

STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-81-R-3

Study No.: 646

Title: Inland creel surveys

Period Covered: October 1, 2001 to September 30, 2002

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: Surveys were conducted on lakes: Burt, Cisco-Thousand Island chain, Crooked and Pickerel, Gull, Higgins, Houghton, Leelanau, Michigamme, Muskallonge, Muskegon; and on rivers: Au Sable (Foote Impoundment), Buck, Coldwater, Upper Grand, Lower Grand, Rogue, and Sucker. Location (county) and survey period dates are given in Table 1. All lake and river sites were surveyed to estimate angling pressure, harvest, and catch by species. In addition, Burt, Cisco-Thousand Island chain, Crooked and Pickerel, Houghton, Leelanau, Michigamme, and Muskegon lakes were surveyed to evaluate the walleye fishery. Gull and Higgins lakes, Buck, Coldwater, Upper Grand, Lower Grand, Rogue, and Sucker rivers were surveyed to evaluate the trout fishery. The Au Sable River (Foote Impoundment) was surveyed to monitor the fishery in general.

Effort and catch estimates were calculated for summer 2001 fisheries on Houghton Lake and Michigamme Reservoir, and winter 2002 fisheries on Houghton Lake.

Findings: Jobs 1, 2, 3, 4, 5, 6, and 7 were scheduled for 2001-02, and progress is reported below.

Job 1. Title: Examine creel survey sites.—Burt, Crooked, Pickerel, Houghton, Higgins and Michigamme lakes were examined during the previous segment (Lockwood 2001). Air flights were completed to field test counting techniques on Cisco-Thousand Island Chain of Lakes and Lake Leelanau. Global Positioning System (GPS) coordinates for flight paths and section boundaries are presented in Figures 1 and 2. Field personnel examined lake survey sites: Muskegon, Gull, and Muskallonge; and river survey sites: Au Sable, Buck, Coldwater, Upper Grand, Lower Grand, Manistee, and Sucker. Each site sampled during current segment was examined to determine appropriate locations for counting and interviewing anglers, and appropriate angler counting and interviewing methods.

For counting and interviewing, three of the current lakes were stratified into grids. The Cisco-Thousand Island Chain of Lakes was stratified into 10 grids (Figure 3), Lake Leelanau was stratified into 2 grids (Figure 2), and Muskegon Lake was stratified into 3 grids (Figure 4).

Job 2. Title: Sampling intensity, techniques, and proposed level of statistical significance.—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 ± 2 SE.

Design and estimation methods used for surveys given in this report followed the multiple-day period (Lockwood et al. 1999). Survey planning in each instance followed general funding and supervisory procedures given in Lockwood (2000a). Survey design naming conventions follow those given Lockwood (2000b).

Burt Lake, winter 2002—Survey followed a progressive-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. The clerk followed a randomized count and interview schedule. One of two shifts was selected each sample day (Table 2). Either section 201 or section 202 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 4 through March 31, 2002. Months will be estimated separately.

Crooked and Pickerel lakes, winter 2002—Survey followed a progressive-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 2). Clerk's time was split between Crooked and Pickerel lakes, and only 1 lake was selected for sampling each day (Figure 6). 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 4 through March 31, 2002. Lakes and months will be estimated separately.

Higgins Lake, winter 2002—Survey followed a progressive-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 three shifts was selected each sample day (Table 3). Either section 270 or section 271 was sampled each day (Figure 7). 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 4 through March 31, 2002. Months will be estimated separately.

Houghton Lake, winter 2002—Survey followed a progressive-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 4). One of the lake's 4 sections was sampled each day (Figure 8). 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 divided into two major sampling periods, January 4 through February 14 and February 15 through March 31, 2002. Each period was further stratified by day type (weekday or weekend day). Estimates will be by major sampling period.

Michigamme Reservoir, winter 2002—Survey followed a progressive-roving design. Partial funding for this project was provided by Wisconsin Electric. This funding covered data collection (creel clerk). Fisheries Division provided survey design, scheduling, data processing, equipment, fuel, and clerk guidelines. One clerk working from a snowmobile collected angler

count and interview data. Count starting location and direction were randomized (Figure 9). Time of count was randomized to cover sample period. Instantaneous counts (one each) of occupied shanties and open ice anglers were made per day. 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. 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. Survey period is from January 4 through February 28, 2002. Months will be estimated separately.

Cisco–Thousand Island Chain of Lakes, summer 2002—Survey followed an aerial-roving design. All funding was provided through Fisheries Division. Two clerks working from boats collected angler interview data. Chain of lakes was stratified into 10 lake-sampling units (Figure 3). Counts progressed along a flight path from Cisco Lake to Record Lake or from Record Lake to Cisco Lake (Figure 1). Flight took approximately 16 min to complete. This sequence was randomized. Time of count was randomized to cover sample period. Only fishing boats were counted. 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 6). One clerk was assigned to interview anglers on lakes: Cisco, Lindsley and Fishhawk, Thousand Island, and Little and Big African and Record. The other clerk was assigned to interview anglers on lakes: Big, West Bay, East Bay, Mamie Belle, Indian, and Poor. Starting location (lake) and direction of travel with their assigned lakes was randomized each sample day. Survey period is from May 4 through October 31. Estimates will be by month for each lake sampling unit.

Lake Leelanau, summer 2002—Survey followed an aerial-roving design. All funding was provided through Fisheries Division. One clerk working from a boat collected angler interview data. Lake was divided into North Lake Leelanau and South Lake Leelanau. Counts progressed from North Lake Leelanau to South Lake Leelanau or from South Lake Leelanau to North Lake Leelanau (see flight path – Figure 2). This sequence was randomized. Only fishing boats were counted. Flight time was approximately 12 min. Time of count was randomized to cover daylight times within the sample period. 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 6). Each sample day the clerk was randomly assigned to start at GPS marker 1 and interview anglers while traveling to GPS marker 10, or from GPS marker 10 to GPS marker 1 (Figure 2). Survey period is from April 27 through September 30, 2002. Estimates will be by month for each lake.

Muskegon Lake, summer 2002—Survey followed a progressive-access design. All funding was provided through Fisheries Division. One clerk working from a boat collected angler count and interview data. Lake was divided into three grids (Figure 4): lake proper, channel, and pier area. Counts progressed along count path from markers 1-12 (lake proper) then from 12-13 (channel), and then from 13-14 (pier area); or from markers 14-13 then from 13-12, and then 12-1. This sequence was randomized. Fishing boats were counted within the lake proper, channel and the pier area. Shore anglers were counted along lake proper and channel. Time of count was randomized to cover daylight times and night times to 2330 h within the sample period. 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 was made per day. One of three shifts was selected each sample day (Table 7). Each sample day the clerk was randomly assigned three locations to

collect interview data (Figure 4): Fisherman's Landing, Hartshorne Marina, Lakeside, Cottage Grove, Channel, Snug Harbor. While at the Channel, only roving interviews of shore anglers were collected. At all other locations, the clerk collected access boat and shore party interviews. Anglers fishing from the piers were not interviewed, boat anglers fishing within the pier area were interviewed upon their return to the access locations previously mentioned. When not counting, the clerk's day was divided approximately equally between the assigned interviewing locations. Survey period is from April 27 through November 30, 2002. Estimates will be by month for each grid.

Gull Lake, summer 2002—Survey followed a progressive-roving design. All funding was provided through Fisheries Division. Survey was done in conjunction with the Upper Grand River angler survey. One clerk working from a boat collected angler count and interview data. Counts began from one of two starting locations: Kellogg Biological Station (approximate middle of east shore) and the country club (approximate middle of west shore). Starting location and direction (clockwise or counter clockwise) from starting location were randomized. Time of count was randomized to cover times within the sample period. One instantaneous count of fishing boats was made per day. Both weekend days and 2 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. One of 2-3 shifts (depending on month) was selected each sample day (Table 8). All interviewing began at the north end of the lake. Direction of travel, clockwise or counter clockwise, was chose randomly. Survey period was from April 27 through August 31, 2002. Months will be estimated separately.

Muskallonge Lake, summer 2002—Survey followed a roving-access design. All funding was provided through Fisheries Division. One clerk made instantaneous counts, from the camp ground, of fishing boats on the lake. This clerk was also used on the Sucker River angler survey and at the Grand Marais Great Lakes angler survey. Clerked worked half time at Muskallonge Lake and alternated 2 and 3 days per week on this survey. Counting and interviewing were done from a vehicle. Time of count was randomized to cover times within sample period. Two instantaneous counts of fishing boats were made per day. One weekend day and 1-2 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. One of two shifts was selected each sample day (Table 9). Angling parties were interviewed as they returned to the launch site. Survey period was from May 18 through September 30, 2002. Months will be estimated separately.

Au Sable River (Foote Impoundment), summer 2002—Survey followed a progressive-roving 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 clerk), data processing, transportation, and supervision of clerk. Fisheries Division provided survey design and scheduling, and is responsible for final estimates. One clerk working from a boat collected angler count and interview data. Each count began from either the upstream or downstream end of the impoundment and progressed to the opposite end. Starting location was randomized. Time of count was randomized to cover times within the sample period. One instantaneous count each of fishing boats, non-fishing boats, and shore anglers was made per day. Both weekend days and 3 randomly selected weekdays were selected for counting and interviewing during each week of the survey season. One holiday within the survey period was selected for sampling (July 4). Counting and interviewing were done on the same days. One of two shifts was selected each sample day (Table 10). No predetermined interviewing route was used. Survey period was from May 8 through September 30, 2002. Months will be estimated separately.

Buck Creek, summer 2002—Survey followed a progressive-roving design. Survey section was from the Grand River (T.6N, R.12W, Sec. 18) to Byron Center Road (84th Street) (T.5N, R.12W, Sec. 14 and 23). All funding was provided by Fisheries Division. Survey was done in conjunction with Coldwater River angler survey and clerk worked one-half time on the Buck Creek angler survey. One clerk working from a vehicle collected angler count and interview data. Clerk worked 1 weekend day and 1-2 week days per week on this survey. Two instantaneous counts of anglers' vehicles parked at bridge crossings and similar access points were made per sample day. Each count began from either the Grand River or Byron Center Road and progressed to the opposite end. Starting location was randomized. Time of count was randomized to cover times within the sample period. No holidays were scheduled for sampling. Counting and interviewing were done on the same days. One of two shifts was selected each sample day (Table 11). No predetermined interviewing route was used. Survey period was from April 27 through August 31, 2002. Months will be estimated separately.

Coldwater River, summer 2002—Survey followed a progressive-roving design. Survey section was from M-43 (T.4N, R.8W, Sec. 5 and 6) to Freeport Ave. bridge (T.5N, R.9W, Sec. 36) and Freeport Ave. bridge to Thornapple River (T.5N, R.10W, Sec. 35). All funding was provided by Fisheries Division. Survey was done in conjunction with the Buck Creek angler survey and clerk worked one-half time on the Coldwater River angler survey. One clerk working from a vehicle collected angler count and interview data. Clerk worked 1 weekend day and 1-2 week days per week on this survey. Two instantaneous counts of anglers' vehicles parked at bridge crossings and similar access points were made per sample day. Each count began from either M-43 or the Thornapple River and progressed to the opposite end. Starting location was randomized. Time of count was randomized to cover times within the sample period. No holidays were scheduled for sampling. Counting and interviewing were done on the same days. One of two shifts was selected each sample day (Table 11). No predetermined interviewing route was used. Survey period was from April 27 through August 31, 2002. Sections and months will be estimated separately.

Upper Grand River, summer 2002—Survey followed a progressive-access design. Two sections were surveyed. Survey sections were: Grand Ledge (T.4N, R.4W, Sec. 2 and 3) to Moores Park (T.4N, R.2W, Sec. 21 – downstream of Martin Luther King Jr. Blvd.), and Lyons (T.7N, R.5W, Sec. 19) to Portland (T.6N, R.5W, Sec. 28). All funding was provided by Fisheries Division. Survey was done in conjunction with the Gull Lake angler survey. One clerk working from a vehicle collected angler count and interview data. Clerk worked 2 weekend days and 3 week days per week during survey period. Only one of the two sections was assigned for counting and interviewing during a sample day and section was chosen randomly. Two instantaneous counts of anglers were made per sample day. All anglers were visible from bridge crossings and access points. Shore and boat anglers were treated as a single mode when counting and interviewing. Each count began from either the upstream or downstream end of a section and progressed to the opposite end. Starting location was randomized. Time of count was randomized to cover times within the sample period. No holidays were scheduled for sampling. Counting and interviewing were done on the same days. One of two shifts was selected each sample day (Table 12). No predetermined interviewing route was used. Survey periods were from March 1 through April 26, 2002 and from September 1 through November 30, 2002. Sections and months will be estimated separately.

Lower Grand River (6th Street Dam area) summer 2002—Survey followed a roving-access design. The 6th Street Dam area is located upstream of highway 196 in Grand Rapids. All funding was provided by Fisheries Division. Survey was done with the Rogue River survey and in conjunction with the Buck Creek and Coldwater River angler surveys. One clerk working from a vehicle collected angler count and interview data. Clerk worked 1 weekend day and 1-2 week

days per week during survey period. Clerk was assigned to work either both of the Rogue River sections or the 6th Street Dam area during a sample day, and selection was made randomly. Two instantaneous counts of individual anglers (shore and wading) were made per sample day. Time of count was randomized to cover times within the sample period. No holidays were scheduled for sampling. Counting and interviewing were done on the same days. One of two shifts was selected each sample day (Table 12). No predetermined interviewing route was used. Survey periods were from March 1 through April 26, 2002 and from September 1 through November 30, 2002. Months will be estimated separately.

Rogue River, summer 2002—Survey followed a progressive-access design. Two sections were surveyed. Survey sections were: Rogue River – 10-Mile Road (T.9N, R.11W, Sec. 32) to Rockford Dam (T.9N, R.11W, Sec. 36); and Rogue River – 10-Mile Road (T.9N, R.11W, Sec. 36) to West River Drive bridge (T.8N, R.11W, Sec. 22). All funding was provided by Fisheries Division. Survey was done with the Lower Grand River survey and in conjunction with the Buck Creek and Coldwater River angler surveys. One clerk working from a vehicle collected angler count and interview data. Clerk worked 1 weekend day and 1-2 week days per week during survey period. Clerk was assigned to work either both of the Rogue River sections or the 6th Street Dam area during a sample day, and selection was made randomly. In the 10-Mile to Rockford Dam section individual anglers (shore and wading) were counted. In the 10-Mile to West River Drive bridge section angler vehicles were counted. Two instantaneous counts were made per sample day. At the Rogue River sites, each count began from either the upstream 10-Mile Road or the downstream West River Road and progressed to the opposite end. Starting location was randomized. Time of count was randomized to cover times within the sample period. No holidays were scheduled for sampling. Counting and interviewing were done on the same days. One of two shifts was selected each sample day (Table 12). No predetermined interviewing route was used. Survey periods were from March 1 through April 26, 2002 and from September 1 through November 30, 2002. Sections and months will be estimated separately.

Manistee River, summer 2002—Survey followed a progressive-access design. Two river sections were surveyed. Survey sections were: Highway 131 bridge (T.24N, R.9W, Sec. 9) to Baxter Road bridge (T.24N, R.10W, Sec. 9), and Baxter Road to Harvey Road bridge (T.24N, R.11W, Sec. 28). All funding was provided by Fisheries Division. Survey was done in conjunction with Great Lakes angler surveys. Two clerks collected count and interview data. Clerks worked 1 weekend day and 1-2 week days per week during survey period. Instantaneous counts were made by boat and both sections were counted each sample day. Order of section counts was randomized and one of two orders was selected: Highway 131 to Baxter Road and then Baxter Road to Harvey Road, or Baxter Road to Harvey Road and then Highway 131 to Baxter Road. One clerk counted anglers while the other interviewed anglers as they exited the river. Shore, wading, and boat anglers were interviewed. All anglers, regardless of mode, were pooled for counts and interviews. Time of count was randomized to cover times within the sample period. No holidays were scheduled for sampling. Counting and interviewing were done on the same days. One of two shifts was selected each sample day (Table 13). No predetermined interviewing route was used. Survey period was from May 14 through September 15, 2002. Sections and months will be estimated separately.

Sucker River, summer 2002—Survey followed a progressive-access design. River surveyed was in T.49N, R.13W, Sec. 12, 13, 14 and 23. All funding was provided by Fisheries Division. Survey was done in conjunction with Great Lakes angler surveys. One clerk collected count and interview data. Clerk worked 1 weekend day and 1-2 week days per week during survey period. Instantaneous counts of anglers' vehicles were made each sample day. Direction of travel when counting was randomized and the clerk traveled either upstream to downstream, or downstream to

upstream. Non-mode specific access party interviews of shore, wading, and boating anglers were collected. Time of count was randomized to cover times within the sample period. No holidays were scheduled for sampling. Counting and interviewing were done on the same days. One of two shifts was selected each sample day (Table 14). No predetermined interviewing route was used. Survey period was from April 17 through May 13, 2002. Estimates will be for a single period.

Job 3. Title: Prepare stratified-random schedules.—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.—A joint, Great Lakes and inland angler surveys, training program was given May 6 and 7, 2002. Management Unit personnel provided additional on-site training for clerks. Written instructions were prepared for Burt, Cisco-Thousand Island Chain, Crooked, Pickerel, Higgins, Houghton, Leelanau, Michigamme, and Muskegon surveys conducted during current segment. Training descriptions for surveys conducted during previous segment are given in Lockwood (2001).

Job 5. Title: Supervise count and interview data processing, and quality control.—Count and interview data from current segment surveys were processed at the Institute for Fisheries Research. Au Sable River (Foote Impoundment) data are being processed by Huron Pines R. C. & D. Council. Additional range checking of all data is done at the Institute for Fisheries Research.

Job 6. Title: Calculate and distribute catch and pressure estimates.—Effort and catch estimates were calculated for summer 2001 fisheries on Houghton Lake and Michigamme Reservoir, and winter 2002 fishery on Houghton Lake.

Houghton Lake, summer 2001—Anglers fished a total of 278,274±26,566 hours (Table 15). A total of 325,148±49,599 fish was harvested. Bluegill were the predominant fish harvested 135,483±29,882, followed by pumpkinseed 103,176±32,028. Anglers harvested 13,486±4,371 walleye.

Houghton Lake, winter 2002—Anglers fished a total of 220,834±74,008 hours (Table 16). A total of 61,139±13,048 fish was harvested. Yellow perch were the predominant fish harvested 19,954±6,702, followed by bluegill 16,754±8,732. Anglers harvested 4,779±1,484 walleye.

Michigamme Reservoir, summer 2001—Anglers fished a total of 34,383±4,638 hours (Table 17). A total of 8,860±1,574 fish was harvested. Yellow perch were the predominant fish harvested 3,127±1,247, followed by walleye 2,102±537.

Job 7. Title: Prepare annual report.—This report was prepared on schedule.

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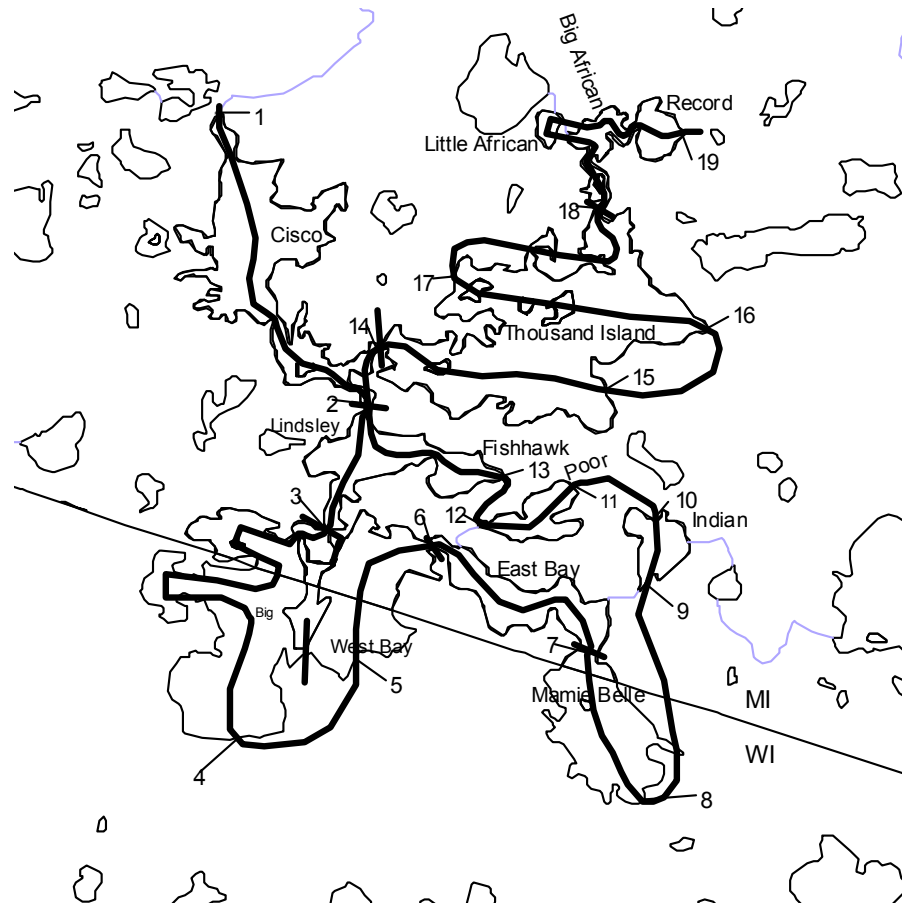
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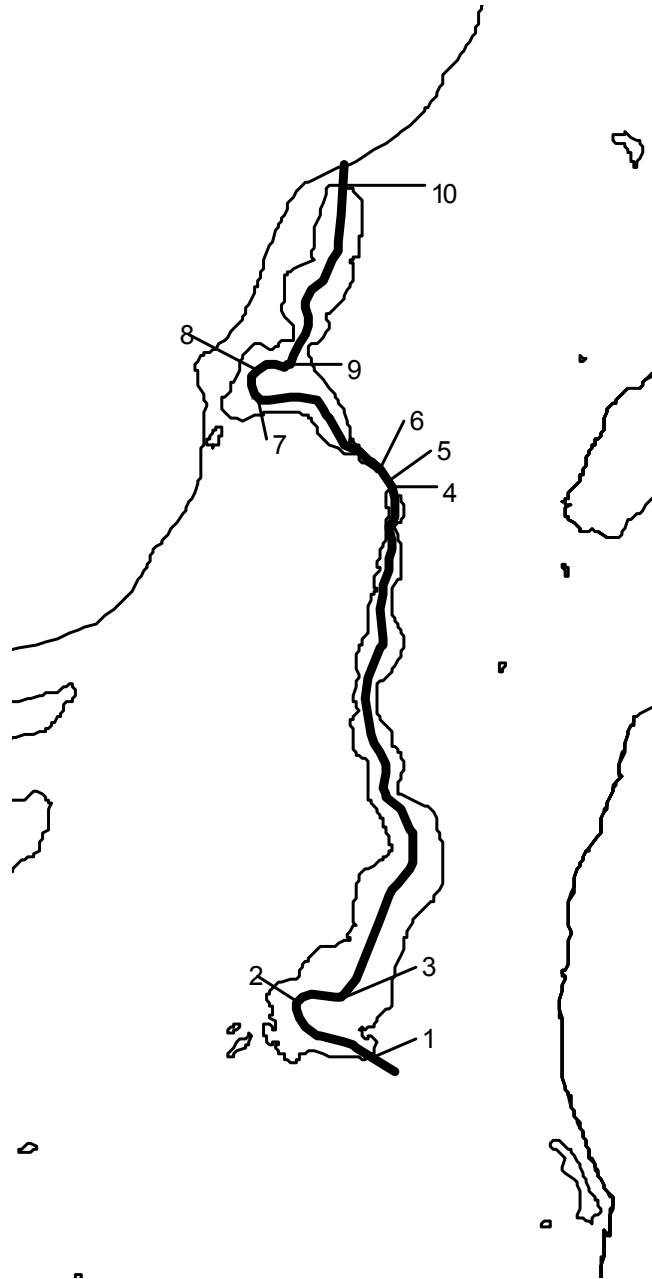
Prepared by: Roger N. Lockwood

Date: September 30, 2002



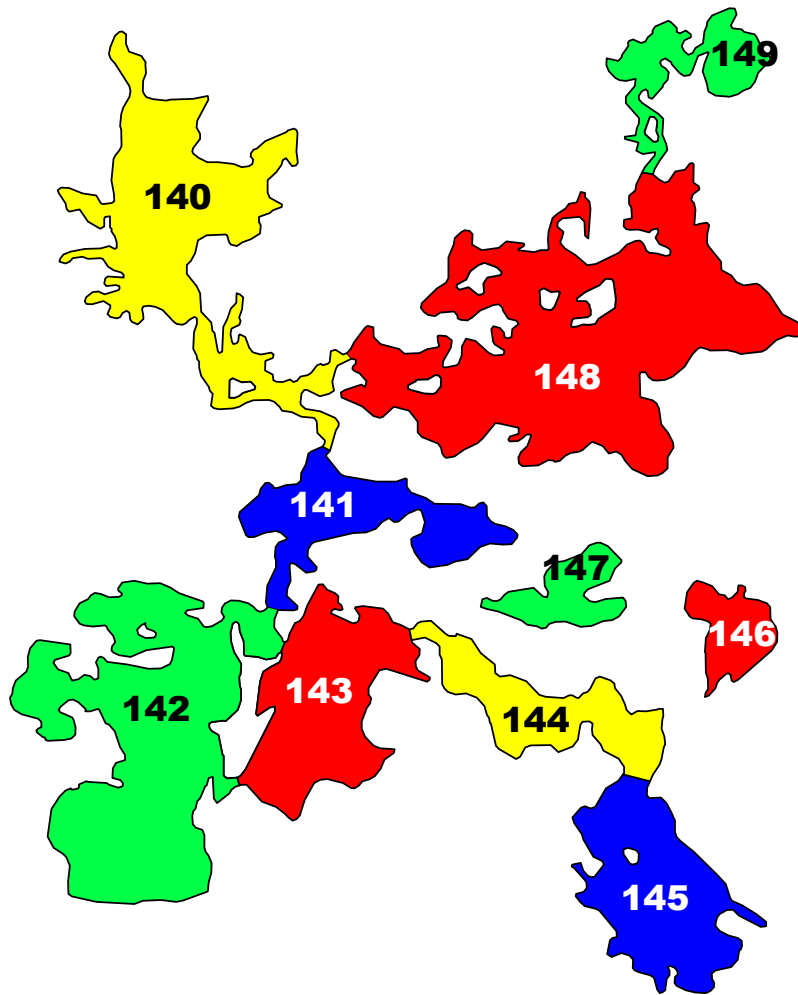
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1	46°15.13'	89°27.14'	11	46°12.95'	89°23.91'
2	46°13.33'	89°25.76'	12	46°12.71'	89°24.72'
3	46°12.93'	89°25.89'	13	46°12.98'	89°24.52'
4	46°11.33'	89°26.74'	14	46°13.76'	89°25.61'
5	46°11.85'	89°25.74'	15	46°13.55'	89°23.65'
6	46°12.55'	89°25.15'	16	46°13.94'	89°22.76'
7	46°11.95'	89°23.70'	17	46°14.19'	89°25.02'
8	46°11.05'	89°23.17'	18	46°14.62'	89°23.78'
9	46°12.41'	89°23.20'	19	46°15.14'	89°23.05'
10	46°12.77'	89°23.16'			

Figure 1.—Cisco-Thousand Island Chain of Lakes map with flight path, markers and GPS latitude-longitude coordinates.



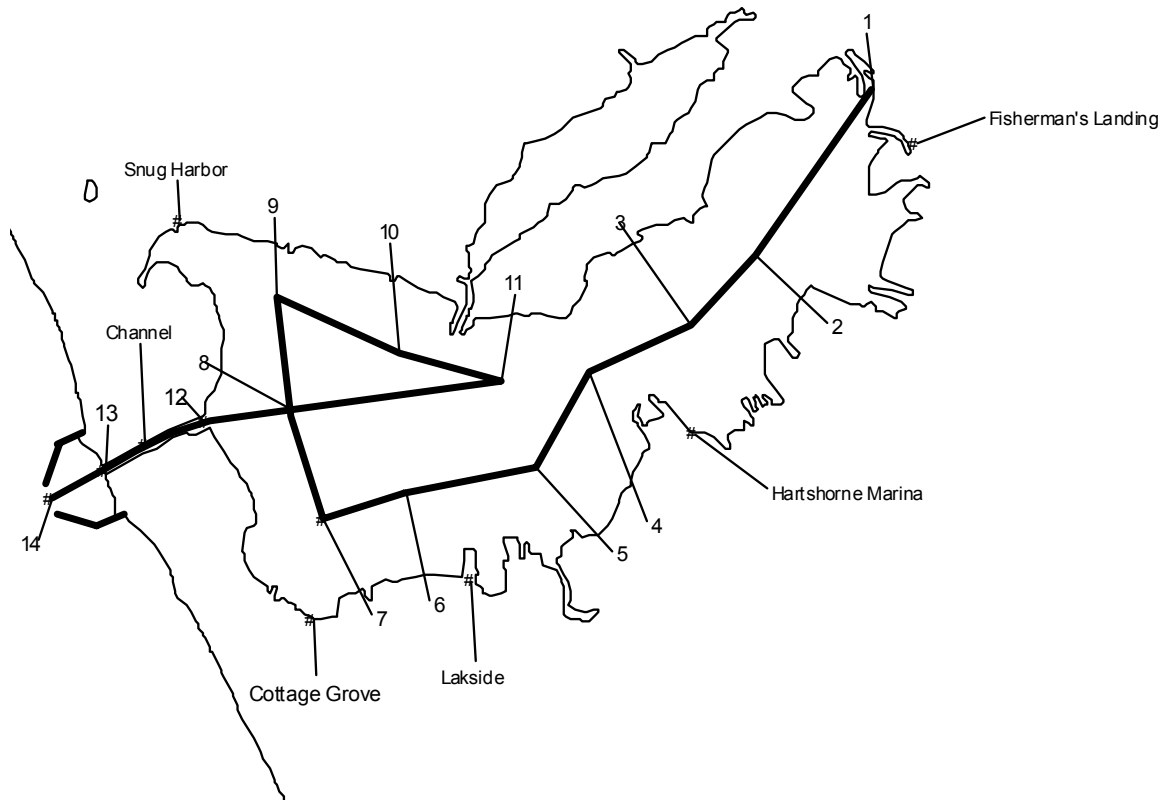
Marker	Latitude	Longitude	Marker	Latitude	Longitude
1	44°50.20'	85°43.13'	6	44°59.03'	85°42.93'
2	44°51.03'	85°44.67'	7	45°00.12'	85°45.53'
3	44°51.08'	85°43.84'	8	45°00.52'	85°45.54'
4	44°58.77'	85°42.64'	9	45°00.60'	85°44.84'
5 Lake separation	44°58.87'	85°42.72'	10	45°03.30'	85°43.66'

Figure 2.—Lake Leelanau map with flight path, markers and GPS latitude-longitude coordinates. Marker 5 is the boundary between North Lake Leelanau and South Lake Leelanau.



Lake name	Lake code
Cisco	140
Lindsley and Fishawk	141
Big	142
West Bay	143
East Bay	144
Mamie Belle	145
Indian	146
Poor	147
Thousand Island	148
Little and Big African, and Record	149

Figure 3.—Lake names and codes for the Cisco-Thousand Island Chain of Lakes angler survey.



Marker	Latitude	Longitude	Marker	Latitude	Longitude
1	43°15.66'N	86°14.88'W	8	43°13.99'N	86°19.05'W
2	43°14.80'N	86°15.72'W	9	43°14.57'N	86°19.16'W
3	43°14.43'N	86°16.19'W	10	43°14.28'N	86°18.27'W
4	43°14.19'N	86°16.92'W	11	43°14.13'N	86°17.54'W
5	43°13.69'N	86°17.30'W	12	43°13.92'N	86°19.66'W
6	43°13.56'N	86°18.23'W	13	43°13.67'N	86°20.39'W
7	43°13.42'N	86°18.82'W	14	43°13.52'N	86°20.76'W

Figure 4.—Muskegon Lake map with count path, markers and GPS latitude-longitude coordinates. Darkened line represents boat used for counting fishing boats. Markers 1-12 are within the lake, 12-13 the channel, and 13-14 the pier area.

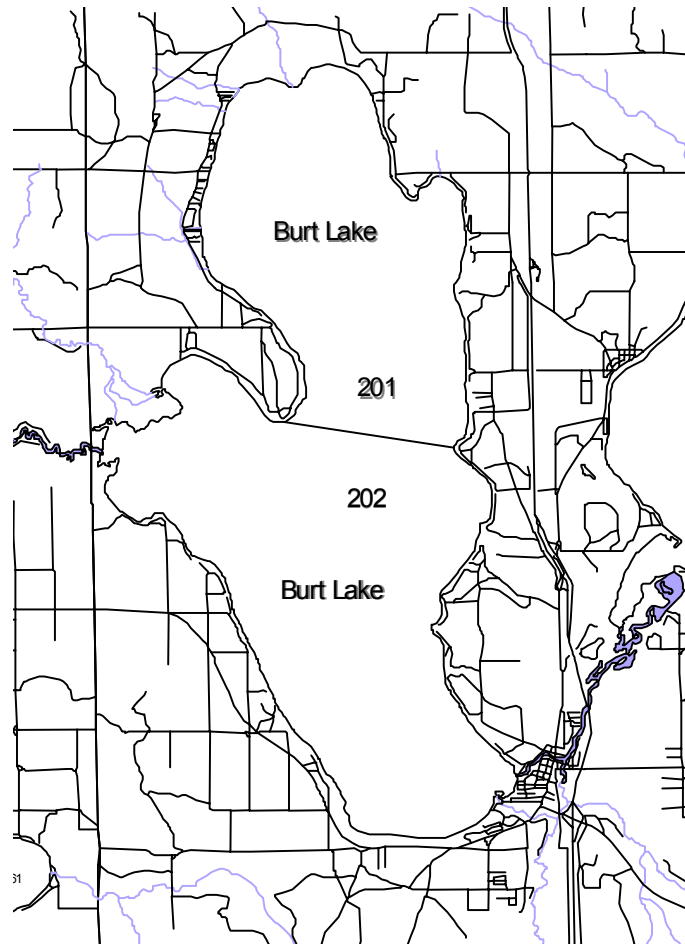


Figure 5.—Burt Lake count and interview grids used during winter 2002 angler survey. Boundary separating grids 201 and 202 extends from 45°28.51'N, 84°40.83'W to 45°28.20'N, 84°38.17'W.

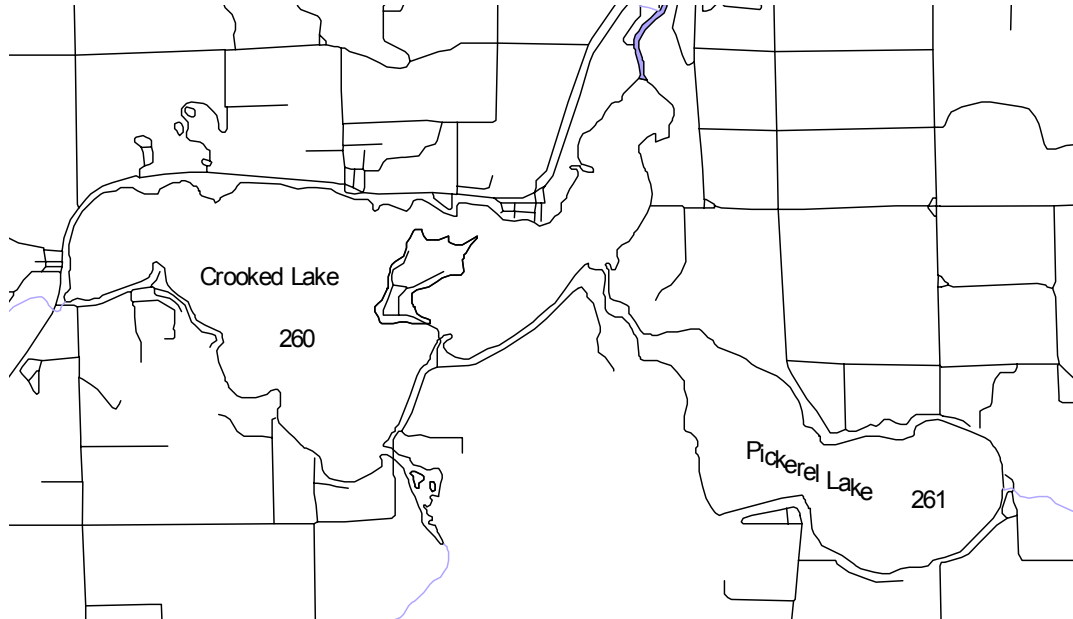


Figure 6.—Crooked and Pickerel lakes. Site codes and boundaries used during winter surveys. Crooked Lake survey area included lake area only, while Pickerel Lake included lake and channel area to shoreline edge of Crooked Lake.

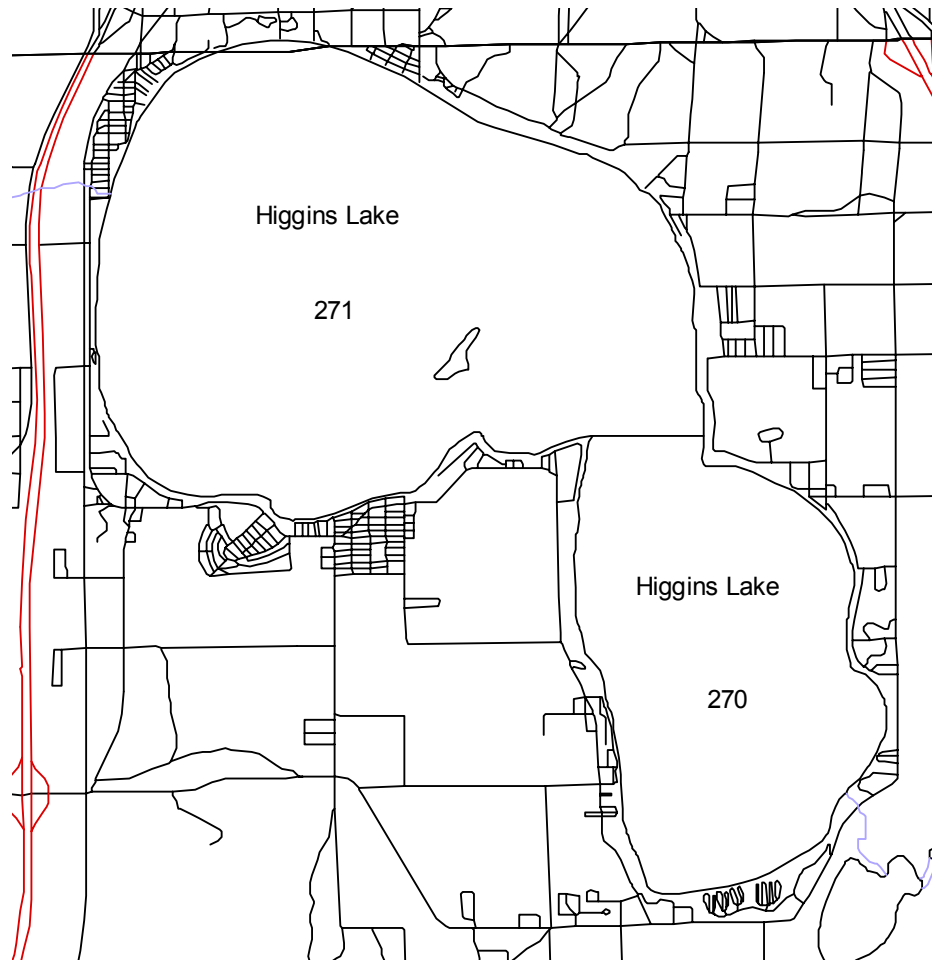
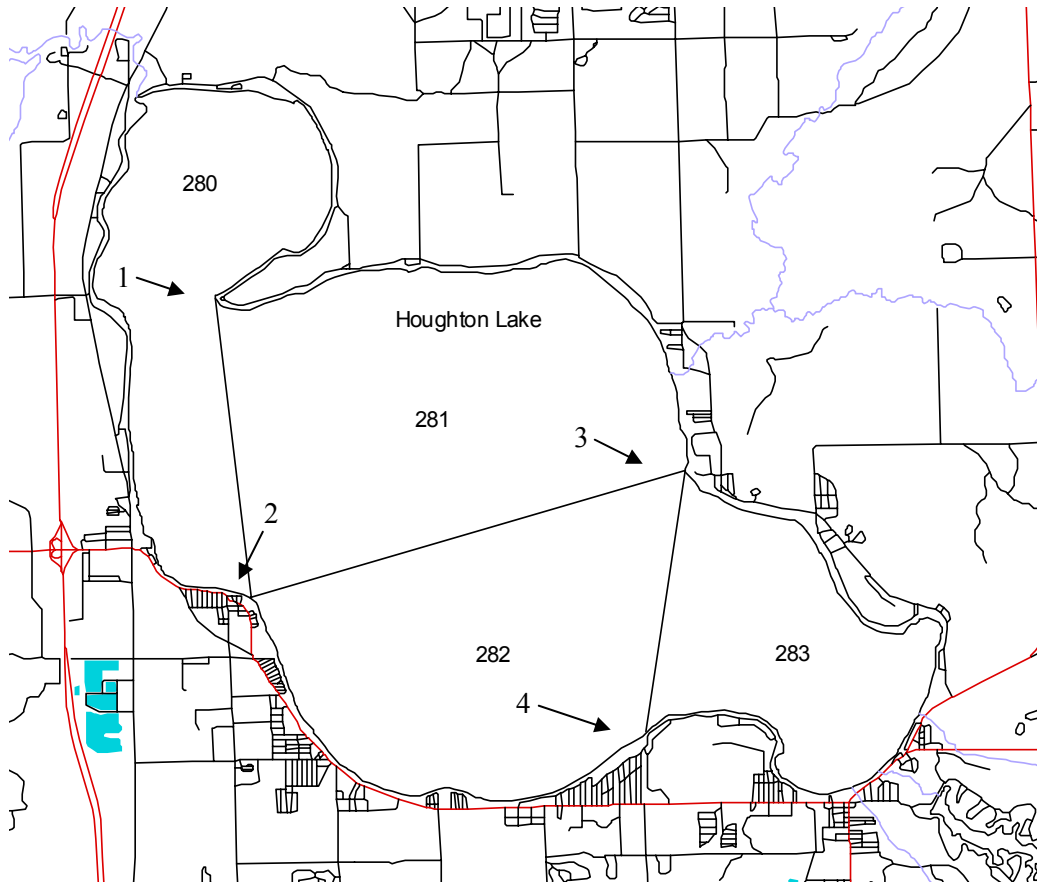
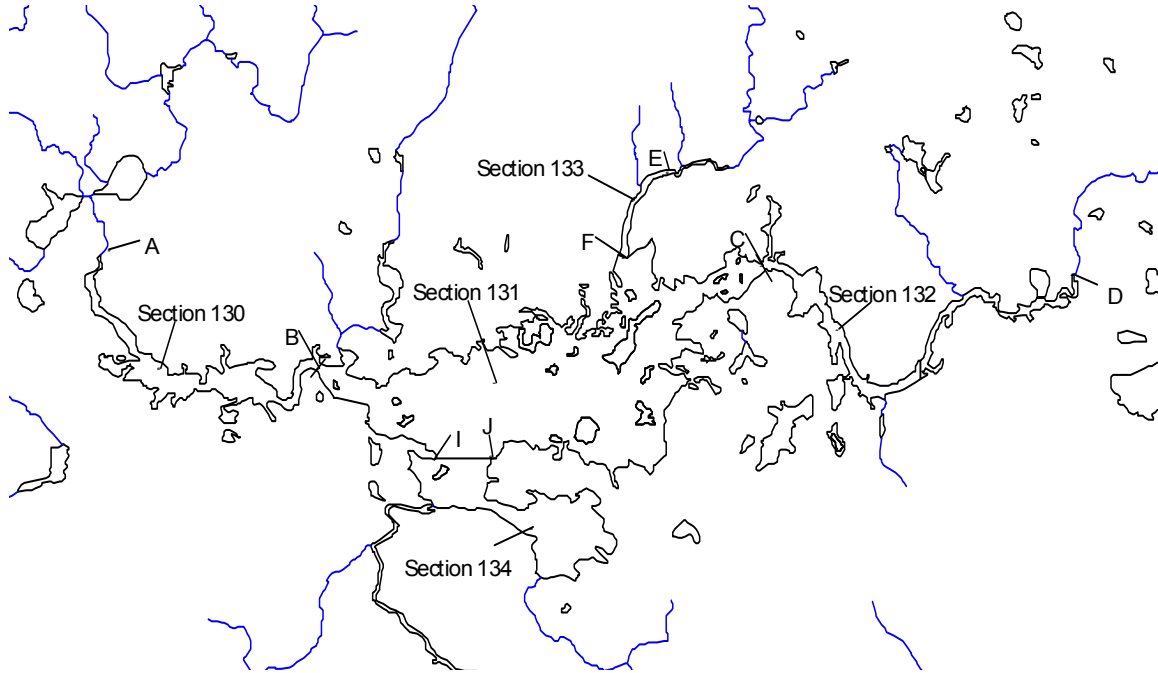


Figure 7.—Higgins Lake count and interview grids used during winter 2002 angler survey. Boundary separating grids 270 and 271 extends from 44°28.27'N, 84°42.44'W to 44°28.07'N, 84°41.49'W.



Marker	Latitude	Longitude	Marker	Latitude	Longitude
1	44°22.24' N	84°46.59' W	3	44°20.74' N	84°40.99' W
2	44°19.69' N	84°46.18' W	4	44°18.53' N	84°41.50' W

Figure 8.—Houghton Lake count and interview grids used during winter 2002 angler survey. Markers indicate grid boundary-line points.



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 section 131-134 boundary	46°10.04' N	88°14.14' W
J – east edge of section 131-134 boundary	46°10.04' N	88°13.33' W

Figure 9.–Michigamme Reservoir count and interview grids, and GPS latitude-longitude coordinates used by creel clerk to distinguish between grids.

Table 1.—Inland creel surveys scheduled and conducted October 1, 2001 through September 30, 2002.

Site	County	Start	End
Lakes			
Burt	Cheboygan	January 4, 2002	March 31, 2002
Cisco, Thousand Island Chain	Gogebic	May 4, 2002	October 31, 2002
Crooked and Pickerel	Emmet	January 4, 2002	March 31, 2002
Gull	Kalamazoo, Barry	April 27, 2002	August 31, 2002
Higgins	Roscommon	January 4, 2002	March 31, 2002
Houghton	Roscommon	January 4, 2002	March 31, 2002
Leelanau	Leelanau	April 27, 2002	September 30, 2002
Michigamme	Iron	January 4, 2002	February 28, 2002
Muskegon	Muskegon	April 27, 2002	November 30, 2002
Muskallonge	Luce	May 18, 2002	September 30, 2002
Rivers			
Au Sable (Foote Impoundment)	Iosco	May 8, 2002	September 30, 2002
Buck	Allegan, Kent	April 27, 2002	August 31, 2002
Coldwater	Barry, Kent	April 27, 2002	August 31, 2002
Upper Grand	Ingham, Ionia	March 1, 2002 September 1, 2002	April 26, 2002 November 30, 2002
Lower Grand	Kent	March 1, 2002 September 1, 2002	April 26, 2002 November 30, 2002
Manistee	Wexford	May 14, 2002	September 15, 2002
Rogue	Kent	March 1, 2002 September 1, 2002	April 26, 2002 November 30, 2002
Sucker	Alger	April 17, 2002	May 13, 2002

Table 2.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Burt (Cheboygan County), Crooked and Pickerel lakes (Emmet County), winter 2002.

Month	Shift		Expansion values
	Early	Late	
January 4-31	0700 h – 1530 h	1100 h – 1930 h	14
February	0700 h – 1530 h	1100 h – 1930 h	14
March	0700 h – 1530 h	1100 h – 1930 h	14

Table 3.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Higgins Lake (Roscommon County), winter 2002.

Month	Shift			Expansion values
	Early	Middle	Late	
January 4–31	0700 h – 1530 h	0900 h – 1730 h	1530 h – 2330 h	18
February	0700 h – 1530 h	0900 h – 1730 h	1530 h – 2330 h	18
March	0700 h – 1530 h	0900 h – 1730 h	1530 h – 2330 h	18

Table 4.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Houghton Lake (Roscommon County), winter 2002.

Month	Shift		Expansion values
	Early	Late	
January 4 – February 14	0700 h – 1530 h	1100 h – 1930 h	14
February 15 – March 31	0700 h – 1530 h	1100 h – 1930 h	14

Table 5.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Michigamme Reservoir (Iron County), winter 2002.

Month	Shift		Expansion values
	Early	Late	
January 4-31	0700 h – 1530 h	1100 h – 1930 h	14
February	0700 h – 1530 h	1100 h – 1930 h	14

Table 6.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Cisco-Thousand Island chain of lakes (Gogebic County) and Lake Leelanau (Leelanau County), summer 2002.

Month	Shift		Expansion values
	Early	Late	
May 15-31	0600 h – 1430 h	1330 h – 2200 h	17
June	0600 h – 1430 h	1330 h – 2200 h	17
July	0600 h – 1430 h	1300 h – 2130 h	17
August	0630 h – 1500 h	1230 h – 2100 h	16
September	0630 h – 1500 h	1200 h – 2030 h	15
October	0630 h – 1500 h	1030 h – 1900 h	14

Table 7.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Muskegon Lake (Muskegon County), summer 2002.

Month	Shift			Expansion values
	Early	Middle	Late	
April 27 - May 31	0600 h – 1430 h	1000 h – 1830 h	1530 h – 2400 h	19
June	0600 h – 1430 h	1000 h – 1830 h	1530 h – 2400 h	19
July	0600 h – 1430 h	1000 h – 1830 h	1530 h – 2400 h	19
August	0600 h – 1430 h	1000 h – 1830 h	1530 h – 2400 h	19
September	0600 h – 1430 h	1000 h – 1830 h	1530 h – 2400 h	19
October	0600 h – 1430 h	1000 h – 1830 h	1530 h – 2400 h	19
November	0600 h – 1430 h	1000 h – 1830 h	1530 h – 2400 h	19

Table 8.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Gull Lake (Kalamazoo and Barry counties), summer 2002.

Month	Shift			Expansion values
	Early	Middle	Late	
April 27 - May 31	0600 h – 1430 h		1330 h – 2200 h	17
June	0600 h – 1430 h	1000 h – 1830 h	1530 h – 2400 h	19
July	0600 h – 1430 h		1300 h – 2130 h	19
August	0630 h – 1500 h		1230 h – 2100 h	16

Table 9.–Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Muskallonge Lake (Luce County), summer 2002.

Month	Shift		Expansion values
	Early	Late	
May 18-31	0600 h – 1430 h	1230 h – 2100 h	16
June	0600 h – 1430 h	1330 h – 2200 h	17
July	0600 h – 1430 h	1430 h – 2300 h	19
August	0630 h – 1500 h	1330 h – 2200 h	17
September	0630 h – 1500 h	1230 h – 2100 h	16

Table 10.–Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Au Sable River - Foote Impoundment (Iosco County), summer 2002.

Month	Shift		Expansion values
	Early	Late	
May 8-31	0600 h – 1430 h	1330 h – 2200 h	17
June	0600 h – 1430 h	1330 h – 2200 h	17
July	0600 h – 1430 h	1300 h – 2130 h	17
August	0630 h – 1500 h	1230 h – 2100 h	16
September	0630 h – 1500 h	1200 h – 2030 h	15

Table 11.–Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Buck Creek (Allegan and Kent counties), and Coldwater River (Barry and Kent counties), summer 2002.

Month	Shift		Expansion values
	Early	Late	
May 8-31	0600 h – 1430 h	1330 h – 2200 h	17
June	0600 h – 1430 h	1330 h – 2200 h	17
July	0600 h – 1430 h	1300 h – 2130 h	17
August	0630 h – 1500 h	1230 h – 2100 h	16

Table 12.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, upper Grand River (Ingham and Ionia counties), lower Grand River (Kent County), and Rogue River (Kent County), summer 2002.

Month	Shift		Expansion values
	Early	Late	
March	0700 h – 1530 h	1100 h – 1930 h	14
April 1-26	0700 h – 1530 h	1200 h – 2030 h	15
September	0700 h – 1530 h	1200 h – 2030 h	15
October	0700 h – 1530 h	1100 h – 1930 h	14
November	0700 h – 1530 h	1000 h – 1830 h	13

Table 13.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Manistee River (Wexford County), summer 2002.

Month	Shift		Expansion values
	Early	Late	
May 14 - 31	0600 h – 1430 h	1230 h – 2100 h	16
June	0700 h – 1530 h	1330 h – 2200 h	17
July	0700 h – 1530 h	1330 h – 2200 h	17
August	0600 h – 1430 h	1230 h – 2100 h	16
September 1-15	0600 h – 1430 h	1130 h – 2000 h	15

Table 14.—Work shifts and expansion values (referred to as “*F*” in Lockwood et al. 1999) used to estimate catch and effort, Sucker River (Alger County), summer 2002.

Month	Shift		Expansion values
	Early	Late	
April 17 – May 13	0800 h – 1630 h	1230 h – 2100 h	13

Table 15.—Total estimated boat angler harvest, catch-and-released fish, catch per hour and fishing pressure, Houghton Lake, Roscommon County. Period is from April 28 through September 30, 2001. Two standard errors are given in parentheses.

Species	Catch/hour	Apr-May	June	July	August	September	Season
Harvested fish							
Smallmouth bass	0.0068 (0.0037)	396 (473)	261 (283)	596 (533)	425 (491)	210 (423)	1,888 (1,004)
Walleye	0.0485 (0.0164)	2,498 (975)	1,249 (570)	4,304 (2,902)	2,301 (1,696)	3,134 (2,556)	13,486 (4,371)
Yellow perch	0.1055 (0.0522)	1,291 (743)	4,147 (2,355)	10,476 (8,950)	11,665 (10,703)	1,759 (1,545)	29,338 (14,253)
Northern pike	0.0059 (0.0063)	191 (139)	208 (226)	807 (1,625)	365 (535)	75 (296)	1,646 (1,756)
Black crappie	0.0625 (0.0508)	2,948 (1,345)	1,562 (794)	2,473 (2,231)	7,344 (12,355)	3,049 (6,098)	17,376 (14,044)
Bluegill	0.4870 (0.1170)	3,935 (1,453)	12,645 (4,669)	67,249 (23,042)	46,311 (16,924)	5,343 (7,189)	135,483 (29,882)
Largemouth bass	0.0012 (0.0011)	0 (0)	211 (250)	56 (22)	0 (0)	73 (151)	340 (293)
Pumpkinseed	0.3709 (0.1204)	969 (565)	7,095 (2,864)	51,539 (22,310)	25,417 (13,304)	18,156 (18,507)	103,176 (32,028)
Rock bass	0.0796 (0.0397)	542 (317)	751 (759)	16,380 (10,431)	4,273 (2,829)	201 (269)	22,147 (10,842)
Common white sucker	0.0010 (0.0019)	0 (0)	0 (0)	0 (0)	268 (534)	0 (0)	268 (534)
Released fish							
Smallmouth bass	0.0041 (0.0034)	30 (14)	284 (248)	289 (415)	0 (0)	543 (810)	1,146 (943)
Largemouth bass	0.0033 (0.0026)	32 (17)	226 (272)	390 (582)	84 (103)	193 (278)	925 (707)
Walleye	0.0057 (0.0047)	0 (0)	0 (0)	0 (0)	1,585 (1,285)	0 (0)	1,585 (1,285)
Northern pike	0.0017 (0.0016)	37 (13)	0 (0)	0 (0)	433 (442)	0 (0)	470 (443)
Total harvest	1.1687 (0.2103)	12,770 (2,466)	28,129 (6,103)	153,880 (35,126)	98,369 (27,245)	32,000 (20,990)	325,148 (49,599)
Total released	0.0148 (0.0066)	99 (25)	510 (367)	679 (713)	2,102 (1,362)	736 (856)	4,126 (1,798)
Total catch	1.1835 (0.2112)	12,869 (2,466)	28,639 (6,115)	154,559 (35,134)	100,471 (27,278)	32,736 (21,008)	329,274 (49,631)
Angler hours		36,135 (8,279)	50,201 (9,742)	115,886 (19,022)	53,155 (10,760)	22,837 (8,041)	278,214 (26,566)
Angler trips		10,633 (3,197)	14,990 (3,367)	54,614 (12,606)	19,417 (7,230)	7,315 (3,236)	106,969 (15,595)

Table 16.—Total estimated harvest, catch-and-released fish, catch per hour and fishing pressure, Houghton Lake, Roscommon County. Period is from January 1 through March 31, 2002. Two standard errors are given in parentheses. Estimates are for open ice and shanty anglers.

Species	Catch/hour	Jan-Feb14	Feb15-Mar	Season
Harvested fish				
Walleye	0.0216 (0.0099)	3,364 (1,262)	1,415 (781)	4,779 (1,484)
Yellow perch	0.0904 (0.0429)	12,972 (5,732)	6,982 (3,474)	19,954 (6,702)
Northern pike	0.0346 (0.0171)	4,729 (1,884)	2,916 (2,028)	7,645 (2,768)
Black crappie	0.0395 (0.0306)	1,704 (925)	7,028 (6,012)	8,732 (6,082)
Bluegill	0.0759 (0.0470)	1,556 (1,382)	15,198 (8,622)	16,754 (8,732)
Pumpkinseed	0.0088 (0.0066)	195 (125)	1,758 (1,293)	1,953 (1,299)
Rock bass	0.0060 (0.0040)	612 (420)	710 (625)	1,322 (753)
Released fish				
Smallmouth bass	0.0001 (0.0002)	15 (41)	0 (0)	15 (41)
Northern pike	0.0101 (0.0089)	77 (46)	2,153 (1,825)	2,230 (1,826)
Total harvest	0.2769 (0.1100)	25,132 (6,398)	36,007 (11,372)	61,139 (13,048)
Total released	0.0102 (0.0089)	92 (61)	2,153 (1,825)	2,245 (1,826)
Total catch	0.2870 (0.1132)	25,224 (6,398)	38,160 (11,517)	63,384 (13,175)
Angler hours		140,065 (53,854)	80,769 (50,763)	220,834 (74,008)
Angler trips		57,962 (22,285)	34,125 (19,820)	92,087 (29,824)

Table 17.—Total estimated boat angler harvest, catch-and-released fish, catch per hour and fishing pressure, Michigamme Reservoir, Iron County. Period is from May 15 through October 14, 2001. Two standard errors are given in parentheses.

Species	Catch/hour	May	June	July	August	Sept-Oct	Season
Harvested fish							
Smallmouth bass	0.0108 (0.0056)	33 (39)	49 (56)	79 (89)	145 (137)	65 (59)	371 (187)
Walleye	0.0611 (0.0177)	423 (227)	502 (301)	602 (334)	289 (140)	286 (123)	2,102 (537)
Yellow perch	0.0909 (0.0383)	91 (80)	597 (477)	715 (419)	504 (298)	1,220 (1,028)	3,127 (1,247)
Northern pike	0.0065 (0.0054)	33 (38)	11 (5)	65 (57)	74 (168)	42 (34)	225 (184)
Black crappie	0.0281 (0.0107)	42 (89)	1 (1)	206 (131)	482 (274)	235 (135)	966 (344)
Bluegill	0.0441 (0.0183)	0 (0)	67 (49)	312 (371)	707 (355)	430 (294)	1,516 (594)
Largemouth bass	0.0001 (0.0000)	0 (0)	0 (0)	0 (0)	0 (0)	3 (1)	3 (1)
Rock bass	0.0154 (0.0095)	12 (25)	41 (54)	211 (246)	202 (180)	65 (74)	531 (320)
Common white sucker	0.0003 (0.0001)	0 (0)	0 (0)	4 (2)	8 (2)	0 (0)	12 (3)
Other	0.0002 (0.0008)	7 (26)	0 (0)	0 (0)	0 (0)	0 (0)	7 (26)
Released fish							
Smallmouth bass	0.0486 (0.0142)	190 (166)	344 (178)	383 (218)	526 (257)	229 (124)	1,672 (434)
Largemouth bass	0.0001 (0.0002)	0 (0)	4 (6)	0 (0)	0 (0)	0 (0)	4 (6)
Walleye	0.2656 (0.0634)	1,470 (763)	1,501 (582)	2,321 (982)	2,236 (784)	1,603 (856)	9,131 (1,798)
Northern pike	0.1624 (0.0507)	658 (353)	1,177 (1,009)	1,051 (500)	1,600 (733)	1,098 (735)	5,584 (1,571)
Musky	<0.0001 (<0.0001)	0 (0)	0 (0)	0 (0)	1 (0)	0 (0)	1 (0)
Total harvest	0.2577 (0.0575)	641 (263)	1,268 (570)	2,194 (715)	2,411 (622)	2,346 (1,089)	8,860 (1,574)
Total released	0.4767 (0.0955)	2,318 (855)	3,026 (1,177)	3,755 (1,123)	4,363 (1,103)	2,930 (1,135)	16,392 (2,425)
Total catch	0.7344 (0.1299)	2,959 (895)	4,294 (1,307)	5,949 (1,331)	6,774 (1,267)	5,276 (1,572)	25,252 (2,891)
Angler hours		5,115 (1,837)	6,411 (2,111)	8,865 (2,632)	7,908 (1,682)	6,084 (1,983)	34,383 (4,638)
Angler trips		2,936 (1,742)	4,391 (1,466)	5,292 (2,244)	5,567 (1,607)	3,866 (2,190)	22,052 (4,195)