Crooked Lake

Montmorency County, T30N, R2E, Section 23, 24
Thunder Bay River watershed, last surveyed 2014

Tim A. Cwalinski, Senior Fisheries Biologist, MDNR Gaylord

Environment

Crooked Lake is a 46-acre natural lake located approximately two miles southwest of the town of Atlanta, Michigan in central Montmorency County. There is one small inlet to this lake and one outlet, both known as Crooked Creek. The inlet enters the southwest lake basin and flows from nearby Avery Lake. A control structure exists on the north end of the lake which deepens the natural lake basins (three basins) and the connections between them. This dam was established by a private source in 1949. The control structure has a 9 foot head and provides for an approximate 460 acre-foot storage (Cwalinski et al. 2006) and a legal lake level of 874.9 feet established in 1967. The Montmorency County Drain Commission oversees maintenance of legal lake levels.

Crooked Lake is a relatively deep water body with high water clarity. The primary basins are shaped like a horseshoe with a narrow strip of land between them (Figure 1). The southwest basin receives the inlet and reaches depths of over 30 feet deep. The northwest basin has a maximum depth of approximately 45 feet deep, and a large amount of water acreage deeper than 20 feet. The eastern basin is the deepest, reaching an approximate depth of 51 feet, with much of this basin deeper than 20 feet. Steep dropoffs separate the open pelagic zones from the limited (by acreage) littoral zone. The narrow littoral zones contain moderate amounts of large woody debris as well as submergent and emergent aquatic vegetation. Bottom substrate is primarily sand and marl, with some extensive areas of silt. The riparian zone is primarily upland hardwood and pine, and lowland conifer at some locations. Shoreline development is moderate. As of August 2014, there were 53 small docks along the shore of the lake, 38 dwellings, and a fair amount of shoreline was armored. Water clarity was measured with a secchi-disk reader and was 17 feet deep. The thermocline was established at 16 feet below the surface and dissolved oxygen concentrations remained very high in the cold, deep water (Table 2). Alkalinity was measured at 176 mg/L. Chlorophyll-a concentration was 7 parts per million.

A public-access boat launch is located on the west shore of Crooked Lake. The gravel-surface ramp is maintained by the Michigan Department of Natural Resources (MDNR) Parks and Recreation Division. This access site has parking for approximately six vehicles with boat trailers, and it also has toilet facilities. Non-native rusty crayfish were known to become established in this lake in the recent decade and are quite abundant today.

History

Fisheries information for Crooked Lake dates back to the 1920s when Michigan Department of Conservation (MDOC) personnel first examined it. Forage fish and invertebrates were considered to be abundant based on examination, but plankton abundance was considered poor. Fish species present included largemouth and smallmouth bass, rock bass, yellow perch, pumpkinseed, white suckers, and a variety of darters, shiners, and chubs.

Fisheries surveys expanded in the 1940s at Crooked Lake and came on the heels of stocking efforts of a variety of species in the late 1930s and early 1940s. Species stocked during that period were walleye, bluegill, largemouth and smallmouth bass. An aquatic community survey was completed by MDOC in August of 1942 and can be reviewed in detail in Allison and Kilpela (1943). At that time, there were 14 cottages on the lake and one boat livery. A thermocline was determined to be well established, with dissolved oxygen declining below the thermocline to levels typically unsuitable to fish. Emergent vegetation was considered to be moderate in abundance, while submergent vegetation was abundant. An examination of the fish community using gill nets documented rock bass, largemouth bass, cisco, walleye, bluegill, northern pike, yellow perch, pumpinseed, and smallmouth bass. A brief follow-up survey with gill nets was made in 1946 and captured many of the same species.

Three decades passed before the next fish community survey was made, this time by the Michigan Department of Natural Resources (MDNR). Sampling effort was expanded to include an unknown number of fyke net, trap net, and experimental gill net lifts during parts of June and July 1976. Prey fish consisted mainly of yellow perch and bluegills. Bluegills were not considered to be abundant, and demonstrated average growth rates. Yellow perch were common and also demonstrated average growth rates. Predators included northern pike, walleye, and largemouth bass. Pike were the most abundant predator with average growth rates. Walleye grew fast in Crooked Lake, but they were not abundant and only sustained through low level stocking efforts. In fact, stocking of this species was done collaboratively between MDNR and lake association efforts from fingerlings at a nearby rearing pond. Largemouth bass were also collected in the survey, but they were scarce, as were smallmouth bass. A coldwater species, the cisco, was not captured during the 1976 survey, although it was captured in the 1942 survey. The lake was considered to have a "fair" fishery, and it was believed that continued stocking efforts for walleye, at higher rates, would benefit the fish community and most importantly, the fishery.

Such consistent walleye stocking efforts were not accomplished until around the late 1980s when MDNR Fisheries Division put a more consistent stocking plan together (Table 1). The next fish community survey was made by MDNR in 1997 with an assortment of fyke nets, trap nets, and experimental gill nets and was done to evaluate a decade worth of periodic walleye stocking efforts (Table 1). Based on the survey, the species composition and size distributions of the Crooked Lake fish populations was slightly different to that of the 1976 survey. Bullheads and white suckers were prevalent. Bluegill numbers were fair with few quality size bluegills present. Black crappie were much more common, pumpkinseed were satisfactory in abundance, and smallmouth bass were common. Yellow perch were common but most were less than three inches long. Northern pike were present in fishable numbers but were mostly sub-legal in size.

A total of 14 walleye were captured during the 1997 survey. It appeared that survival of the 1995 walleye stocked year class was minimal. Most of the walleye present in the survey were older, larger fish ranging from 18-27 inches long, and likely survivors from the stocking events in the late 1980s. Only two smaller (13-14 inch) walleye showed up in the survey and were from the 1995 stocked year class.

Current Status

The most recent fish community survey in Crooked Lake was conducted by the MDNR Fisheries Division from May 27-30, and June 23 in 2014. Sampling effort consisted of 9 large-mesh fyke net

lifts, 4 small mesh fyke net lifts, 8 experimental gill net lifts, and 30 minutes of direct-current nighttime electrofishing. Fyke netting efficiency was low due to the steep dropoffs and limited littoral zone.

Eighteen species of fish were collected during the 2014 survey (Table 3). Total catch was 734 fish weighing 149 pounds. Large predator fish included smallmouth and largemouth bass, walleye, and northern pike which, in total made up 5% of the total catch by number and 50% by weight. The panfish community of Crooked Lake is dominated by yellow perch, rock bass, and bluegill, and to a lesser degree green sunfish and pumpkinseed (Table 2). Non-game species such as black bullhead and brown bullhead, and white suckers are present in Crooked Lake, but are not abundant based on survey catches.

Bluegill are an important component of the Crooked Lake fish community and the fish sought after the most by Crooked Lake anglers, according to various reports. Bluegill ranged from 1-9 inches in length (Table 4) and were represented by nine ages (Table 5). On average, a Crooked Lake bluegill will need about 6-7 years to reach eight inches in length. Growth of Crooked Lake bluegill was considered average when compared to the growth of this species statewide. Bluegill were not overly abundant in the survey catch, however, they were observed in decent numbers at the surface of open water and likely not completely vulnerable to the sampling gear.

Yellow perch were the most abundant game fish caught and observed in Crooked Lake. Small (less than 4 inches) yellow perch were extremely abundant in the littoral zone during the June nighttime electrofishing run. We did not collect these fish in proportion to their true abundance which allowed us to net other species. No yellow perch greater than eight inches were collected, although anglers occasionally catch large perch in Crooked Lake. Despite the high numbers of juvenile perch, growth rates of this species still appeared to be average. Most perch that were collected were ages 1-3.

Rock bass are also abundant in the survey catches in Crooked Lake and were up to 8 inches in length. Their growth rates were slightly below the statewide average. Green sunfish are common in the lake, which is not typical for most northeast Michigan lakes, and is usually undesirable because they do not grow to a large size and do not offer quality table fare. Pumpkinseed were also collected, but in low numbers. Only four black crappie were caught during the 2014 survey (Table 4). They have never been prolific in Crooked Lake, but were captured both in the 1976 and 1997 surveys. All these species add to the diversity of panfish catches.

Multiple predators can be found in Crooked Lake, but none were considered abundant by number. Twenty northern pike were surveyed, ranging in length from 17-27 inches and represented by six year classes (Table 5). Pike were more abundant during the 1976 and 1997 surveys, but were mostly represented by younger fish. Both young and a few old northern pike were captured in 2014. Growth rates of Crooked Lake northern pike were above average.

Smallmouth bass are the dominant black bass in Crooked Lake. They can grow up to 19 inches in length at this lake and growth rates were good. This species may also be more prolific than what the catch data indicates since more smallmouth were observed, but not netted. Largemouth bass are present in Crooked Lake, adding to species diversity, albeit in low numbers.

Spring fingerling walleye have been stocked at high rates periodically in Crooked Lake since 1986 (Table 1). It it not typical for local MDNR to stock walleye in such a small natural lake. This species was stocked beginning in the mid 1980s as a control on overabundant prey, particularly small yellow perch. Only three walleye were collected during this survey, but we also believe they are likely more abundant. Good numbers and age groups were collected during the 1997 survey as well. Past and recent data suggests that walleye can grow well over 20 inches in length in Crooked Lake.

Other species found in Crooked Lake include mudminnows, golden shiners, bullheads, darters, white suckers, and various shiners and minnows. All these are typical fish components in the natural lake region of northeastern Michigan.

Analysis and Discussion

The current fish community of Crooked Lake can be generally characterized as having the following: 1) a diverse panfish community with average growth rates and dominated by yellow perch, bluegill, and rock bass; large panfish are not abundant and most do not live to older ages with the exception of bluegill 2) a diverse predator population having low densities and dominated by northern pike and smallmouth bass, 3) a low density walleye population supported through periodic stocking events; a goal for this population is to control panfish populations, particularly abundant small yellow perch , 4) a cold-water niche in the lake that once (and still may) supported cisco, 5) a typical population of small bait fish including shiners and minnows, and 6) a non-game fish community with low diversity and dominated by bullheads and white suckers. Management of Crooked Lake fishes has primarily been with the use of statewide regulations, maintenance of most species through natural reproduction, and providing low level, periodic stocking of walleye in recent decades.

The Crooked Lake panfish community is moderate in diversity and fairly poor in quality. Species available to anglers include bluegill, rock bass, yellow perch, pumpkinseed sunfish, and an occasional black crappie. Growth of panfish is typically average when compared to growth rates for each species statewide. Most of these panfish do not make it to older ages, but bluegill can and do provide older age classes for anglers. Small yellow perch are extremely abundant and likely outcompete young of other species for limited food resources. Black crappie, another popular game fish, are present and boost the fishery on occasion, yet this species is not abundant.

The predator base of Crooked Lake is dominated by northern pike and smallmouth bass. Both species are important predators which are needed to help keep many other species in balance. Smallmouth bass are an important predator on rusty crayfish which is a non-native species and now is prolific in the lake. Smallmouth bass provide a quality fishing experience in Crooked Lake. Largemouth bass appear to be an incidental part of the fishery and likely also help limit overabundance of certain panfish.

Northern pike remain a typical component in the lake, and have for decades. Walleye have been stocked at variable rates and sizes over time. More recent stocking events were for spring fingerlings (1.4-1.7 inches) at high stocking densities. The goal was to have enough walleye survive to adulthood and act as a control on overabundant perch. Although some walleye survive, they are not abundant and small yellow perch are still prolific. This fish was stocked on an irregular basis since the 1980s (Table 1) and stocking may need to be more frequent for goals to be obtained.

Management Direction

1) The Crooked Lake aquatic community is dynamic and should be monitored on a fairly consistent basis. Each game fish plays a vital role not only in the fishery, but also for overall ecosystem balance. A complete fish community survey documenting changes should be accomplished approximately every 15-20 years at Crooked Lake. Previous fish community surveys were done in 1976, 1997, and 2014.

2) Panfish populations, especially perch, need to be managed at Crooked Lake. Continue to stock spring fingerling walleye, but return to an alternate year stocking regime at higher densities (100/acre).

3) Crooked Lake has had an established legal lake level for nearly four decades. Fisheries Division Policy and Procedure 02.02.008 discourages the construction of lake level controls or establishment of legal levels. It is encouraged that lake level operations should minimize disruption of annual or seasonal hydrological regimes. However, the control structure and legal lake level do exist and have become part of the Crooked Lake system. High and low water cycles from natural processes have less influence now on lakeshore vegetation, beaches, and shorelines at Crooked Lake.

4) Assess the fishery through angler reports. We will continue to gather information from the public as to their catches at Crooked Lake. This is a valuable tool that provides good information to managers, especially when surveys are not completed on a frequent basis.

5) Standard State of Michigan fishing regulations apply for Crooked Lake.

References

Cwalinski, T.A., N.A. Godby, Jr., and A.J. Nuhfer. 2006. Thunder Bay River Assessment. Michigan Department of Natural Resources, Fisheries Special Report 37, Ann Arbor.

Allison, L. and Kilpela, H., Fisheries Survey of Crooked Lake, Montmorency County., I.F.R. Report No. 893, November 1, 1943.

Figure 1. Crooked Lake, Montmorency County

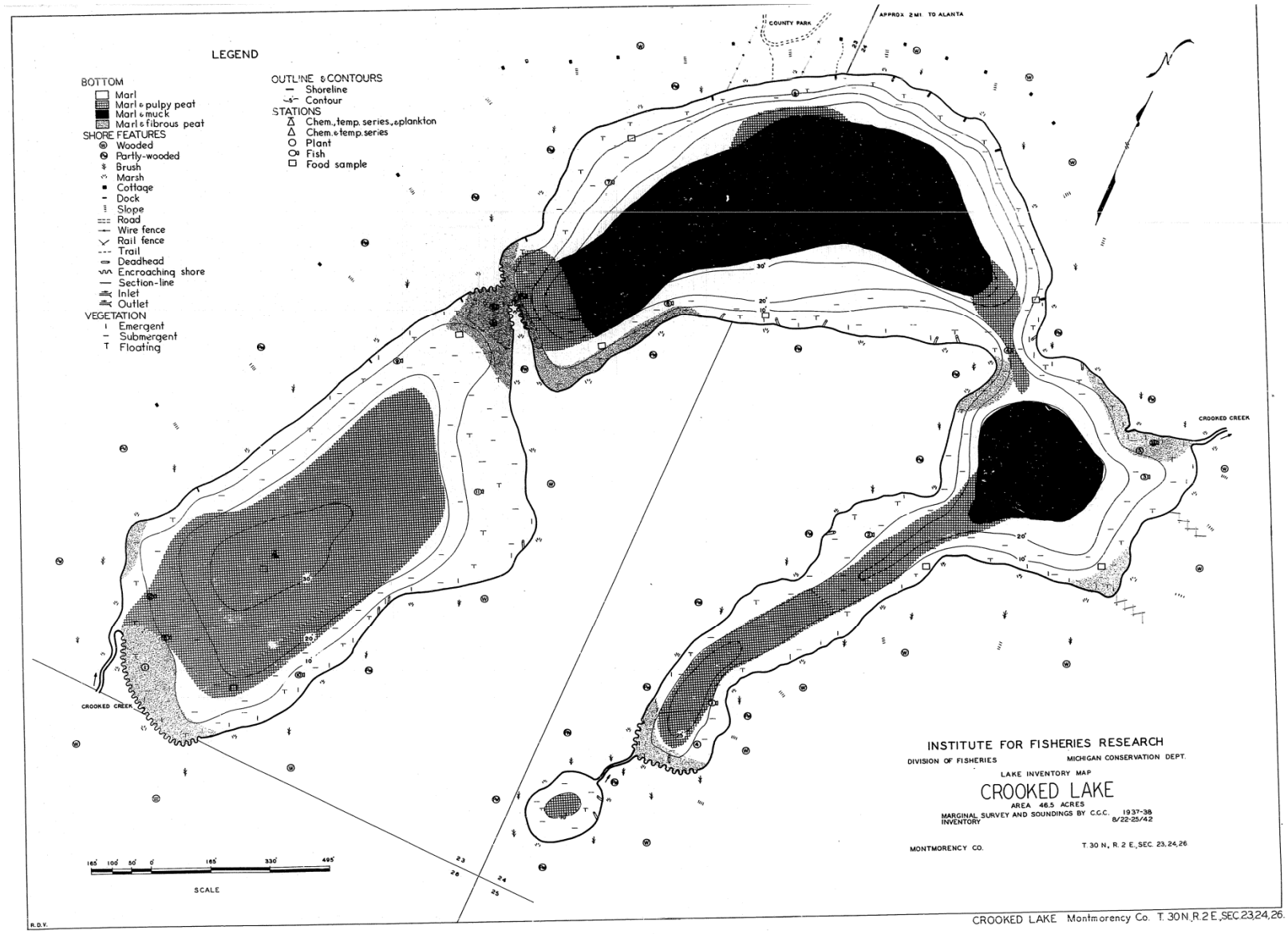

Table 1.Known DNR walleye stocking history for Crooked Lake.

Year	Strain	Number	Number/Acre	Avg. Length (in)
1977	--	3,650	78	Fall fingerlings
1978	New York	600	13	4.5
1981	--	3,650	78	2.3
1986	--	6,000	129	1.4
1989	Muskegon	6,000	129	1.3
1991	Muskegon	5,000	108	1.6
1995	Bay De Noc	8,200	176	1.7
1997	Tittabawassee	8,000	172	1.4
1999	Muskegon	5,400	116	1.7
2003	Muskegon	7,150	154	1.4
2005	Tittabawassee	5,038	108	1.5
2011	Muskegon	5,926	127	1.5
2012	Muskegon	6,840	147	1.5
2014	Muskegon	5,000	108	1.6

Table 2. Water temperature and dissolved oxygen profile for Crooked Lake, August 25, 2014.

Depth (ft)	Temperature (F)	Dissolved Oxygen (ppm)
1	73	8.4
2	72	8.4
4	72	8.4
6	70	8.4
8	69	8.4
10	68	8.3
12	67	8.0
14	65	8.0
16	60	9.2
18	55	10.0
20	51	10.3
22	48	10.3
24	47	10.4
26	46	10.5
28	45	10.0
30	44	9.2
32	43	8.8
34	43	7.4
36	42	6.0
38	42	4.5
40	42	4.1
42	41	3.8
44	41	3.7
46	41	3.6
48	41	3.4
50	41	3.3

Table 3. Species catch and relative abundance of fishes collected during the Crooked Lake fish community survey, May 27-June 23, 2014. Weight is estimated.

Species	Number	Percent by number	Weight (lb.)	Percent by weight	Length range (in.)
Yellow perch	255	34.2	4.2	2.8	1-7
Rock bass	170	22.8	9.9	6.6	1-7
Bluegill	155	20.8	15.9	10.7	1-9
Cent. mudminnow	32	4.3	0.2	0.1	1-3
Northern pike	20	2.7	51.3	34.4	17-27
Black bullhead	14	1.9	14.0	9.3	9-15
Golden shiner	14	1.9	0.1	0.1	2-3
Smallmouth bass	14	1.9	11.9	8.0	2-18
Green sunfish	13	1.7	0.1	0.1	1-3
Iowa darter	9	1.2	0.0	0.0	1-2
White sucker	9	1.2	27.0	18.1	14-22
Pumpkinseed	7	0.9	0.9	0.6	2-7
Sand shiner	7	0.9	0.0	0.0	2
Blacknose shiner	6	0.8	0.0	0.0	2
Bluntnose minnow	5	0.7	0.0	0.0	2
Common shiner	4	0.5	0.0	0.0	2
Black crappie	4	0.5	2.4	1.6	7-11
Largemouth bass	3	0.4	3.3	2.2	12-13
Walleye	3	0.4	7.8	5.2	13-22
Brown bullhead	1	0.1	0.2	0.1	7
TOTAL	**745**		**149.2**		

Table 4. Length-frequency distribution of important game fishes collected during the 2014 netting survey at Crooked Lake.

Length (in)	Bluegill	Black crappie	Rock bass	Yellow perch	Smallmouth bass	Walleye	Northern pike
1	24		5	1			
2	47		45	98	1		
3	31		34	138	3		
4	12		52	5			
5	9		25	6			
6	8		8	5	1		
7	5	1	1	2			
8	11						
9	8	1			1		
10					2		
11		2			2		
12					1		
13						1	
14							
15					1		
16					1		
17							1
18					1		
19							2
20							1
21						1	5
22						1	3
23							2
24							4
25							1
26							
27							1
28							
29							
30							

Table 5. Mean length (inches) at age for various game fishes of Crooked Lake in various years. Number in parentheses represents number aged. Growth comparison in last column was across all ages.

Species	Age group	June 1976	June 1997	May 2014	2014 growth compared to state average across all ages
Bluegill	I	--	1.7 (3)	1.5 (11)	+0.0
	II	--	3.9 (1)	3.0 (17)	
	III	5.9 (14)	5.2 (4)	4.9 (13)	
	IV	7.9 (2)	5.5 (1)	6.3 (12)	
	V	7.5 (2)	6.7 (7)	7.1 (2)	
	VI	7.9 (4)	7.1 (20)	7.6 (6)	
	VII	9.2 (1)	7.7 (9)	8.7 (10)	
	VIII	9.5 (7)	7.9 (2)	9.1 (4)	
	IX	9.8 (1)	8.6 (2)	8.7 (1)	
Pumpkinseed sunfish	I	--	--	--	--
	II		3.2 (2)	2.7 (1)	
	III	5.3 (6)	4.1 (10)	4.6 (3)	
	IV	5.9 (3)	4.6 (5)	--	
	V	6.8 (9)	--	7.4 (1)	
	VI	7.4 (2)	6.1 (3)	6.9 (3)	
	VII	--	6.8 (3)	--	
Yellow perch	I	--	2.8 (22)	3.3 (13)	+0.2
	II	5.8 (4)	4.1 (9)	5.5 (7)	
	III	7.0 (24)	4.8 (5)	6.6 (6)	
	IV	8.0 (7)	--	--	
	V	9.0 (3)	--	7.7 (1)	
	VI	10.3 (6)	--	--	
	VII	11.3 (3)	8.1 (1)	--	
Walleye	I	--	--	--	--
	II	--	14.0 (2)	13.0 (1)	
	III	--	--	--	
	IV	--	--	--	
	V	20.9 (5)	--	--	
	VI	--	--	21.0 (1)	
	VII	--	--	22.1 (1)	
	VIII	--	20.9 (3)	--	
	IX	--	21.9 (5)	--	
	X	--	24.2 (2)	--	
	XI	--	25.7 (2)	--	

Table 5.-continued.

Species	Age group	June 1976	June 1997	May 2014	2014 growth compared to state average across all ages
Smallmouth bass	I	--	--	3.3 (4)	+3.1
	II	--	--	10.6 (6)	
	III	--	10.4 (3)	12.3 (2)	
	IV	--	13.2 (6)	16.5 (1)	
	V	--	--	--	
	VI	--	16.2 (1)	--	
	VII	--	--	--	
	VIII	--	--	--	
	IX	--	--	--	
	X	--	--	--	
	XI	--	--	18.9 (1)	
Largemouth	I	--	--	--	--
bass	II	9.8 (2)	--	--	
	III	11.0 (3)	10.1 (1)	12.1 (1)	
	IV	--	13.1 (6)	13.0 (2)	
	V	--	--	--	
	VI	--	--	--	
	VII	--	15.1 (1)	--	
	VIII	--	15.7 (6)	--	
	IX	--	18.3 (1)	--	
	X	--	19.1 (1)	--	
	XI	--	--	--	
	XII	--	--	--	
Northern pike	I	13.0 (5)	13.2 (2)	--	+1.6
	II	17.3 (12)	18.2 (1)	20.1 (5)	
	III	20.7 (6)	21.0 (10)	21.6 (8)	
	IV	24.2 (1)	23.4 (11)	23.0 (3)	
	V	--	--	24.5 (1)	
	VI	--	--	25.2 (1)	
	VII	--	--	--	
	VIII	--	--	--	
	IX	--	--	27.7 (1)	
Black crappie	I	--	2.6 (1)	--	
	II	--	6.2 (9)	--	
	III	--	--	7.6 (1)	
	IV	9.2 (1)	9.6 (1)	--	
	V	--	--	11.6 (1)	
	VI	--	--	--	
	VII	--	12.4 (1)	--	