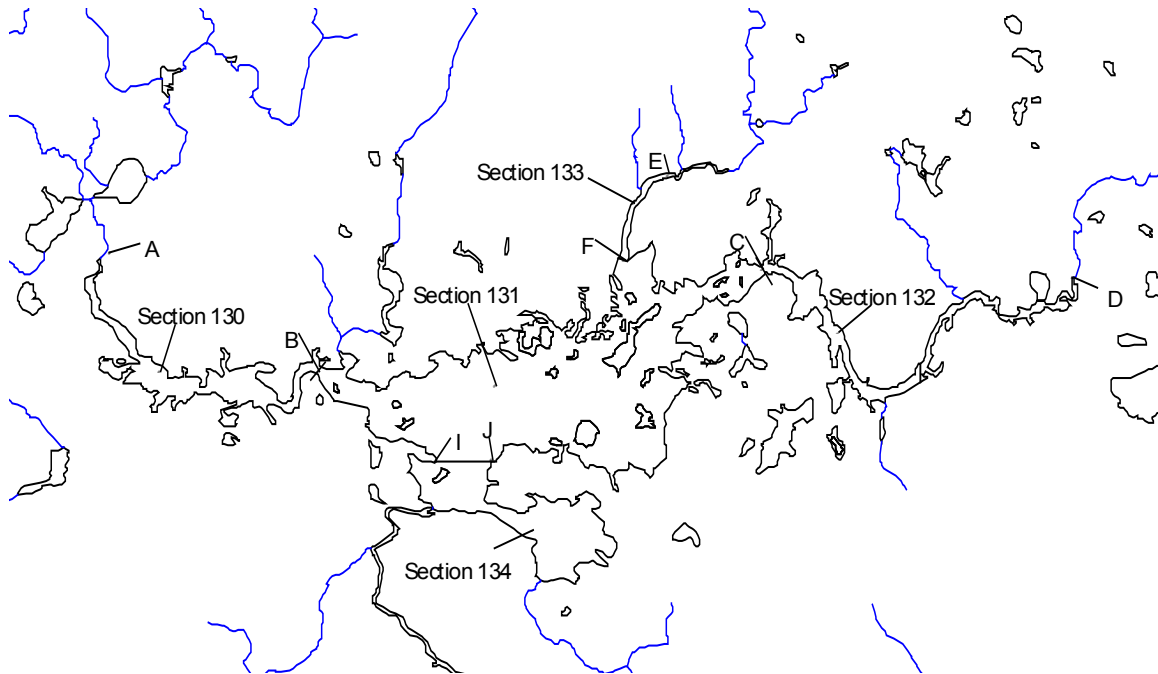
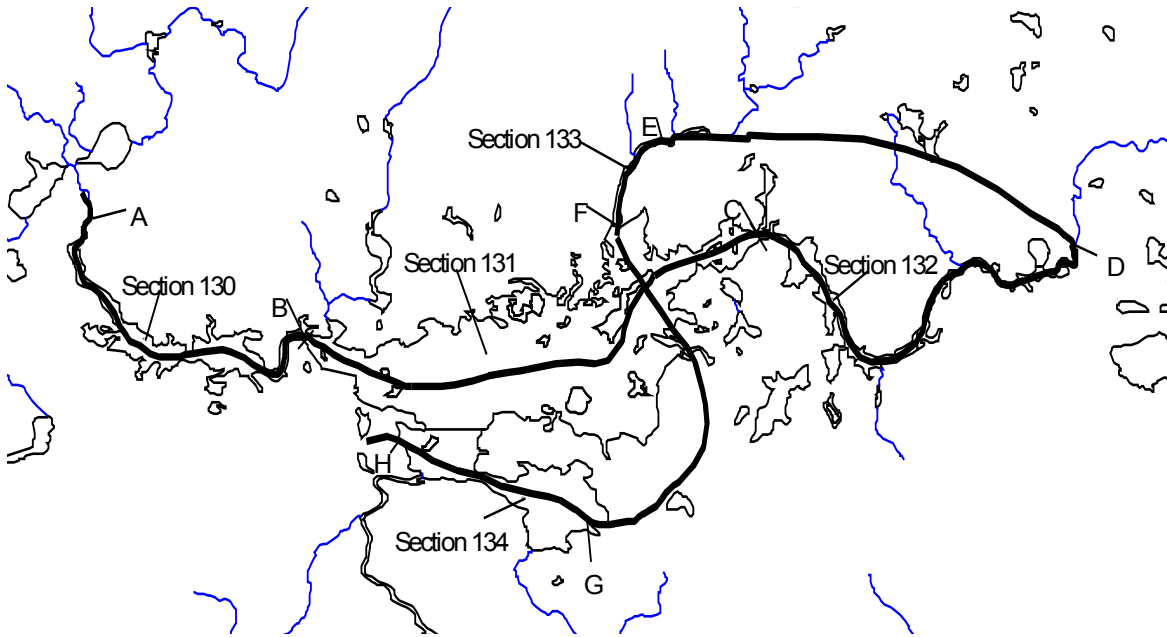


Figure 7.—Houghton Lake count and interview grids used during summer 2001 angler survey. Included are GPS coordinates indicating grid boundaries.



Map location code and description	Latitude	Longitude
A – WPA bridge	46°12.23' N	88°19.11' W
B – boundary sections 130-131	46°10.93' N	88°15.90' W
C – boundary sections 131-132	46°12.10' N	88°09.42' W
D – upper end of Section 132	46°12.08' N	88°04.83' W
E – upper end of Section 133	46°12.78' N	88°11.31' W
F – boundary sections 131-133	46°12.15' N	88°11.47' W
I – west edge of sections 131-134 boundary	46°10.04' N	88°14.14' W
J – east edge of sections 131-134 boundary	46°10.04' N	88°13.33' W

Figure 8.–Michigamme Reservoir count and interview grids, and way point coordinates used by creel clerk to distinguish between grids (April 12 – September 30, 2001 survey period).



Map location code and description	Latitude	Longitude
A – WPA bridge	46°12.23' N	88°19.11' W
B – boundary sections 130-131	46°10.93' N	88°15.90' W
C – boundary sections 131-132	46°12.10' N	88°09.42' W
D – upper end of Section 132	46°12.08' N	88°04.83' W
E – upper end of Section 133	46°12.78' N	88°11.31' W
F – boundary sections 131-133	46°12.15' N	88°11.47' W
G – SE edge of Section 134	46°09.18' N	88°11.77' W
H – west edge of Section 134	46°09.92' N	88°14.53' W

Figure 9.–Michigamme Reservoir count and interview grids used. Line indicates aircraft route and letters symbolize GPS marker locations (April 12 – September 30, 2001 survey period).

Table 1.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort at Burt (Cheboygan County), Crooked, Pickerel (Emmet County), Higgins, and Houghton lakes (Roscommon County), winter 2001.

Month	Shift		Expansion values
	Early	Late	
January 13	0700 h – 1530 h	0900 h – 1730 h	12
February	0700 h – 1530 h	0900 h – 1730 h	12
March	0600 h – 1430 h	1000 h – 1830 h	12

Table 2.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort at Tahquamenon River, and Monocle Lake, Chippewa County, 2000.

Month	Shift		Expansion values
	Early	Late	
May	0600 h – 1430 h	1330 h – 2200 h.	16
June	0600 h – 1430 h	1330 h – 2200 h.	16
July	0600 h – 1430 h	1330 h – 2200 h.	16
August	0600 h – 1430 h	1330 h – 2200 h.	16
September	0600 h – 1430 h	1330 h – 2200 h.	16

Table 3.–Hourly coverage on Friday and Saturday nights between June 9 and August 12, 2000, on 10 Southern Michigan trout lakes. Date period covers 20 d.

Lake	Hourly coverage	Hours
Allens	1600 h – 0300 h	12
Bear	1900 h – 2200 h	4
Bird	1600 h – 0300 h	12
Cary	2000 h – 2400 h	5
Deep	1900 h – 2400 h	6
Farwell	2100 h – 0100 h	5
Gilead	1800 h – 0100 h	8
Lavine	2000 h – 0300 h	8
Lee	1600 h – 0200 h	11
Swains	1700 h - 0100 h	9

Table 4.–Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort at Au Sable River sections 255 (Alcona County), 256, and 257 – Loud Impoundment (Iosco County), 1999.

Month	Shift		Expansion values
	Early	Late	
May	0600 h – 1430 h	1230 h – 2100 h	16
June	0600 h – 1430 h	1330 h – 2200 h	17
July	0600 h – 1430 h	1330 h – 2200 h	17
August	0600 h – 1430 h	1330 h – 2200 h	17
September	0700 h – 1530 h	1130 h – 2000 h	14



Table 5.—Work shifts used to estimate catch and effort at Burt (Cheboygan County), Crooked, Pickerel (Emmet County), Higgins, and Houghton lakes (Roscommon County), and Michigamme Reservoir, summer 2001.

Month	Shift	
	Early	Late
April	0600 h – 1430 h	1330 h – 2200 h
May	0600 h – 1430 h	1330 h – 2200 h
June	0600 h – 1430 h	1330 h – 2200 h
July	0600 h – 1430 h	1300 h – 2130 h
August	0630 h – 1500 h	1230 h – 2100 h
September	0630 h – 1500 h	1200 h – 2030 h

Table 6.—Total estimated harvest, catch per hour, and fishing pressure at Burt Lake, Cheboygan County. Period is from January 13 through March 31, 2001. Two standard errors are given in parentheses.

Species	Catch/hour	Jan	Feb	Mar	Season
Rainbow trout	0.0021 (0.0022)	31 (39)	55 (82)	2 (2)	88 (91)
Brown trout	0.0079 (0.0046)	185 (125)	55 (55)	97 (118)	337 (180)
Lake herring	0.0004 (0.0008)	0 (0)	18 (36)	0 (0)	18 (36)
Walleye	0.0394 (0.0182)	1,016 (486)	595 (449)	59 (51)	1,670 (664)
Yellow perch	0.8507 (0.3036)	11,767 (5,804)	15,247 (6,184)	9,050 (4,524)	36,064 (9,612)
Rock bass	0.0002 (0.0003)	0 (0)	7 (10)	0 (0)	7 (10)
Northern pike	0.0054 (0.0043)	92 (144)	89 (78)	47 (55)	228 (173)
White bass	0.0017 (0.0022)	58 (86)	13 (21)	0 (0)	71 (89)
Total harvest	0.9078 (0.3132)	13,149 (5,828)	16,079 (6,202)	9,255 (4,527)	38,483 (9,640)
Angler hours		16,282 (6,577)	16,738 (5,518)	9,371 (5,243)	42,391 (10,060)
Angler trips		4,277 (2,192)	5,428 (2,452)	2,520 (1,570)	12,225 (3,644)

Table 7.—Total estimated harvest, catch per hour, and fishing pressure at Crooked Lake, Emmet County. Period is from January 13 through March 31, 2001. Two standard errors are given in parentheses.

Species	Catch/hour	Jan	Feb	Mar	Season
Rainbow trout	0.0002 (0.0004)	0 (0)	0 (0)	1 (2)	1 (2)
Brown trout	0.0005 (0.0012)	3 (7)	0 (0)	0 (0)	3 (7)
Walleye	0.0253 (0.0236)	78 (90)	58 (74)	3 (5)	139 (117)
Yellow perch	0.3674 (0.2296)	1,153 (785)	361 (199)	508 (521)	2,022 (963)
Rock bass	0.0002 (0.0004)	0 (0)	1 (2)	0 (0)	1 (2)
Northern pike	0.0064 (0.0085)	28 (43)	7 (8)	0 (0)	35 (44)
Total harvest	0.4000 (0.2395)	1,262 (791)	427 (212)	512 (521)	2,201 (971)
Angler hours		2,984 (1,960)	1,534 (725)	985 (771)	5,503 (2,227)
Angler trips		1,241 (895)	567 (267)	400 (312)	2,208 (985)

Table 8.—Total estimated harvest, catch per hour, and fishing pressure at Pickerel Lake, Emmet County. Period is from January 13 through March 31, 2001. Two standard errors are given in parentheses.

Species	Catch/hour	Jan	Feb	Mar	Season
Walleye	0.0068 (0.0094)	22 (29)	0 (0)	0 (0)	22 (29)
Yellow perch	0.6200 (0.3985)	1,152 (771)	321 (370)	547 (438)	2,020 (961)
Rock bass	0.0003 (0.0006)	0 (0)	1 (2)	0 (0)	1 (2)
Northern pike	0.0025 (0.0042)	0 (0)	8 (13)	0 (0)	8 (13)
Total harvest	0.6295 (0.4013)	1,174 (771)	330 (370)	547 (438)	2,051 (961)
Angler hours		2,069 (1,193)	638 (644)	551 (379)	3,258 (1,408)
Angler trips		884 (569)	269 (291)	216 (168)	1,369 (661)

Table 9.—Total estimated harvest, catch per hour, and fishing pressure at Higgins Lake, Roscommon County. Period is from January 13 through March 31, 2001. Two standard errors are given in parentheses.

Species	Catch/hour	Jan	Feb	Mar	Season
Smelt	1.0087 (0.3517)	1,461 (1,278)	113,354 (50,614)	76,135 (34,133)	190,950 (61,061)
Rainbow trout	0.0055 (0.0035)	279 (278)	258 (230)	513 (541)	1,050 (650)
Atlantic salmon	0.0025 (0.0021)	179 (254)	285 (310)	0 (0)	464 (401)
Brook trout	0.0001 (0.0001)	0 (0)	12 (25)	0 (0)	12 (25)
Lake trout	0.0375 (0.0119)	1,701 (834)	3,450 (1,700)	1,943 (717)	7,094 (2,025)
Splake	0.0001 (0.0002)	0 (0)	0 (0)	21 (43)	21 (43)
Lake whitefish	0.0019 (0.0015)	0 (0)	81 (100)	288 (269)	369 (287)
Yellow perch	2.4770 (0.4825)	150,942 (39,451)	138,175 (30,912)	179,794 (39,753)	468,911 (63,971)
Rock bass	0.0002 (0.0003)	11 (20)	0 (0)	22 (44)	33 (48)
Muskellunge	0.0005 (0.0010)	0 (0)	0 (0)	92 (184)	92 (184)
Northern pike	0.0023 (0.0026)	325 (478)	107 (105)	0 (0)	432 (489)
Total harvest	3.5362 (0.6784)	154,898 (39,484)	255,722 (59,332)	258,808 (52,405)	669,428 (88,462)
Angler hours		51,398 (10,808)	74,850 (18,952)	63,057 (14,734)	189,305 (26,326)
Angler trips		9,971 (2,192)	13,584 (3,154)	11,351 (2,699)	34,906 (4,694)

Table 10.—Total estimated harvest, catch per hour, and fishing pressure at Houghton Lake, Roscommon County. Period is from January 13 through March 31, 2001. Two standard errors are given in parentheses.

Species	Catch/hour	Jan-Feb	Mar	Season
Walleye	0.0425 (0.0226)	2,357 (723)	1,287 (1,677)	3,644 (1,826)
Yellow perch	0.1933 (0.0651)	12,502 (2,930)	4,058 (3,789)	16,560 (4,790)
Rock bass	0.0038 (0.0030)	231 (232)	95 (95)	326 (251)
Pumpkinseed	0.0517 (0.0226)	2,363 (1,240)	2,068 (1,278)	4,431 (1,780)
Bluegill	0.2425 (0.1173)	3,722 (2,266)	17,046 (9,111)	20,768 (9,389)
Black crappie	0.0442 (0.0187)	1,070 (488)	2,715 (1,378)	3,785 (1,461)
Northern pike	0.0150 (0.0058)	1,268 (448)	19 (26)	1,287 (448)
Total harvest	0.5931 (0.1638)	23,513 (4,033)	27,288 (10,184)	50,801 (10,954)
Angler hours		66,211 (11,814)	19,439 (8,894)	85,650 (14,788)
Angler trips		19,795 (3,613)	5,811 (2,680)	25,606 (4,499)

Table 11.—Total estimated harvest, catch and release, catch rate, and angling effort at Tahquamenon River, Chippewa County. Period is from May 16 through September 6, 2000. All estimates are given with 2 standard errors in parentheses.

Species	Catch/hour	May 16-31	Jun	Jul	Aug Sep 6	Season
Brook t. - kept	0.1571 (0.1815)	11 (24)	24 (67)	28 (50)	125 (151)	188 (174)
Brook t. - released	0.4904 (0.6964)	6 (15)	71 (200)	299 (661)	211 (231)	587 (728)
Angler hours		229 (348)	172 (344)	384 (583)	412 (327)	1,197 (828)
Angler trips		105 (191)	113 (234)	176 (307)	223 (230)	617 (488)

Table 12.—Total estimated harvest, catch rate, and angling effort at Monocle Lake, Chippewa County. Period is from May 16 through September 6, 2000. All estimates are given with 2 standard errors in parentheses.

Species	Catch/hour	May 16-31	Jun	Jul	Aug Sep 6	Season
Walleye	0.0125 (0.0147)	0 (0)	2 (5)	0 (0)	19 (23)	21 (24)
Northern pike	0.0053 (0.0095)	0 (0)	2 (5)	0 (0)	7 (15)	9 (16)
Yellow perch	0.0006 (0.0018)	0 (0)	0 (0)	0 (0)	1 (3)	1 (3)
Smallmouth bass	0.0220 (0.0184)	1 (3)	27 (26)	8 (13)	1 (3)	37 (29)
Total harvest	0.0404 (0.0270)	1 (3)	31 (27)	8 (13)	28 (28)	68 (41)
Angler hours		219 (178)	427 (240)	499 (270)	540 (278)	1,685 (489)
Angler trips		95 (77)	177 (100)	280 (141)	274 (143)	826 (237)



Table 13.—Total estimated catch and release, catch rate, and angling effort at Monocle Lake, Chippewa County. Period is from May 16 through September 6, 2000. All estimates are given with 2 standard errors in parentheses.

Species	Catch/hour	May 16-31	Jun	Jul	Aug Sep 6	Season
Walleye	0.0469 (0.0667)	0 (0)	3 (7)	12 (17)	64 (108)	79 (110)
Northern pike	0.0362 (0.0260)	2 (4)	12 (17)	14 (22)	33 (29)	61 (40)
Rock bass	0.0326 (0.0391)	1 (3)	3 (6)	36 (61)	15 (17)	55 (64)
Yellow perch	0.2427 (0.1504)	1 (3)	36 (77)	57 (57)	315 (203)	409 (224)
Smallmouth bass	0.0338 (0.0235)	4 (6)	28 (26)	11 (14)	14 (19)	57 (36)
Total catch	0.3923 (0.1932)	8 (8)	82 (84)	130 (89)	441 (233)	661 (263)
Angler hours		219 (178)	427 (240)	499 (270)	540 (278)	1,685 (489)
Angler trips		95 (77)	177 (100)	280 (141)	274 (143)	826 (237)

Table 14.—Total estimated harvest, harvest rate, catch and release, catch rate, and angling effort for 10 Southern Michigan rainbow trout lakes. All estimates are given with 2 standard errors in parentheses.

Lake	Rainbow trout				Angler	
	Harvest	Harvest/hour	Catch and release	Catch/hour	hours	trips
Allens	0 (0)	0.0000 (0.0000)	29 (65)	0.0200 (0.0462)	1,447 (779)	354 (241)
Bird	1,077 (600)	0.7804 (0.5329)	518 (563)	0.3754 (0.4341)	1,380 (545)	409 (174)
Cary	11 (13)	0.0430 (0.0576)	0 (0)	0.0000 (0.0000)	256 (162)	49 (32)
Deep	231 (174)	0.5718 (0.5331)	0 (0)	0.0000 (0.0000)	404 (222)	92 (60)
Swains	854 (467)	1.1237 (0.8024)	708 (667)	0.9316 (0.9763)	760 (349)	262 (129)
Farwell	1,226 (1,091)	1.1405 (1.2354)	276 (404)	0.2567 (0.4079)	1,075 (664)	385 (265)
Gilead	421 (149)	0.8789 (0.4303)	3 (6)	0.0063 (0.0127)	479 (162)	109 (41)
Bear	280 (298)	1.0000 (1.2030)	56 (81)	0.2000 (0.3103)	280 (157)	90 (58)
Lavine	46 (69)	0.3067 (0.5729)	0 (0)	0.0000 (0.0000)	150 (167)	29 (32)
Lee	0 (0)	0.0000 (0.0000)	0 (0)	0.0000 (0.0000)	1,004 (491)	186 (121)

Table 15.—Total estimated harvest, catch rate, and angling effort at Au Sable River, Section 255, Alcona and Iosco counties. Period is from May 20 through September 30, 1999. Two standard errors are given in parentheses.

Species	Catch/Hour	May 20-31	June	July	August	September	Season
Walleye	0.0172 (0.0207)	0 (0)	85 (226)	40 (54)	85 (124)	15 (35)	225 (266)
Rock bass	0.1100 (0.0769)	0 (0)	168 (240)	258 (291)	674 (639)	341 (588)	1,441 (947)
Yellow perch	0.0014 (0.0041)	18 (52)	0 (0)	0 (0)	0 (0)	0 (0)	18 (52)
Smallmouth bass	0.0353 (0.0376)	0 (0)	144 (268)	23 (49)	132 (238)	163 (316)	462 (480)
Brown trout	0.0022 (0.0044)	0 (0)	0 (0)	5 (11)	24 (57)	0 (0)	29 (58)
Rainbow trout	0.2903 (0.1572)	0 (0)	2,362 (1,595)	1,281 (900)	148 (239)	10 (19)	3,801 (1,847)
Brook trout	0.0023 (0.0047)	0 (0)	30 (61)	0 (0)	0 (0)	0 (0)	30 (61)
Bluegill	0.0668 (0.0616)	0 (0)	128 (208)	380 (576)	367 (482)	0 (0)	875 (779)
Redhorse spp.	0.0063 (0.0167)	0 (0)	82 (217)	0 (0)	0 (0)	0 (0)	82 (217)
Crappie sp.	0.0036 (0.0039)	0 (0)	0 (0)	0 (0)	47 (49)	0 (0)	47 (49)
Total harvest	0.5353 (0.2172)	18 (52)	2,999 (1,679)	1,987 (1,110)	1,477 (881)	529 (669)	7,010 (2,297)
Angler hours		1,301 (628)	3,157 (1,778)	4,133 (1,925)	2,708 (1,496)	1,796 (564)	13,095 (3,133)
Angler trips		249 (121)	1,100 (557)	1,481 (820)	769 (416)	829 (287)	4,428 (1,119)

Table 16.—Total estimated catch and release, catch rate, and angling effort at Au Sable River, Section 255, Alcona and Iosco counties. Period is from May 20 through September 30, 1999. Two standard errors are given in parentheses.

Species	Catch/Hour	May 20-31	June	July	August	September	Season
Walleye	0.0674 (0.0459)	9 (13)	30 (61)	433 (425)	348 (350)	63 (102)	883 (563)
Northern pike	0.0021 (0.0031)	2 (5)	0 (0)	17 (37)	9 (18)	0 (0)	28 (41)
Rock bass	0.3044 (0.1495)	36 (103)	412 (494)	1,011 (814)	1,573 (1,284)	954 (597)	3,986 (1,709)
Largemouth bass	0.0102 (0.0101)	30 (50)	34 (74)	35 (74)	35 (56)	0 (0)	134 (129)
Smallmouth bass	0.5111 (0.2390)	304 (527)	503 (516)	1,327 (769)	3,058 (2,201)	1,501 (1,119)	6,693 (2,689)
Rainbow trout	0.0747 (0.0433)	22 (37)	472 (418)	308 (222)	130 (171)	46 (108)	978 (516)
Brook trout	0.0053 (0.0101)	4 (9)	0 (0)	0 (0)	0 (0)	65 (130)	69 (130)
Bluegill	0.1197 (0.0794)	0 (0)	67 (134)	332 (316)	636 (784)	532 (457)	1,567 (970)
Sunfish spp.	0.0061 (0.0128)	0 (0)	0 (0)	0 (0)	80 (167)	0 (0)	80 (167)
White sucker	0.0075 (0.0103)	2 (5)	30 (61)	0 (0)	66 (118)	0 (0)	98 (133)
Redhorse spp.	0.0102 (0.0122)	0 (0)	27 (90)	52 (74)	54 (103)	0 (0)	133 (156)
Crappie sp.	0.0026 (0.0052)	0 (0)	34 (68)	0 (0)	0 (0)	0 (0)	34 (68)
Bullhead spp.	0.0005 (0.0010)	0 (0)	0 (0)	7 (14)	0 (0)	0 (0)	7 (14)
Total catch	1.1218 (0.3752)	409 (541)	1,609 (854)	3,522 (1,263)	5,989 (2,705)	3,161 (1,362)	14,690 (3,434)
Angler hours		1,301 (628)	3,157 (1,778)	4,133 (1,925)	2,708 (1,496)	1,796 (564)	13,095 (3,133)
Angler trips		249 (121)	1,100 (557)	1,481 (820)	769 (416)	829 (287)	4,428 (1,119)

Table 17.—Total estimated harvest, catch rate, and angling effort at Au Sable River, Section 256, Iosco County. Period is from May 20 through September 30, 1999. Two standard errors are given in parentheses.

Species	Catch/Hour	May 20-31	June	July	August	September	Season
Walleye	0.0152 (0.0320)	0 (0)	0 (0)	37 (76)	0 (0)	0 (0)	37 (76)
Angler hours		328 (243)	706 (751)	431 (446)	910 (660)	53 (105)	2,428 (1,126)
Angler trips		84 (60)	99 (110)	64 (72)	334 (281)	7 (15)	588 (316)

Table 18.—Total estimated catch and release, catch rate, and angling effort at Au Sable River, Section 256, Iosco County. Period is from May 20 through September 30, 1999. Two standard errors are given in parentheses.

Species	Catch/Hour	May 20-31	June	July	August	September	Season
Walleye	0.0881 (0.1589)	0 (0)	0 (0)	45 (90)	169 (362)	0 (0)	214 (373)
Smallmouth bass	0.0630 (0.0983)	0 (0)	0 (0)	97 (193)	56 (121)	0 (0)	153 (228)
Total catch	0.1512 (0.1932)	0 (0)	0 (0)	142 (213)	225 (382)	0 (0)	367 (437)
Angler hours		328 (243)	706 (751)	431 (446)	910 (660)	53 (105)	2,428 (1,126)
Angler trips		84 (60)	99 (110)	64 (72)	334 (281)	7 (15)	588 (316)

Table 19.—Total estimated harvest, catch rate, and angling effort at Au Sable River, Section 257 – Loud Impoundment, Iosco County. Period is from May 20 through September 30, 1999. Two standard errors are given in parentheses.

Species	Catch/Hour	May 20-31	June	July	August	September	Season
Walleye	0.0147 (0.0122)	5 (11)	0 (0)	103 (79)	26 (57)	46 (104)	180 (143)
Northern pike	0.0036 (0.0041)	25 (40)	0 (0)	19 (28)	0 (0)	0 (0)	44 (49)
Rock bass	0.0264 (0.0271)	0 (0)	0 (0)	51 (75)	271 (312)	0 (0)	322 (321)
Yellow perch	0.0769 (0.0463)	41 (54)	0 (0)	625 (461)	227 (217)	46 (84)	939 (519)
Largemouth bass	0.0007 (0.0015)	0 (0)	0 (0)	8 (17)	0 (0)	0 (0)	8 (17)
Smallmouth bass	0.0032 (0.0041)	0 (0)	0 (0)	0 (0)	24 (35)	15 (34)	39 (49)
Rainbow trout	0.0020 (0.0029)	0 (0)	0 (0)	0 (0)	24 (34)	0 (0)	24 (34)
Bluegill	0.3133 (0.1883)	218 (275)	739 (1,202)	916 (578)	1,785 (1,603)	170 (198)	3,828 (2,113)
Sunfish spp.	0.0135 (0.0151)	10 (21)	0 (0)	115 (159)	40 (81)	0 (0)	165 (180)
White sucker	0.0020 (0.0042)	25 (52)	0 (0)	0 (0)	0 (0)	0 (0)	25 (52)
Redhorse spp.	0.0017 (0.0036)	0 (0)	0 (0)	21 (44)	0 (0)	0 (0)	21 (44)
Total harvest	0.4580 (0.2113)	324 (289)	739 (1,202)	1,858 (766)	2,397 (1,651)	277 (241)	5,595 (2,213)
Angler hours		558 (365)	2,558 (1,461)	3,310 (1,210)	4,082 (1,725)	1,709 (1,311)	12,217 (2,903)
Angler trips		116 (78)	644 (407)	645 (239)	987 (474)	549 (423)	2,941 (795)

Table 20.—Total estimated catch and release, catch rate, and angling effort at Au Sable River, Section 257 – Loud Impoundment, Iosco County. Period is from May 20 through September 30, 1999. Two standard errors are given in parentheses.

Species	Catch/Hour	May 20-31	June	July	August	September	Season
Walleye	0.0228 (0.0156)	10 (15)	49 (106)	97 (86)	91 (91)	31 (70)	278 (179)
Northern pike	0.0405 (0.0258)	137 (220)	46 (91)	162 (114)	89 (85)	61 (93)	495 (292)
Rock bass	0.0661 (0.0605)	81 (100)	49 (108)	105 (104)	457 (660)	116 (205)	808 (714)
Yellow perch	0.0670 (0.0405)	30 (63)	241 (280)	116 (107)	192 (166)	239 (291)	818 (454)
Largemouth bass	0.0165 (0.0199)	15 (32)	145 (231)	42 (53)	0 (0)	0 (0)	202 (239)
Smallmouth bass	0.1193 (0.0556)	116 (124)	49 (106)	496 (288)	631 (438)	166 (200)	1,458 (584)
Brown trout	0.0004 (0.0009)	5 (11)	0 (0)	0 (0)	0 (0)	0 (0)	5 (11)
Bluegill	0.2907 (0.2000)	137 (239)	1,568 (1,823)	474 (410)	1,220 (1,283)	153 (255)	3,552 (2,293)
Sunfish sp.	0.0043 (0.0052)	0 (0)	0 (0)	17 (34)	32 (52)	4 (13)	53 (63)
White sucker	0.0020 (0.0031)	0 (0)	0 (0)	17 (34)	8 (16)	0 (0)	25 (38)
Redhorse spp.	0.0019 (0.0032)	0 (0)	0 (0)	0 (0)	8 (16)	15 (35)	23 (38)
Crappie sp.	0.0014 (0.0028)	0 (0)	0 (0)	17 (34)	0 (0)	0 (0)	17 (34)
Carp	0.0004 (0.0008)	5 (10)	0 (0)	0 (0)	0 (0)	0 (0)	5 (10)
Bullhead spp.	0.0007 (0.0014)	0 (0)	0 (0)	0 (0)	8 (16)	0 (0)	8 (16)
Total catch	0.6341 (0.2574)	536 (369)	2,147 (1,870)	1,543 (548)	2,736 (1,523)	785 (497)	7,747 (2,549)
Angler hours		558 (365)	2,558 (1,461)	3,310 (1,210)	4,082 (1,725)	1,709 (1,311)	12,217 (2,903)
Angler trips		116 (78)	644 (407)	645 (239)	987 (474)	549 (423)	2,941 (795)