Introduction

Chippewa Lake is a 790-acre lake located in Mecosta County. It is located 9 miles east and 3 miles north of Big Rapids. The lake is in the uppermost headwaters of the Chippewa River. Its outlet, Chippewa Creek flows through the Martiny Chain and then becomes the West Branch Chippewa River, eventually flowing into the Tittabawassee River in Midland, then to the Saginaw River and to Saginaw Bay, Lake Huron. The lake has two small inlets, Whaley Creek (from Long Lake) and Wilbur Creek. A MDNRE boating access site with a double concrete ramp and two courtesy piers is maintained on the northeast shore and supports approximately 40 vehicles and trailers, and two additional car only spaces (Eric Fransen, MDNRE, personal communication).

Geology of the area is glacial moraine and till dominated by permeable to moderately permeable soils. The USGS Soil Conservation Service identifies the soils to be various sands, sandy loams, loamy sands, and mucks of mostly low slopes (0 to 6%). Common lowland tree species include green and white ash, basswood, silver and red maple. Buckthorn and tag alder are common in the understory. Upland tree species include red and white oak, white ash, hard maple, red maple, bitternut hickory, and American beech with an understory of witch hazel and juneberry (Peter Kailing, personal communication).

Topography of the area is described as gently rolling hills with low elevation change (slopes generally less than 6%). Land use in the county is categorized as agriculture (58%), range land (8.5%), forested (13.8%), urban (15.1%), water (.5%), wetlands (3.5%), and barren land (.02%).

Residential development is extensive on Chippewa Lake. In August, 2009, a total of 279 dwellings were counted around the perimeter yielding an estimated density of 52 dwellings/mile. Shoreline development was high with an estimated 47% of the shoreline displaying some sort of armoring mostly in the form of steel, wood, or concrete seawalls.

In general, Chippewa Lake is considered a large shallow to medium depth lake with warm temperature characteristics. The percentage of shoal habitat in Chippewa lake is roughly 57%. Aquatic vegetation is the dominant form of aquatic habitat in the littoral zone with a common occurrence of chara, and curly leaf pondweed. Reeds and cattails were common along the shoreline in a few areas. Bottom substrate in the shoals is comprised of sand, fibrous peat, and marl.

Limnological parameters measured in 2009 found characteristics of a mesotrophic lake. Measurements of secchi disk (12 ft.), total phosphorus (0.0337 mg/l), and total chlorophyll-*a* (0. 5 ug/l) yielded a Carlson Trophic Status Index (TSI) of 44. Trophic status parameters collected show Chippewa Lake as a mesotrophic lake (Fuller and Minnerick 2008). Mesotrophic lakes are typically those that have good water quality and medium biological productivity. Lakes in the mesotrophic range are moderately productive, with some chance of hypolimnetic anoxia in summer, and are fully supportive of all water uses. Past TSI measurements for Chippewa Lake in 1998 and 2002 ranked Chippewa Lake as eutrophic (more enriched). Water quality may have improved by 2009. pH ranged from 6.6 in the lower water column to 7.8 at the surface. Alkalinity was 94 mg/l indicating reasonably well buffered water.

Temperature and oxygen profiles taken in August, 2009 were consistent with historical profiles and showed a summer thermocline development near 30 feet (Table 1). In addition, dissolved oxygen concentrations appear fish limiting (<3 mg/l) below the 30 ft. water depth (Table 1).

Historic stocking records indicate that perch and bluegills were stocked in 1930 and 1931, and 1937 to 1939. Bluegill were also stocked in 1941 – 1944. Walleye fry were stocked once in 1930 along with a .

few smallmouth and largemouth bass. Largemouth bass were also stocked from 1938- 1944. Smallmouth bass were stocked in 1943 and 1944. One stocking of walleye spring fingerlings occurred in 1976 which eventually did show up in subsequent surveys. Tiger muskellunge were stocked in 1980.

An early inventory was completed during the summer of 1952. The management focus was on investigating pike movement to their spawning grounds by particularly focusing on the culverts. Some larger culverts were installed as a result. The Mecosta County Rod and Gun Community pike marsh project was developed in 1961.

Netting was conducted in 1987 to collect age growth data. Bluegill, black crappie, yellow perch, largemouth bass, and northern pike were all growing below State average. Four walleyes were collected and these were all aged at 11 years coinciding with the 1976 plant. At this time it was recommended that management in this lake concentrate on establishing a walleye fishery to bolster the predatory base and recreational fishery. Spring fingerling walleye stocking was initiated in 1988 and has occurred for the most part beinnially at rates ranging from 50-100 walleye/acre (Table 2). Most recent stocking rates have been targeting 50 spring fingerling walleye/acre.

Post stocking surveys have shown limited survival of walleye. In 1988, 12 young of the year walleye were captured after night shocking the entire shore perimeter. Walleye growth and survival was moderate. An early spring, 1997 fish community survey was conducted to assess the fish stocking and fish community. Twelve trap nets were used. Nineteen walleye were captured. Six year classes of walleye were present. Species composition appeared similar to the past netting survey. Age growth data in 1997 indicated walleye were growing above State average with a mean growth index (MGI) of +3.5. Bluegill growth was slightly below State average with an MGI of -0.8. Black crappie and pumpkinseed sunfish sizes and growth improved to slightly above State average having an MGI of +0.3 and +0.6 respectively. Northern pike continued to grow slowly as did bass. Another walleye electrofishing evaluation was conducted in 2000. Only one young of the year and fifteen yearling and older were captured. Another evaluation was conducted in 2003. No young of the year walleye were captured and only one adult was seen. This survey was conducted in slightly warmer temperatures than suggested for a Serns evaluation. The low numbers of young of the year captured may indicate reduced survival from the past or Chippewa Lake may not lend itself very well to this type of a sampling technique. Walleye tend to show up as larger fish in subsequent surveys.

Methods and Materials

This survey was conducted as a part of Fisheries Division's Status and Trends Monitoring Program. The Status and Trends Monitoring Program seeks to randomly sample various sized lakes, using similar protocol, to determine trends among lakes at the regional and statewide levels.

Status and Trends protocol incorporates a variety of gear to sample the fish community within a recommended temperature range (55°-80° F). Large mesh trap and fyke nets are used to capture larger (>3 inches) species that inhabit the littoral zone or that move inshore at night. Gill nets are used to sample fishes that occupy offshore waters and are particularly effective at capturing perch, salmonids, and northern pike. Night electrofishing is used to capture all size ranges of species and life stages that inhabit the littoral zone or that move inshore at night. Seining is used to capture representative samples of small-bodied nongame species and smaller size classes (<3 inches) of sport fishes that inhabit the littoral zone. Collectively, the catch from these gears presents a general picture of the overall fish community.

The fish community of Chippewa Lake was sampled May 18-20 with a seine and trap, fyke, and gill nets. Three electrofishing stations were sampled the evening of June 29. Habitat sampling occurred in August.

Results

A total of 2,289 fish representing 26 species were collected in this assessment (Table 3). Night time electroshocking accounted for 39% of the total catch, while trap nets, fyke nets, seine, and gill nets accounted for 27%, 10%, 4%, and 4%, respectively. Bluegill were the most abundant species collected comprising 38.6% of the total catch. Yellow and Brown bullhead comprised 22% of the catch, pumpkinseed 8%, bluntnose minnow 9%, largemouth bass 3%, bowfin 3%, northern pike 3%, rock bass 3 %, black crappie 1%, and yellow perch 6%. Species caught in lesser abundance included largemouth bass, walleye, smallmouth bass, banded killifish, blacknose shiner, carp, white sucker, golden redhorse, silver redhorse, longnose gar, logperch, central mudminnow, johnny darter, Iowa darter, tadpole madtom, and warmouth.

A total of 875 bluegill averaging 3.5inches were collected with all survey gear (Table 3). Night electrofishing accounted for 64% of the total catch and trap and fyke nets accounted for 8.8% of the total catch. Average size of the electrofishing catch was 3.1 inches compared to 6.7 inches for the trap and fyke net catch. Less than one percent of the electrofishing catch met or exceeded the acceptable harvest size of 6 inches compared to 75% of the trap and fyke net catch. Age and growth analysis indicated bluegill were growing below State average having a mean growth index of -1.2. Multiple year classes (ages 1-10) were found suggesting acceptable recruitment to the harvestable fishery.

A total of 97 yellow bullheads averaging 12.7 inches and 407 black bullheads averaging 10.3 inches were collected in this assessment (Table 3). Ninety-eight percent of the total bullhead catch was captured with large mesh trap and fyke net gear. Ninety-nine percent of the bullhead catch met or exceeded the acceptable harvest size of 7 inches. Age and growth analysis was not conducted for these species.

A total of 185 pumpkinseed sunfish averaging 5.1 inches were collected (Table 3). Night electrofishing accounted for 55% of the total catch and trap and fyke nets accounted for 36% of the total catch. Less than 1 percent of the electrofishing catch met or exceeded the acceptable harvest size of 6 inches compared to 8.6% of the trap and fyke net catch. Age and growth analysis indicated pumpkinseed sunfish were growing near State average having a mean growth index of -0.1. Multiple year classes (ages 2-9) were found suggesting acceptable recruitment into the harvestable fishery.

A total of 124 yellow perch averaging 4.6 inches were collected (Table 3). Night electroshocking accounted for 98% of the total catch and Maxi-mini nets, seining and gillnetting accounted for 2% of the total catch. Less than one percent of the electrofishing catch met or exceeded the acceptable harvest size of 7 inches. Age and growth analysis indicated yellow perch were growing slightly below State average having a mean growth index of -0.2.

A total of 56 rock bass averaging 7.1 inches were collected (Table 3). Trap and fyke nets accounted for 52% of the total catch. Sixty-eight percent of the rock bass collected met or exceeded the acceptable harvest size of 6 inches. Age and growth analysis indicated rock bass were growing somewhat below State average having a mean growth index of -0.3. Multiple year classes were found (ages 1-11) suggesting acceptable recruitment into the harvestable fishery.

Twenty seven black crappie were captured averaging 8.1 inches (Table 3). Trap and fyke nets accounted for 41 % of the total catch. Seventy percent of the total catch met or exceeded the acceptable harvest size of 7 inches. Age growth analysis indicated that black crappie were growing somewhat below State average having a mean growth index of -0.4.

A total of 73 largemouth bass averaging 12.1 inches were collected (Table 3). Trap and fyke nets accounted for 73% of the total catch and night electrofishing accounted for 21% of the total catch. Average largemouth bass size for the trap and fyke net catch was 13.7 inches compared to 5.8 inches for electrofishing gear. Sixty-eight percent of the trap and fyke net catch met or exceeded the legal harvest size of 14 inches compared to 0% of the electrofishing catch. Age and growth analysis indicated largemouth bass were growing above State average having a mean growth index of +0.1. Multiple year classes were found (age 1-11) suggesting acceptable recruitment into the harvestable fishery.

A total of 65 northern pike averaging 21.7 inches were collected (Table 3). Gill nets accounted for 75% of the total catch and trap and fyke nets accounted for 20% of the total catch. Nine percent of the total catch met or exceeded the legal harvest size of 24 inches. Age and growth analysis indicated northern pike were growing below State average having a mean growth index of -1.9. Multiple year classes (ages 3-6) were found suggesting acceptable reproduction but poor growth and longevity appear to suggest less than acceptable recruitment into the harvestable fishery.

Nineteen walleye averaging 24.2 inches were collected. They were represented by 7 year classes indicating contribution and survival of stocked fish. More investigation is needed to fully understand the numbers and recruitment of walleyes in Chippewa Lake. To get this information, netting or shocking would have to be conducted immediately after ice out. Walleye were growing above State average with a mean growth index of +0.2.

Other sport fish collected in this assessment were in low abundance and do not allow for detailed analysis (Table 3). Only 3 smallmouth bass were captured, averaging 14.5 inches. Ten warmouth were captured averaging 5.2 inches.

A total of 10 banded killifish, 192 bluntnose minnows, 4 blacknose shiner, 4 Iowa darter, 11 Johnny darter, 1 logperch, 1 central mudminnow, were collected with night electrofishing, maxi-mini fyke nets and seine gear (Table 3).

Chippewa Lake also supports populations of white sucker, silver redhorse, and golden redhorse. It also has a modest population of bowfin (73 captured), carp, and longnose gar.

Samples of fish from Chippewa Lake were also collected for Viral Hemorrahagic Septicemia (VHS) and contaminant analysis. Chippewa Lake tested negative for VHS for yellow perch, bluegill and pumpkinseed sunfish. Fish contaminant results were not available at the time of this report.

Discussion

The limnological characteristics and mesotrophic status of Chippewa Lake present a basic view of available habitat for fish species. As a mesotrophic lake, medium productivity typically results in higher overall biomass of fish and other aquatic organisms than oligotrophic lakes.

Temperature characteristics of Chippewa Lake also influence the fish community. Mid-summer thermocline development results in insufficient oxygen concentrations for most fish below the 30 ft. water depth. As a result, the epilimnion and littoral zone of the lake provide the most desirable habitat for fish. Thermal characteristics of the epilimnion and littoral zone are characteristic of warmwater classification where summer temperatures approach the mid to upper 70° F's for an extended period of time.

The limnological and temperature characteristics of Chippewa Lake favor warm to cool water fish species. Bluegill, bullhead, pumpkinseed sunfish, rock bass, black crappie, northern pike, walleye and

largemouth bass are the prevalent sport fishes. Their relative abundance and average size remains fairly consistent compared with the last survey conducted in 1997, except there was a decrease in black crappie captured and numbers of walleye and largemouth bass were up (Table 4). Other sport fishes including smallmouth bass and warmouth occur in lesser abundance but contribute to the overall recreational fishery.

The bluegill population of Chippewa Lake displayed a good size structure and growth rate. Using the Schneider Index (Schneider 1990) for classifying bluegill populations, Chippewa Lake scored 5.0 for a good rating (Table 5). The Schneider Index in 2009 was down from that found in 1997 but still better than many lakes in the area (Table 5). Sample size was also much lower in 2009. The 1997 survey only captured large bluegills which allowed for an excellent to superior rating to be calculated. Bluegill appear to be fairly long lived with several specimens aged beyond 7 years.

The pumpkinseed population displayed good size structure and growth and constituted a reasonably good sport fishery. Like bluegill, pumpkinseed size structure was similar to that found in 1997, although growth was reduced somewhat, suggesting stability within the population. Longevity of pumpkinseeds was good with several specimens aged beyond 7 years allowing them to obtain larger sizes.

The sample of largemouth bass collected in this survey indicates a very good sport fishery. Relative abundance was very good and the size structure was dominated by largemouth $\geq$14 inches with good representation of younger fish which should recruit into the fishery. Longevity was very good with several specimens aged beyond 7 years allowing them to achieve a large size. Largemouth growth was good and many reach large sizes. Largemouth bass size structure and growth was improved from that found in 1997.

Northern pike were found in appreciable numbers and their size structure and age distribution was good. Nine percent of the northern pike exceeded the legal harvest size of 24 inches. Growth, compared to State average was somewhat slow and age distribution suggested some mortality occurs after age 6. Mortality is most likely from natural causes or from harvest.

Walleye stocking has been the only fisheries management action taken on Chippewa Lake in recent years (Table 2). Evaluations of recently stocked fish have not shown great success, but older walleye were sampled fairly regularly, and anglers do catch walleye. Chippewa Lake may not be a good candidate for the Serns type of evaluation. Walleye seem to appear as adult fish later. The current fishery offers potential for incidental catch or perhaps more frequent catch for those anglers specifically targeting walleye. Walleye growth is good and walleye are known to exhibit some predatory control on panfish but prefer feeding on other forage items including abundant minnows and small suckers.

Although yellow perch were found in appreciable numbers, their size structure and age distribution was poor. Only 2 of the 124 yellow perch collected in this survey were $\geq$ 7 inches. Age distribution indicates a high mortality after age 2 or this could be a function of sampling bias. This mortality is most likely due to natural causes and predation from other piscivorous species may play a role. At best, the current fishery only offers an opportunity for incidental catch of yellow perch of harvestable size.

As in past surveys, black crappie appeared in relatively low abundance although up slightly in 2009. Despite their scarcity, 70 % were of desirable size for anglers. Many were in the 8-12 inch range. Although limited by number, recreational opportunities to catch fairly large black crappie exists in Chippewa Lake.

Rock bass, smallmouth bass and warmouth also provide recreational opportunities for anglers.

Chippewa Lake also offers a diversity of non game species including bowfin, carp, suckers and redhorse species.

Minnow species collected with seine, maxi-mini fyke nets, and electrofishing gear represent part of the forage base available in Chippewa Lake. Both bluntnose minnow and banded killifish were found in appreciable numbers in this survey.

Recommendations

Bluegill, pumpkinseed, northern pike, largemouth bass, and bullheads dominate the fish community in Chippewa Lake and provide good recreational fisheries. No management recommendations are suggest for them.

The current fisheries management prescription for Chippewa Lake requests spring fingerling walleye stocking on a biennial schedule at a rate of 50/acre (~39,500 fish) with the next scheduled plant occurring in 2011. It should be emphasized that the goal of this stocking effort is to create a more significant walleye fishery and to provide an additional and highly desirable sport fish for recreational angling opportunities. If surplus walleye are ever available, stocking at a higher rate up to 100/acre is acceptable. Efforts should be made also to stock the largest size fingerling available.

Walleye stocking in Michigan has always been dependent upon available stock. Chippewa Lake is one of many lakes in the Southern Lake Huron Management Unit stocked with a limited number of available walleye. In recent years, concern over the spread of VHS has greatly reduced statewide production and stocking efforts. As a result, several Michigan lakes which are routinely stocked with walleye have not been stocked. So far, Chippewa Lake has remained on its stocking schedule. MDNR, Fisheries is hopeful ongoing research will enhance the ability to detect VHS and allow for a resumption of stocking at previous levels with an assurance of a "disease free" product. In the meantime, there remains a chance that Chippewa Lake may miss its 2011 stocking date.

Figure 1. Chippewa Lake, Mecosta County

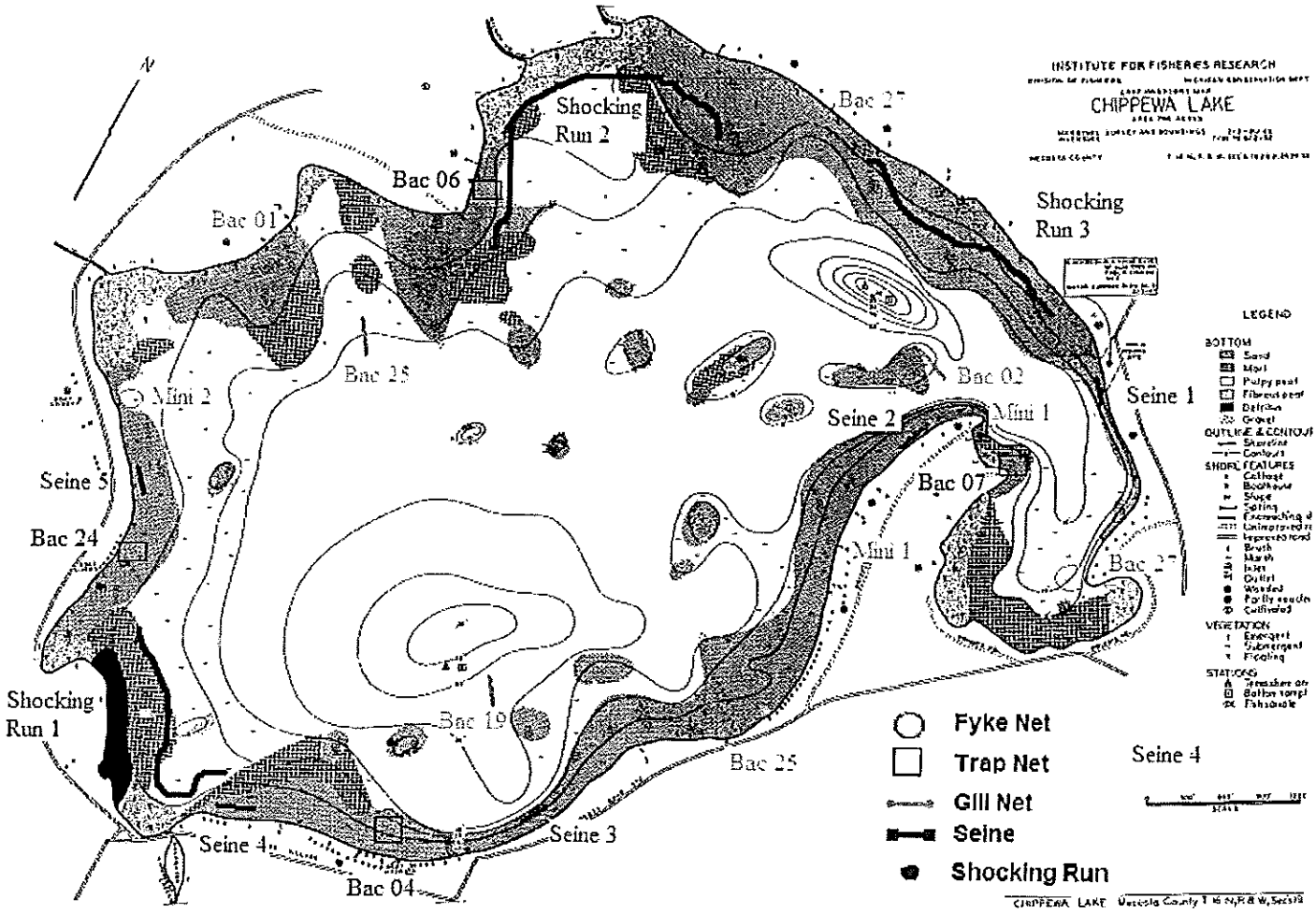

Table 1. Oxygen, temperature, and pH profiles from Chippewa Lake, August 2009.

Depth (ft)	Temperature (°F)	Oxygen (mg/l)	pH
0	73.65	8.23	7.79
3	73.65	8.20	7.7
6	73.63	8.19	7.67
9	73.38	8.09	7.64
12	73.25	7.97	7.64
15	73.21	7.95	7.62
18	73.14	7.95	7.62
21	73.00	7.76	7.6
24	72.85	7.31	7.56
27	72.27	6.91	7.5
30	69.18	5.53	7.36
33	62.31	0.69	7.07
36	61.01	0.016	6.86
39	60.63	0.012	6.82
40	60.55	0.10	6.64

Table 2. Fish stocking in Chippewa Lake, 1979-present.

Species	Date	Number	Avg. Length (In.)
Tiger muskellunge	09/17/1980	2,000	8.6
Tiger muskellunge	09/23/1980	12,000	9.12
Walleye (Mu)	06/15/1988	10,259	2.04
Walleye (Mu)	06/13/1990	10,156	1.92
Walleye (Mu)	06/06/1991	38,929	1.64
Walleye (Bd)	06/11/1991	53,121	1.64
Walleye (Mu)	06/02/1992	148,685	1.2
Walleye (Mu)	06/03/1993	81,320	1.04
Walleye (Mu)	06/05/1995	81,070	1.36
Walleye (Mu)	06/16/1997	7,155	1.44
Walleye (Mu)	06/16/1997	31,369	1.4
Walleye (Mu)	06/17/1997	38,892	1.32
Walleye (Mu)	06/02/1998	80,401	1.28
Walleye (Mu)	05/31/2000	79,000	1.08
Walleye (Mu)	06/10/2003 9:03	41,778	1.116
Walleye (Ti)	06/02/2006 14:09	39,913	1.624
Walleye (Mu)	07/02/2008	10,718	1.832
Walleye (Mu)	07/02/2008	7,137	1.832
Walleye (Mu)	06/10/2009 13:27	30,890	1.524

Mu = Muskegon strain, Ti = Tittabawassee strain, Bd = Bay DeNoc

Table 3. Total catch (all gear) from Chippewa Lake Lake, June-July, 2009.

Species	Number	Percent by number	Weight (lb.)	Percent by weight	Length range (in.)*	Average length (in.)	Percent legal size**
Black crappie	27	1.2	9.5	0.7	4-12	8.1	70
Banded killifish	10	0.4	0.1	0	1-2	2.4	--
Bluegill	875	38.6	38.2	2.7	1-8	3.5	7
Bluntnose minnow	192	8.5	1.5	0.1	1-3	2.6	--
Blacknose shiner	4	0.2	0	0	2-2	2.5	--
Bowfin	73	3.2	376.3	27	15-29	24.1	100
Brown bullhead	407	17.9	397.9	28.5	8-15	12.7	100
Common carp	6	0.3	57.4	4.1	21-32	27.2	100
White sucker	4	0.2	10	0.7	13-21	18	100
Golden redhorse	1	0	1.6	0.1	16-16	16.5	100
Iowa darter	4	0.2	0	0	2-2	2.5	--
Johnny darter	11	0.5	0	0	1-2	2.1	--
Largemouth bass	73	3.2	85.6	6.1	2-19	12.1	33
Longnose gar	19	0.8	54.7	3.9	15-40	30.7	100
Logperch	1	0	0	0	3-3	3.5	--
Central mudminnow	1	0	0	0	3-3	3.5	--
Northern pike	65	2.9	147	10.5	18-26	21.7	9
Pumpkinseed	185	8.2	31.3	2.2	1-9	5.1	34
Rock bass	56	2.5	20.5	1.5	2-10	7.1	68
Silver redhorse	1	0	1.5	0.1	16-16	16.5	100
Smallmouth bass	3	0.1	4.8	0.3	13-16	14.5	33
Tadpole madtom	1	0	0	0	2-2	2.5	--
Walleye	19	0.8	96.6	6.9	8-28	24.2	95
Warmouth	10	0.4	1.8	0.1	2-8	5.2	40
Yellow Perch	124	5.5	5.3	0.4	3-9	4.6	2
Yellow bullhead	97	4.3	52.9	3.8	4-15	10.3	98
All species totals:	**2,269**		**1,394.60**				

Table 4. Comparison (percent of trap net catch) of 1997 and 2009 trap net surveys of Chippewa Lake, (average size in parenthesis).

Species	1997	2009
Bluegill	9	10
	(7.3)	(6.7)
Bullhead (sp.)	64	54
	(12.1)	(12.9)
Pumpkinseed	3	8
	(7.2)	(7.4)
Rock bass	4	4
	(7.4)	(8.5)
Largemouth bass	4	7
	(13.9)	(14.0)
Black crappie	10	2
	(7.3)	(9.3)
Northern pike	2	2
	(20.1)	(22.4)
Walleye	<1	2
	(21.9)	(25.0)
Smallmouth bass	<1	0
	(16.8)	
Bowfin	1	7
	(22.5)	(24.5)
Longnose gar	<1	1
		(32.0)

Table 5. Chippewa Lake bluegill classification using trap net data and the Schneider Index (Schneider 1990). Size score is given in parentheses.

Sample date	5/1/97	5/18/09
Sample size	219	65
Average length (inches)	7.3 (6)	6.7 (5)
% ≥ 6 inches	96 (7)	76 (5)
% ≥ 7 inches	70 (7)	48 (5)
% ≥ 8 inches	16 (6)	3 (5)
Schneider Index	6.5	5.0
Rank[1]	Excellent-Superior	Good

[1]Rank: 1 = Very poor, 2 = Poor, 3 = Acceptable, 4=Satisfactory, 5 = Good, 6 = Excellent, 7 = Superior

References

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