

Crooked Lake

Alcona County, T27N, R5E, S17 and 18
Thunder Bay River watershed, 2009

Mike Phillips, Fisheries Technician; Tim Cwalinski, Fisheries Biologist

Environment

Crooked Lake is located in west-central Alcona County in the northeastern Lower Peninsula of Michigan, approximately three miles west and two miles north of the village of Curran. Acreage estimates of Crooked Lake varied over the years with its fluctuating lake levels. The 1949 Department of Conservation lake mapping survey measurement of 89.5 acres is most often used. An intermittent outlet, which apparently only flows during extremely high water table years, connects Crooked Lake to the Silver Creek drainage. Silver Creek is a designated Michigan trout stream and tributary of the Upper South Branch Thunder Bay River. There are no inlets to Crooked Lake.

Crooked Lake is composed of two basins of 26 and 28 feet maximum depth. Both basins are nearly identical in size and shape (Figure 1). They are separated by a constricted, shallow (3 feet or less) sand and marl bar. The littoral zones (near shore area of a lake where sun light reaches all the way to the bottom) of both basins are relatively narrow and composed of sand with a small band of marl. The bottom composition of the deeper portions of both basins (profundal zone) is silt, pulpy peat and a small amount of fibrous peat. A narrow, shallow, organic bottom bay is located on the north end of the lake. A wider bay, similar in acreage and bottom type or composition to the northern bay, is found on the east side of the south basin (Figure 1). The intermittent outlet of the lake is located on the east end of this bay.

Secchi disc measurements of Crooked Lake water clarity taken May through September in the mid 1970s and early 1980s ranged from 11 ft. to 16 ft., averaging 14 ft. The Crooked Lake limnological evaluations of 1979, 1991 and 2005 all produced similar results and a TSI (Trophic State Index) of M, or mesotrophic rating (Fuller and Minnerick 2008). Lakes are classified on their level of primary biological productivity or trophic state. A lake with low productivity is classified as oligotrophic. A lake moderate in productivity is classified as mesotrophic. A biologically productive lake is classified as eutrophic, and an excessive biologically productive lake is classified as hypereutrophic. The trophic state of lakes can be compared and tracked over time to help evaluate eutrophication resulting from nutrient enrichment that may reflect changes in land-use practices (Fuller and Minnerick 2008). Crooked Lake has remained mesotrophic the past 27 years according to the 1979, 1991 and 2005 surveys. These limnological evaluations also revealed that Crooked Lake does not develop a thermocline. This is consistent with similar, relatively shallow lakes found in the northern Lower Peninsula of Michigan. The littoral zone and the two shallow bays of Crooked Lake have abundant aquatic vegetation. Submergent species include clasping leaf, big leaf, floating leaf and sago pond weed, spatterdock and water shield along with chara (an alga). Emergent vegetation includes bulrush and cattail. There have been no aquatic plant control permits associated with Crooked Lake based on MDNRE databases. The topography surrounding Crooked Lake consists of rolling hills of northern hardwoods, red pine and white pine. Slopes surrounding the lake vary from 0% to 45%. Development of Crooked Lake's shore can be characterized as moderate to moderately heavy. A 2005 survey of riparian use indicated 86 dwellings and 61 small docks in nine 1000 foot stations around the perimeter

of the lake. Public access to Crooked Lake is gained via Mitchell Township Park, located on the southeast portion of the lake. The park incorporates a small picnic area, outhouse, and a single boat-width concrete boat ramp with parking for approximately 4-6 vehicles with trailers.

History

Crooked Lake's archival documents show minimal aquatic management activity prior to 1949. In 1949, the lake bottom was mapped by the Michigan Department of Conservation (MDOC). The notes and reference for this survey indicated reports of good winter and summer fishing were received from anglers. Fish species present at that time included bluegills, yellow perch, black crappies, sunfish, largemouth bass, smallmouth bass, a few northern pike and a very few walleyes. It was estimated that 50 cabins could be found around the lake in 1949.

The first fish population survey of Crooked Lake was performed in September of 1949. This survey consisted of three experimental gill-nets (125 ft. long with five 25 ft. panels of 1.5 in., 2 in., 2.5 in., 3 in. and 4 in. stretch mesh), three straight run gill-nets (125 ft. long with mesh sizes of 1 in., 1.25 in. and 1.5 in. bar measurement, respectively) and a common shoreline seine (30 ft. long with 1/6 inch mesh). The survey consisted of one night of netting (net night) for the six gill nets and one haul of the seine. The catch included largemouth bass, walleye, bluegill, pumpkinseed sunfish, black crappie, rock bass, green sunfish, yellow perch and lake chubsucker. In addition, bluntnose minnow, banded killifish and iowa darters were captured in the seine haul. Angler reports indicated northern pike and smallmouth bass were present in the lake but none were caught in the abbreviated survey. The fish aged in this survey revealed nearly all species were growing slightly above, to well above, their State of Michigan average lengths at age for that period. Bluegills were the lone exception as they demonstrated slightly slower growth.

About this same time (1948), Crooked Lake property owners became concerned with the commercial harvest of wigglers (mayfly nymphs) occurring on their lake. Fifteen years of ongoing debate involving petition signing and much written and verbal interaction occurred between the property owner's association and MDOC representatives. No changes were ever made to the regulations covering commercial wiggler harvest in Crooked Lake and harvest was thought to occur for some unknown time. Low lake levels provided another reason for discourse in the early to mid 1960s. The theory of spring holes draining the lake was explored, but in the end, a natural ground water table fluctuation was deemed the cause of lake level variation. One partial fish kill was noted in June of 1963 and was attributed to spawning stress, with a reported 95% of the fish involved bluegills, with the remaining 25% pumpkinseed sunfish and black crappie.

Reference is made to stocking 1.2 million walleye fry in the period of 1926 to 1940. In addition, smallmouth bass fingerlings and adults, largemouth bass, bluegill and yellow perch fingerlings were stocked in various numbers between 1937 and 1945. A hand written note on the back of the 1949 mapping survey report mentioned stocking 1,352 rainbow trout in 1939. Interest in walleyes by property owners led to several requests to stock these fish in Crooked Lake. Interest peaked in the late 1950s and late 1960s, as well as the early 1980s with requests from the Crooked Lake Property Owners Association (C.L.P.O.A.) for the initiation of a stocking program to supplement the lake's marginal walleye fishery. Occasional mention of instituting a walleye stocking program appeared in Fisheries Division notes in the late 1950s and 1960s but no walleyes were stocked during this time period. DNR

fisheries managers authorized the stocking of walleye at 50 fingerlings per acre, every three years in the lake by the mid 1980s. A single introduction of 6,169 summer fingerlings followed in 1990 but no other stocking efforts were enacted. No other authorized walleye stocking has occurred in Crooked Lake since the 1990 event.

A northern pike spawning marsh was constructed in 1961 by MDOC personnel. Sketchy information indicates the marsh was located on the east end of the southern basin, somehow incorporating a portion of the shallow bay on that end of the lake. Twenty-one male and 29 female adult northern pike were transferred to the pond in the spring of 1962. No harvest or production records exist for this effort. The only subsequent mention of the pike marsh was an entry in the management record for 1966 which read "disregard additional stockings - cooperators do not cooperate".

The next survey of the fish community of Crooked Lake occurred in September of 1961. This effort incorporated the use of a 1,600 foot long seine. This seine was comprised of three sections: 400 feet long by 16 feet high by $\frac{3}{4}$ inch stretch mesh, 600 feet long by 16 feet to 24 feet high by 2 inch stretch mesh and 600 feet long by 24 feet high by 2 inch stretch mesh. Two seine hauls were made, one in each basin, collectively sampling nine surface acres of the lake. Bluegills (5,228) made up the bulk of the fish handled, providing 88% of the catch. Other species sampled and their relative abundance in the catch included: yellow perch (4%), pumpkinseed sunfish (3%), largemouth bass (3%), smallmouth bass, black crappie, green sunfish, rock bass, and lake chubsuckers (all less than 1% each). Growth rates for individual species from scale samples analyzed revealed bluegills were still growing slightly below their state average while the rest of the species were growing equal to or above their State of Michigan average length at age.

One habitat improvement effort was planned in 1986. A permit was issued to the C.L.P.O.A. by the Michigan Department of Natural Resources (MDNR), Division of Land Resources Programs for the installation of 17 log crib/brush shelters in waters 10 to 15 feet deep in Crooked Lake. Follow up records are sorely lacking. However, a hand written note attached to the back of the C.L.P.O.A. minutes of a meeting in May 1986 mentioned 8 shelters were placed north of the Township Park in the south basin. The explanation for not installing the remaining structures in the lake alluded to concerns by fishermen of the risk of losing fishing tackle on the cribs while trolling.

July of 1981 provided the next opportunity to survey Crooked Lake's fish community. The survey was made by MDNR in response to local fishermen's complaints of poor fishing success. Local residents recalled 1978 or 1979 as the last time a walleye was caught in the lake. The C.L.P.O.A. reported a great deal of interest existed in re-establishing a viable walleye fishery in their lake at that time. Sampling gear utilized in the 1981 survey included 18 fyke-nets; of both $\frac{3}{4}$ inch stretch mesh by 75 foot leader and 2 inch stretch mesh by 125 ft. leader configuration. The catch was combined as a total for all fyke net efforts. Six experimental gill-nets, set in three 2 net gangs, were also used. A total of 72 net lifts were recorded for all the gear types mentioned. The catch of 2,217 fish included some predators and an abundance of panfish. The predator catch was comprised only of northern pike and largemouth bass, while panfish diversity was high. Growth rates for most species in the survey, including bluegill, either exceeded or were near state average. The exception was northern pike which demonstrated very slow growth (2 inches slower than statewide average).

Upon review of the size distribution and catch figures from the 1981 survey it was decided by the fisheries biologist in charge that Crooked Lake was a good candidate for a fish removal of certain sizes and species. Manual removals were performed in May of 1983, May and June of 1984, and August and September of 1985. The fish removals lasted 2-3 weeks and incorporated the assistance of volunteer help from the C.L.P.O.A. The intention was to remove less desirable or over-populated fish from the lake in order to reduce competition and stimulate growth of remaining fish. Over 400 net lifts were performed in these three years of effort. The total number of pounds removed by individual species in those three years included: bullheads 545 lbs, yellow perch 313 lbs, white suckers 172 lbs, rock bass 51 lbs, pumpkinseed sunfish 34 lbs, golden shiner 24 lbs, lake chubsucker 13 lbs, and green sunfish 2 lbs. Scale samples of certain fish were collected during the 1984 effort. The results mirrored the results found in 1981 with northern pike extremely slow growing (near 3 inches slower than state average) and yellow perch growing one-inch less than state average. The remaining species were growing near or above their individual state averages.

A nighttime electro-survey was conducted in October of 1990 to evaluate the survival of young walleye stocked by the State of Michigan that early summer. This survey utilized Sern's Index protocol; a method of evaluating survival of young of the year and age I walleyes based on the number caught in a portion of shoreline with electrofishing gear. Effort was aimed at the two to four foot depths and the entire shoreline of the lake was surveyed in one night. Windy weather provided less than ideal conditions by impairing visibility at times. Two walleyes were captured in the two hours of shocking, one young of the year which measured 7.6 inches and one age III fish at 17.3 inches. It was not known however if the young walleye captured was a wild or stocked fish. Regardless, it showed a poor number of age-0 walleye based on results.

Current Status

The most recent fish community survey of Crooked Lake was performed by MDNR Fisheries Division from June 6-11, 2009. This Status and Trends survey was carried out with reduced effort due to extreme Fisheries Division budgetary constraints. Sampling protocol was reduced or manipulated enough to reduce overall costs. A ¾ inch stretch small mesh fyke-net replaced the standard electro-shocking efforts while a 3/16 inch mesh walleye harvest fyke-net substituted for the protocol beach seine efforts.

The netting gear utilized in the survey included one large mesh trap-net (1.5 in. stretch mesh and 150 ft. leader) with three net lifts (net nights), three large mesh fyke-nets (2" in. stretch mesh and 100 ft. leader) with three lifts per net, one small mesh fyke-net (¾ in. stretch mesh and 75 ft. leader) with three nets lifts, one walleye harvest fyke-net (3/16 in. mesh and 50 ft. leader) with two net lifts, and two experimental gill-nets (125 ft. long with 5 - 25 ft. panels of 1.5 in., 2 in., 2.5 in., 3 in. and 4 in. stretch mesh) with two net lifts each. These 21 net lifts/net nights of sampling effort resulted in a total of 774 fish caught, divided among 14 species, with a combined weight of 299 pounds (Table 1). The catch per effort in 2009 (~37 fish per net lift) exceeded that of the 1981 survey (~31 fish per net lift). Top line predators in this catch included northern pike, largemouth bass and walleye. The panfish species captured included bluegill, pumpkinseed sunfish, black crappie, rock bass and yellow perch. Two hybrid sunfish (bluegill X green sunfish) were also caught. No stocking records (MDNRE or private plant) of hybrid sunfish exist and their presence was most likely a result of natural reproduction. Previous year's surveys included green sunfish in their catch. The non-game species

captured in the 2009 survey were brown and black bullheads, white suckers and two minnow species: mimic shiners and a blunt nose minnow.

Largemouth bass, walleye and northern pike comprised 15% of the catch by number, and 66% of the total weight of the fish in the survey. Largemouth bass up to 20 inches were collected with most in the 9-10 inch range (Table 2). This species was growing near the State of Michigan length at age average in 2009 (Table 3). This compares favorably to largemouth growth calculations of past surveys (Table 4). Eight age-groups (Table 3) were represented in the largemouth bass sample which would be considered a normal age distribution.

Crooked Lake northern pike have demonstrated growth rates well below the State of Michigan in the past (Table 4). Lack of sufficient pike numbers in individual age groups prevented calculating a mean length at age from the 2009 survey data. However, three of the five age groups represented were growing above the State of Michigan average length for their age. The largest pike in the survey measured almost 32 inches in length. Half of the northern pike collected were legal size (24 inches or larger) (Table 2).

Thirty-six walleyes were captured in the survey and produced the most pounds in the catch for any individual species (Table 1). The walleyes ranged from 14.9 to 21.7 inches in length (Table 2). Crooked Lake walleyes are growing extremely well, with the four age groups (II, III, IV and V) producing a mean growth index of 2.5 inches above their State of Michigan average (Table 3). Walleyes were noticeably more abundant in the current survey compared to historical sampling efforts (Table 5).

Bluegills were the predominate panfish species, by number, in the 2009 survey. This was not the case in some of the previous surveys (Table 5). Eight bluegill year classes were found in the survey, ranging from age II to IX (Table 3). The largest bluegill in the survey was a 10.2 inch individual. The overall mean growth index for bluegills was -0.5 inches in 2009. Thus, Crooked Lake bluegill growth is slightly slower than the statewide average, but well within natural variability. However, commencing at age V, bluegills began growing above the State of Michigan average length at age (Table 3). Bluegill growth over time has always been within an inch (+/-) of the statewide average.

The growth trend for Crooked Lake bluegill in 2009 was also evident in all but one of the panfish species sampled in the 2009 survey. Pumpkinseed sunfish and rock bass began exceeding the State of Michigan average rate of growth at age IV, while yellow perch displayed this same trend at age III (Table 3). Prior to these ages the individual specie's growth rates were below their respective state averages. Pumpkinseed's mean growth index was 1.2 inches above the State of Michigan average thanks to their accelerated growth commencing at age IV. These sunfish display this above average growth rate in previous surveys as well (Table 4).

The rock bass mean growth index was -0.5 inches but produced slightly above average growth from age IV and older fish. No age I centrarchids (sunfish family) were captured in the 2009 survey. This might be attributable to the colder than normal May and June of 2009. Unseasonably cold water temperatures may have hampered successful spawning by these panfish. Age I perch, however, were found in the catch of the Crooked Lake survey. Yellow perch spawn earlier than centrarchids, in much cooler water temperatures, and would be less affected by cold May and June temperatures. The yellow

perch catch was too small to generate a mean growth index for 2009. However, individual perch age groups did exhibit increased growth rates above their state average length at age commencing at age III. The small sample of black crappie collected in 2009 only allows speculation on their growth rate. Previous surveys produced black crappie mean growth indexes above State of Michigan averages (Table 4). The two fish aged in 2009 were growing above, to well above, the State of Michigan average (Table 3). Older individuals of certain panfish species were noticeably absent in the survey (Table 3). Yellow perch and rock bass only produced age groups to VI while pumpkinseed sunfish peaked at age VII. The percent catchable (7 inches and above for panfish species) ranged from approximately 29% for bluegills to 50% for yellow perch, 58% for rock bass, 83% for pumpkinseeds and 100% for black crappie (Table 2).

Two large white suckers were captured in the 2009 survey along with a small number brown and black bullheads. Bullheads ranged in length from 9 to 14 inches. Mimic shiners were very abundant and provided 14% of the total catch, by number (Table 1). Large schools of mimic shiners were observed in the shallow sandy shoal areas during the survey. One bluntnose minnow was also captured.

Analysis and Discussion

Historical data dating back to 1949 provides an interesting window to the Crooked Lake fish community's changes over time. Banded killifish were caught in the 1949 survey but were not seen again in any subsequent effort. Two Iowa darters were caught in 1949 but were never identified again in any follow-up surveys. Smallmouth bass appeared in the 1961 survey. None were caught in a subsequent survey and can be presumed to no longer exist in the lake. No golden shiners were sampled in the 1949, 1961, or 1981 surveys but 24 pounds were removed during the manual removals of the 1980s. They did not appear in the 2009 survey but some gear and sampling methods were different than past efforts. Northern pike numbers may have declined from past surveys based on historical catches. Lack of suitable spawning areas in Crooked Lake is the likely culprit. This thought is illustrated by the early 1960s attempt to establish a pike spawning marsh on Crooked Lake.

The three manual removals in 1983 to 1985 appeared to have an impact on the fish community of Crooked Lake. The eleven bullheads caught in the 2009 survey were an atypically low number for a relatively shallow inland lake in Michigan's northern Lower Peninsula. The absence of golden shiners in 2009 could also be a direct result of their extraction in the early 1980s manual removals. Lake chubsuckers were caught in all previous netting surveys but were not found in the 2009 survey. Again, this might be a direct result of their removal in the 1980s. The absence or low numbers of some of these fish may be explained by predation from an apparently larger current walleye population.

One walleye was captured in 1949 and none appeared in subsequent surveys, until a fall walleye evaluation in 1990. No walleye were collected with intensive effort (401 net lifts) for the three consecutive years of manual removals in the 1980s. The electro-survey in 1990 produced a three year old walleye and a single young of the year (presumably from the June, 1990 stocking). Anecdotal comments from fishermen prior to the 1981 survey indicated occasional walleyes were caught in Crooked Lake, but none since 1978 or 1979. Surprisingly, the 2009 survey produced a good number of walleyes representing four age classes (age II through V). These fish may or may not be a result of natural reproduction from the lone 1990 DNR stocking. One would expect to have caught a few older age class walleyes in the survey to give credence to the natural reproduction theory. It would be more

reasonable to surmise that some type of unauthorized stocking effort had produced the present walleye population found in Crooked Lake. A conversation with the C.L.P.O.A. president produced a disclaimer to their involvement in any walleye stocking of Crooked Lake in the recent past.

In conclusion, Crooked Lake's fish community seems to be in decent shape. Panfish numbers in the catch were somewhat low, but catchable size fish were common. Their growth rates are close to the State of Michigan averages and well within the range of natural variability. One detail of note was the low numbers of age V and older yellow perch, rock bass, pumpkinseed and black crappies. Heavy angling pressure might account for the removal of the older age classes of these species. No information is available on the fishing pressure Crooked Lake received around the time of the 2009 survey. Predator species (northern pike, walleye and largemouth bass) numbers are acceptable and show good growth rates. They (especially walleyes) are adequately controlling the panfish populations (Schneider 1997). Non-game species (white suckers, brown and black bullheads) are present in very low, acceptable numbers. Minnow species (mimic shiners) are abundant. Panfish growth rates (perch and rock bass) reflect this in the noticeable jump in growth they attain at older age and larger size by taking advantage of the minnows in Crooked Lake.

Management Direction

At this time the fish community of Crooked Lake is in good condition. Panfish populations display relatively good mean growth index values while providing decent numbers of catchable size fish. Largemouth bass, northern pike and walleye growth rates range from acceptable to extremely good, respectively. Largemouth bass and walleyes provide good numbers of legal size fish. Though lower in number, legal northern pike are also available to the angling public. Non-game fish species' populations are low and adequate forage species (mimic shiners and blunt nose minnows) are present. Active management of Crooked Lake is unnecessary at this time.

Because walleyes seem to do well in Crooked Lake and are in high demand by the angling public their population should be monitored in the future. This could confirm or dispel the notion that natural reproduction is maintaining the walleye population. Evaluation could be accomplished by a one night boom shocking effort three years in the future. The two youngest year classes would be five and six years old, respectively. The survey could be done in early fall utilizing Sern's Index protocols. If declining walleye numbers or absence of additional year classes is found, a prescription can be written to initiate a stocking program. This stocking effort could be accomplished by either Fisheries Division-supplied fingerlings or a possible permit for a private plant by the C.L.P.O.A.

References

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Schneider, J.C. 1997. Dynamics of a Bluegill, Walleye and Yellow Perch Community. Fisheries Research Report 2020, Michigan Department of Natural Resources and Environment, Ann Arbor.

Figure 1. Crooked Lake map with net locations, Status and Trends MDNRE survey, June 8-11, 2009.

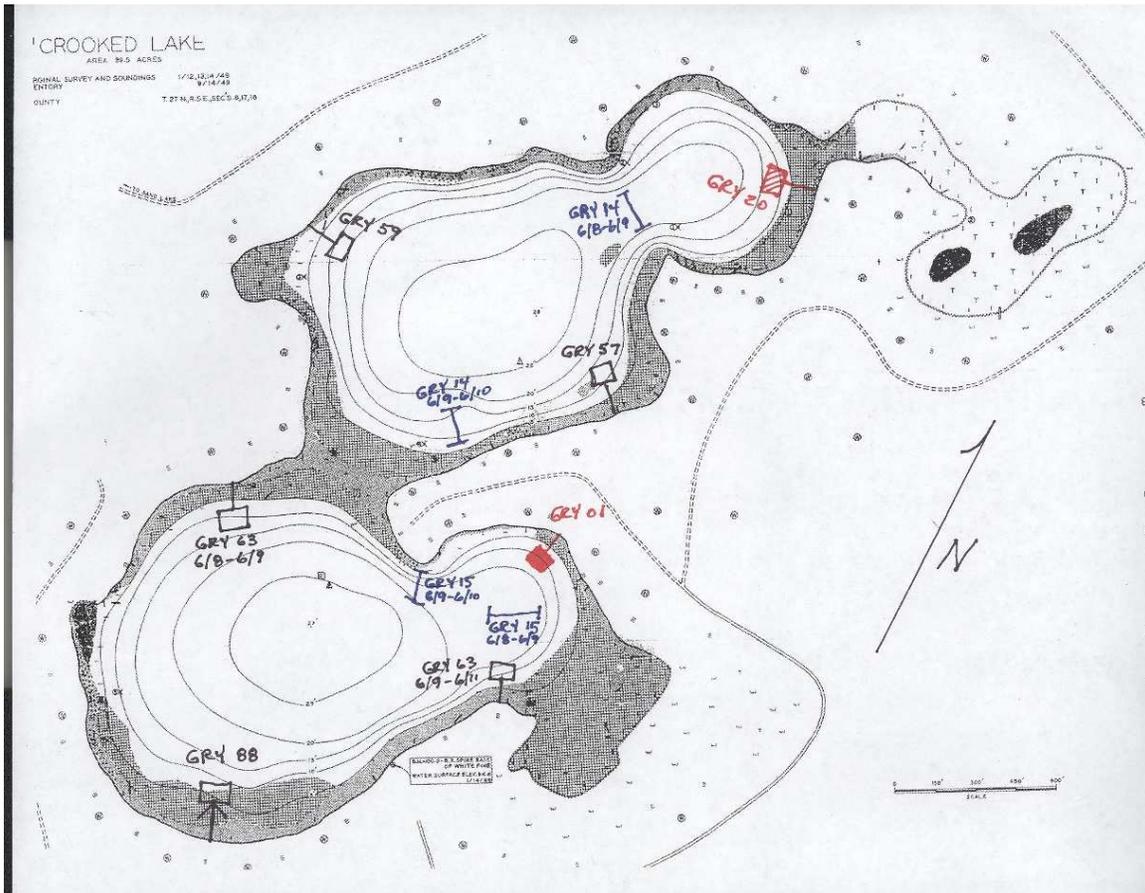


Table 1. Species and relative abundance of fishes collected with all survey gear in Crooked Lake, June 8-11 2009.

Common Name	Number	% of Total	Length Range (inches)	Weight (lbs)	% of Total
Northern pike	10	1.29	20 to 33	42.38	14.2
Walleye	36	4.65	14 to 21	79.57	26.65
Largemouth bass	73	9.43	6 to 20	76.46	25.61
Bluegill	431	55.68	1 to 10	54.28	18.18
Pumpkinseed	30	3.88	4 to 9	9.95	3.33
Hybrid sunfish	2	0.26	6 to 8	0.68	0.23
Black crappie	3	0.39	7 to 13	1.89	0.63
Yellow Perch	14	1.81	3 to 13	4.26	1.43
Rock bass	50	6.46	1 to 8	8.98	3.01
White sucker	2	0.26	22	8.94	2.99
Brown bullhead	8	1.03	9 to 14	7.59	2.54
Black bullhead	3	0.39	12 to 13	3.16	1.06
Mimic shiner	111	14.34	1 to 2	0.4	0.13
Bluntnose minnow	1	0.13	2	0.01	0.1
TOTAL	774			298.55	

Table 2. Length-frequency distribution of important game fishes collected during the 2009 netting survey at Crooked Lake

Length (in)	Bluegill	Pumpk. sunfish	Rock bass	Yellow perch	Largemouth bass	Walleye	Northern pike
1	8		1				
2	155		2				
3	111		4	2			
4	14	2	9	3			
5	19	3	5				
6	27	6	18	2	2		
7	28	13	7	1	5		
8	54	5	4		3		
9	14	1		2	12		
10	1			1	12		
11				2	6		
12					9		
13				1	5		
14					7	1	
15					5		
16					3	5	
17					1	1	
18					2	11	
19						6	
20					1	5	1
21						4	2
22							
23							2
24							
25							1
26							
27							
28							1
29							1
30							
31							1
32							
33							1

Table 3. Weighted mean length and age composition of selected species in the Crooked Lake survey, June 8-11, 2009.

Species/Age	No. Aged	Length range (in.)	State avg. length (in.)	Weighted mean length (in.)	Weighted age freq.	Mean growth index *
Northern pike						
Age III	2	20.4 - 21.5	21.8	20.95	20.00%	
Age IV	4	21.4 - 29.8	24.2	25.65	40.00%	
Age V	1	23.0 - 23.0	26.1	23	10.00%	
Age VI	2	25.6 - 33.2	27.8	29.4	20.00%	
Age VII	1	31.9 - 31.9	30	31.9	10.00%	
Walleye						+ 2.5
Age II	2	14.9 - 16.2	11.4	15.55	5.56%	
Age III	12	16.4 - 19.2	14.4	17.63	34.44%	
Age IV	3	17.8 - 20.7	16.2	19.47	9.03%	
Age V	18	18.1 - 21.7	18	19.63	50.97%	
Largemouth bass						+ 0.1
Age II	7	6.4 - 10.9	8.7	7.68	9.71%	
Age III	38	7.5 - 13.9	10.6	10.72	55.77%	
Age IV	7	8.8 - 14.1	12	11.66	9.86%	
Age V	5	14.0 - 16.0	13.7	14.86	6.85%	
Age VI	6	14.8 - 16.7	15	15.35	8.22%	
Age VII	2	15.2 - 15.4	16.7	15.3	2.74%	
Age VIII	4	16.5 - 18.5	17.6	17.53	5.48%	
Age IX	1	20.6 - 20.6		20.6	1.37%	
Bluegill						-0.5
Age II	9	2.1 - 2.9	4.2	2.48	32.98%	
Age III	21	2.7 - 4.7	5.3	3.47	33.22%	
Age IV	22	5.4 - 7.1	6.2	6.18	11.62%	
Age V	3	6.6 - 9.1	6.9	8.06	2.07%	
Age VI	17	7.4 - 9.3	7.4	8.3	14.58%	
Age VII	7	7.9 - 9.3	8	8.75	4.31%	
Age VIII	3	9.0 - 9.5	8.4	9.17	0.99%	
Age IX	1	10.2 - 10.2	8.7	10.2	0.24%	
Pumpkinseed						+1.2
Age III	2	4.6 - 4.9	5.2	4.75	6.67%	
Age IV	20	5.6 - 8.0	5.8	7.02	76.67%	
Age V	3	6.9 - 8.1	6.3	7.67	10.00%	
Age VI	1	8.1 - 8.1	6.8	8.1	3.33%	
Age VII	1	9.0 - 9.0	7.2	9	3.33%	
Black crappie						
Age II	1	7.6 - 7.6	6.5	7.6	66.67%	
Age V	1	13.4 - 13.4	9.7	13.4	33.33%	
Yellow perch						
Age I	2	3.0 - 3.2	4	3.1	14.29%	
Age II	4	4.2 - 6.2	5.7	4.83	28.57%	
Age III	3	6.2 - 9.8	6.8	7.87	21.43%	

Table 3. continued

Age IV	2	9.2 - 11.5	7.8	10.35	14.29%	
Age V	1	11.5 - 11.5	8.7	11.5	7.14%	
Age VI	2	10.2 - 13.1	9.7	11.65	14.29%	
Rock bass						-0.5
Age II	6	2.8 - 3.7	4.3	3.17	12.24%	
Age III	12	4.1 - 5.8	5.4	4.8	24.49%	
Age IV	20	5.5 - 7.7	6.4	6.47	49.74%	
Age V	4	7.1 - 8.0	7.2	7.64	7.40%	
Age VI	3	8.0 - 8.7	8.1	8.33	6.12%	

* Mean growth index is the average deviation from the state average length at age.

Table 4. Growth rate comparisons to the state average, by species, for all fish community surveys of Crooked Lake.

Survey Year	Walleye	Northern pike	Largemouth bass	Bluegill	Pumpkin-seed	Black crappie	Yellow perch	Rock bass
1949			0.5	-0.6	0.6	0.6	0.2	0.7
1961			0.0	-0.2	0.6		0.7	
1981		-2.1	0.5	0.4	0.2	0.5	0.5	-0.2
1984		-2.9	0.7	0.8	0.9	0.5	1.1	-0.1
1990		-2.1	-0.3	-0.7				
2009	2.5		0.1	-0.5	1.2			-0.5

Growth is compared to the statewide average and is measured in inches of growth. A negative number connotes slower growth.

Table 5. Catch by species by year of survey for Crooked Lake, Alcona County.

	1949	1961	1981	1983	1984	1985	2009
walleye	1						36
largemouth bass	8	200	46	31	79	244	73
smallmouth bass		2					
northern pike			55	67	32	65	10
bluegill	11	5,228	235	130	172	2,036	431
pumpkinseed	8	196	264	182	291	247	30
black crappie	10	29	49	8	14	29	3
green sunfish	13	5	7		15	103	
hybrid sunfish							2
rock bass	9	14	750	491	316	1,212	50
yellow perch	27	240	405	5,841	496	360	14
bullhead spp.			384	388	108	520	11
white sucker				57	2	1	1
lake chubsucker	11	31	2	12	2	27	
mimic shiner							111
blunt nose							
minnow	37			many			1
golden shiner				254	14	902	
banded killifish	10						
iowa darter	2						
common shiner				1			