SANS CHAMBRE LAKE

URBAN LAKES FISHERIES STUDY 2014

Fisheries Assessment by:
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INTRODUCTION

Sans Chambre Lake (46°43'16" N, 81°07'48" W) is a 14.5 ha lake located within the City of Greater Sudbury, in Bowell township. It has one main basin with a maximum depth of 17.5 m (Figure 1). A complete summary of physical characteristics can be seen in Table 1.

Sans Chambre Lake is accessed by an unnamed, recreational-use road off of Nelson Lake Rd. There are no residents living around the lake and it is surrounded by Crown land. Sans Chambre Lake does receive some angling pressure during the open-water season, however the access road is in poor condition.

Sans Chambre Lake has been monitored as early as 1981 as part of a continuation of the Sudbury Environmental Study's (SES) Extensive Monitoring Program. This continuation has been investigating the effects of SO_2 reductions from Sudbury smelters on the chemistry of lakes that had been adversely affected by atmospheric sulphur and metal deposition during the mid-1970s (Keller *et al*., 2006). Changes in the zooplankton community have also been documented throughout this lake's recovery process by Keller *et al*., 2004. Regular fisheries index netting surveys on Sans Chambre Lake began in 2001 (Cooperative Freshwater Ecology Unit, 2014).

Table 1 Sans Chambre Lake location and physical description (Keller *et al*., 2006).

Township	Bowell
Latitude/Longitude	46°43'16" N, 81°07'48" W
MNRF District	Sudbury
Watershed Code	2CF13
Elevation (m)	385
Shoreline Development Factor	-
Number of Cottages/Lodges	0
Forest Type	Coniferous
Shoreline Type	Bedrock
Rubble Type	Rock/sand
Lake Surface Area (ha)	14.5
Maximum Depth (m)	17.5
Mean Depth (m)	5.6
Volume ($x10^4 m^3$)	83
Secchi (m)	5.0 (August 13, 2014)
Access	Public access from unnamed road, off Nelson Lake Rd (approx. 28 km from Sudbury).

METHODS

Fisheries Community Assessment

The fish community of Sans Chambre Lake was sampled according to the Nordic Index Netting protocol (Appelberg, 2000; Morgan and Snucins, 2005). This netting procedure was developed in Scandinavia and has been used extensively across northeastern Ontario since 1999 (Selinger *et al*., 2006) to assess the relative abundance and biomass of fish species and provide biological information on population status (Morgan and Snucins, 2005).

A total of 16 multi-mesh gillnets were set in Sans Chambre Lake from August 26 - 28, 2014. Nets were set for approximately 12 hours at randomly selected locations on the lake across multiple depth strata (4 nets in <3.0 m; 4 nets in 3.0 - 5.9 m; 4 nets in 6.0 – 11.9 m; 4 nets in 12.0 – 19.9 m). Figure 2 shows the locations of all gillnets set in Sans Chambre Lake during the survey.

All fish captured were identified to species and tallied by net. Biological information such as fork and total length (mm), weight (g), sex and maturity, and stomach contents were recorded for all large-bodied species. Ageing structures were collected from all of these species, and a muscle tissue sample was collected from up to 20 individuals per species across a size range for contaminant and stable isotope analysis. All other fish were measured (total length only) and bulk weighed for each net. A bulk sample of up to 20 individuals per species was collected for contaminant and stable isotope analysis.

Baseline Organisms

Attempts were made to collect samples of clams (n=10), snails (n=30), crayfish (n=20), Heptageniid mayflies (n=50), and aquatic plants from Sans Chambre Lake for food web studies.

Clams and snails were targeted by visually scanning near-shore areas and picking the organisms by hand or with a dip net. Crayfish were targeted by setting three to five wire mesh minnow traps baited with canned cat food overnight in littoral areas. Heptageniid mayflies were targeted by turning over rocks and woody debris along the shore of Sans Chambre Lake, and picking the organisms off the surface by hand or with a pair of tweezers. A bulk sample of up to five plants of the same species was targeted by visually scanning the near-shore areas of Sans Chambre Lake and picked by hand.

Water Quality Assessment

A dissolved oxygen (mg/L) and temperature (°C) profile was measured in the main basin of Sans Chambre Lake on August 13, 2014, using a YSI Model 52 dissolved oxygen – temperature meter. Readings were taken at 1 m intervals through the water column.

Water samples were collected on July 17, 2014 from the surface of Sans Chambre Lake. Samples were sent to the Ministry of Environment and Climate Change (MOECC) chemistry lab in Dorset, and analyzed for pH, conductivity, total inflection point alkalinity, dissolved organic carbon, and metals and major ions.

The sampling location for water quality can be seen in Figure 2.

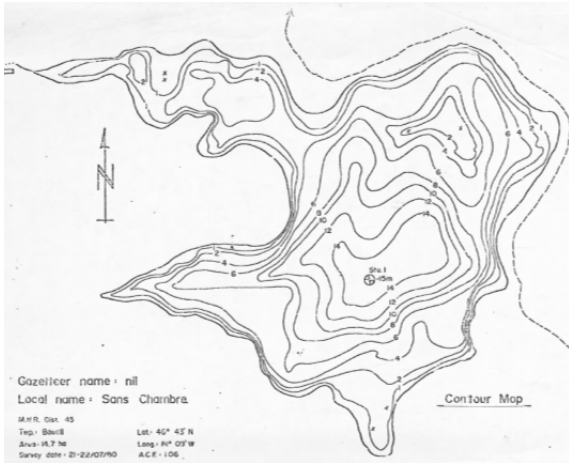

Figure 1 Bathymetric map of Sans Chambre Lake.

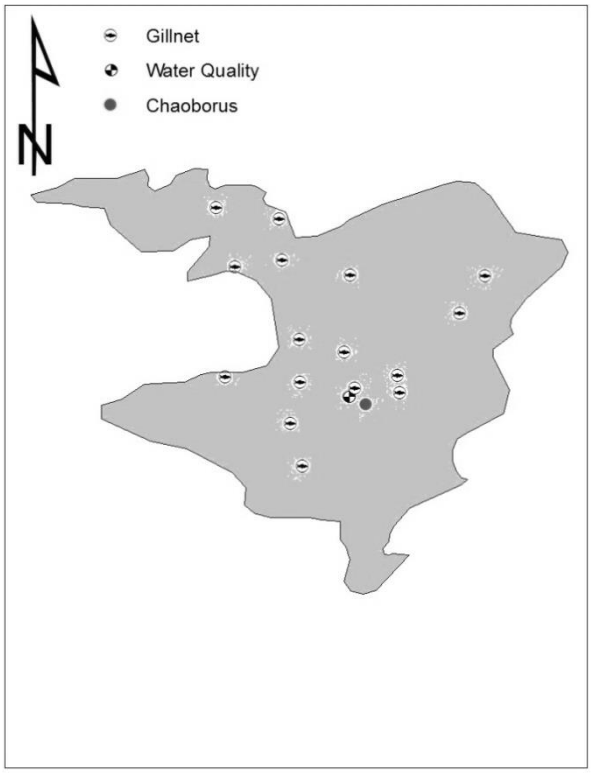

Figure 2 Outline map of Sans Chambre Lake showing the location of sampling gear or collected organisms (map not to scale).

RESULTS AND DISCUSSION

Fisheries Community Assessment

In 2014 a total of three species were captured: brown bullhead (*Ameiurus nebulosis*), smallmouth bass (*Micropterus dolomieu*) and yellow perch (*Perca flavescens*). Other species observed during previous netting surveys, including white sucker (*Catostomus commersonii*) and brook trout (*Salvelinus fontinalis*) were not captured in 2014 (Cooperative Freshwater Ecology Unit, 2014). Total catch, total weight (g) and catch-per-unit effort (CPUE) from the Nordic survey can be seen in Table 2.

Table 2 Catch summary and CPUE for all species captured in Sans Chambre Lake August 26 - 28, 2014.

Fish Species	Total Catch	Sample Size	Total Weight (g)	CPUE (fish/net)	CPUE (g/net)
Brown Bullhead	4	4	598.1	0.2	37.4
Smallmouth Bass	71	71	12647.8	4.4	790.5
Yellow Perch	58	58	7593.1	3.6	474.6
Total	133	133	20839.0	8.3	1302.4

Smallmouth bass was the most abundant species caught during this netting survey with a total catch of 71 fish that ranged from 109 mm to 308 mm in total lengths. A complete summary of morphological data for smallmouth bass can be seen in Appendix I.

Yellow perch was another commonly occurring species in 2014 with 58 perch captured that ranged in total lengths from 65 mm to 360 mm. A length frequency histogram can be seen in Figure 3.

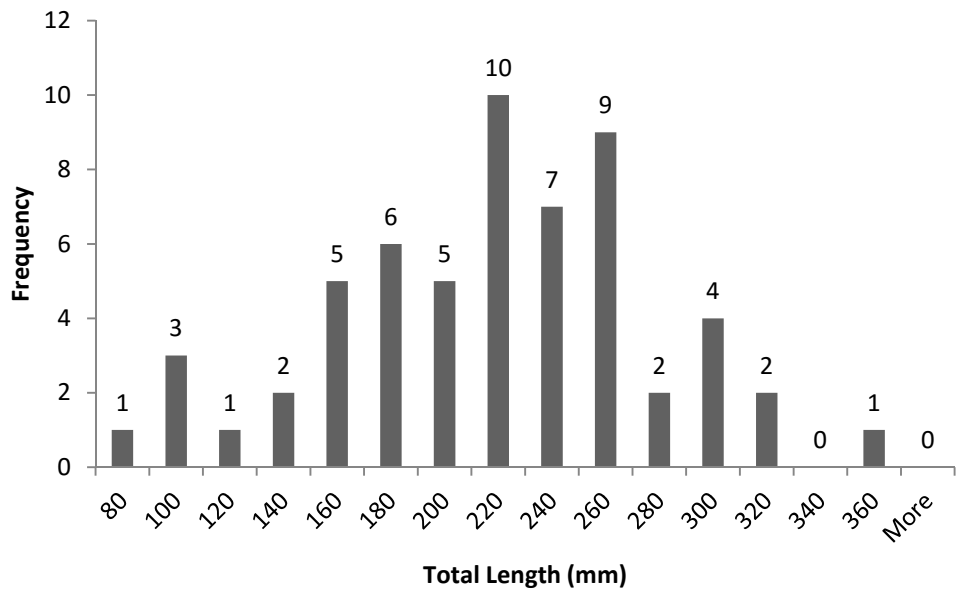

Figure 3 Length frequency histogram for yellow perch (n=58) captured in Sans Chambre Lake August 26 - 28, 2014.

Previous netting results indicate that two to four species have inhabited Sans Chambre Lake since the first Nordic survey was conducted on the lake in 2001. Smallmouth bass have inhabited Sans Chambre Lake since at least 2001 and have always been the most abundant species in the lake. Yellow perch arrived to Sans Chambre Lake in 2007 as part of a stocking experiment (G.Morgan and A. Luek) , accounting for almost 7% of the total catch at the time (Cooperative Freshwater Ecology Unit, 2014). As of 2014, yellow perch account for 43.6% of

the total catch. Brook trout have not been observed in the lake since 2007 and white sucker have not been observed since 2001 (Cooperative Freshwater Ecology Unit, 2014). Species richness and proportion of total catch can be seen in Table 3.

Table 3 Species richness and proportion of total catch for Sans Chambre Lake (Cooperative Freshwater Ecology Unit, 2014).

Survey Type	**Nordic**		**Nordic**		**Nordic**		**Nordic**		**Nordic**	
Year	**2001**		**2004**		**2007**		**2009**		**2014**	
Species	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
Brook Trout	-	-	-	-	1	0.98	-	-	-	-
White Sucker	1	0.51	-	-	-	-	-	-	-	-
Brown Bullhead	3	1.52	2	1.65	3	2.94	7	4.43	4	3.01
Smallmouth Bass	193	98	119	98.3	91	89.2	117	74.1	71	53.4
Yellow Perch	-	-	-	-	7	6.86	34	21.5	58	43.6
Total	197	100	121	100	102	100	158	100	133	100
Species Richness	3		2		4		3		3	

Total catch records indicate that smallmouth bass have always been the most abundant species in Sans Chambre Lake. However, bass appear to be declining slightly over time, while yellow perch has increased since the arrival of this species in 2007. Historic total catch data can be seen in Figure 4.

Smallmouth bass have also accounted for the majority of the total biomass in Sans Chambre Lake, the highest biomass of the species occurring in 2009 with a total weight of 18374 g. The total biomass of yellow perch has increased along with their abundance from 3180 g in 2009 to 7022g in 2014 (Cooperative Freshwater Ecology Unit, 2014). Total biomass data can be seen in Figure 5.

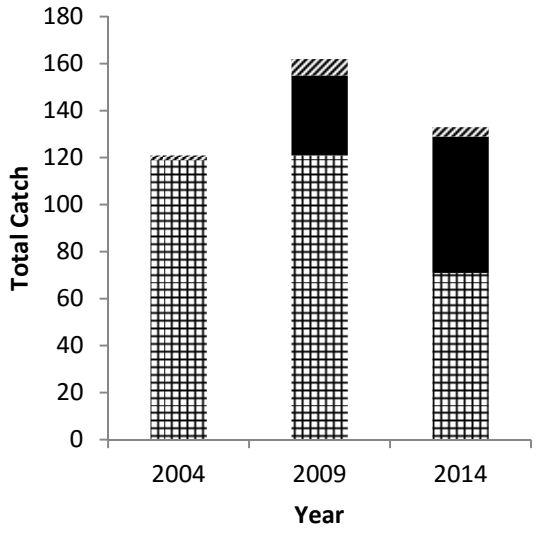

Figure 4 Total catch data from Sans Chambre Lake.

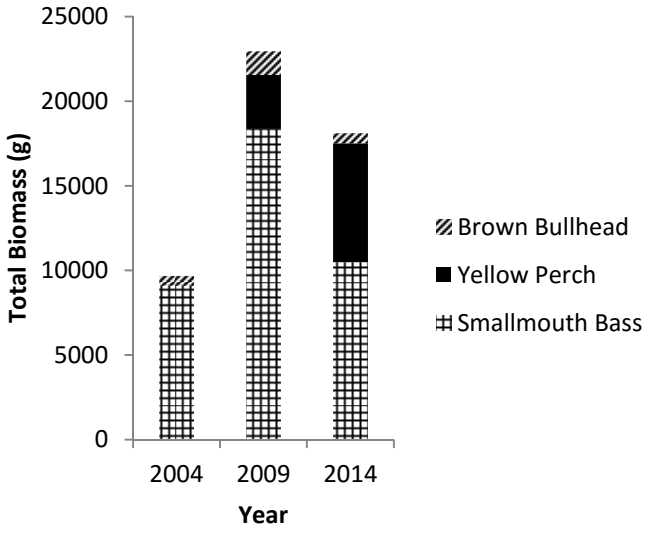

Figure 5 Total biomass (g) data from Sans Chambre Lake.

Species diversity has made considerable improvements since the first Nordic survey was conducted on Sans Chambre Lake in 2004. At the time, only two species inhabited the lake, resulting in a "very low" Shannon H Diversity value of 0.0842. This classification increased to "low" in 2009 with a diversity value of 0.6911. As of 2014, species diversity has improved to "below average" with a value of 0.8024 (Morgan and Snucins, 2005). Species diversity values can be seen in Figure 6.

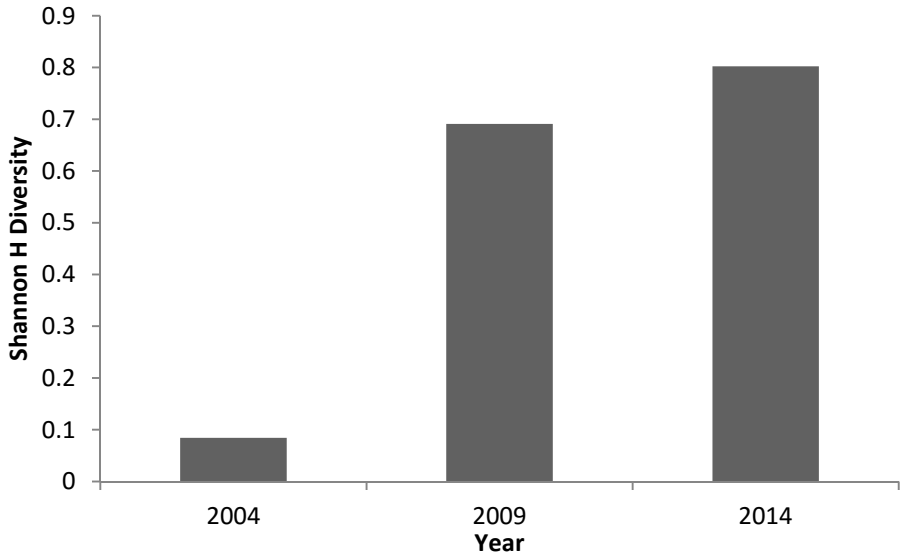

Figure 6 Species diversity (Shannon H Diversity) values for Sans Chambre Lake.

Baseline Organisms

No clams, snails, mayflies or crayfish were collected from Sans Chambre Lake. Six night time zooplankton hauls were conducted at Sans Chambre Lake on August 26, 2014. Approximately 300 *Chaoborus* sp. were collected from the collection vessel. No aquatic plants were collected from Sans Chambre Lake.

Water Quality Assessment

At the time of the Nordic Index Netting survey, Sans Chambre Lake was thermally stratified (Figure 7). Water temperatures ranged from 21 °C at the surface to 4.9 °C at 17 m. Dissolved oxygen levels ranged from 7.6 mg/L to 0.1 mg/L. Sans Chambre Lake displayed signs of anoxia as dissolved oxygen levels significantly declined at 10 m. Depth at the site of the temperature and dissolved oxygen profiles was 17.5 m and the secchi water clarity was 5.0 m.

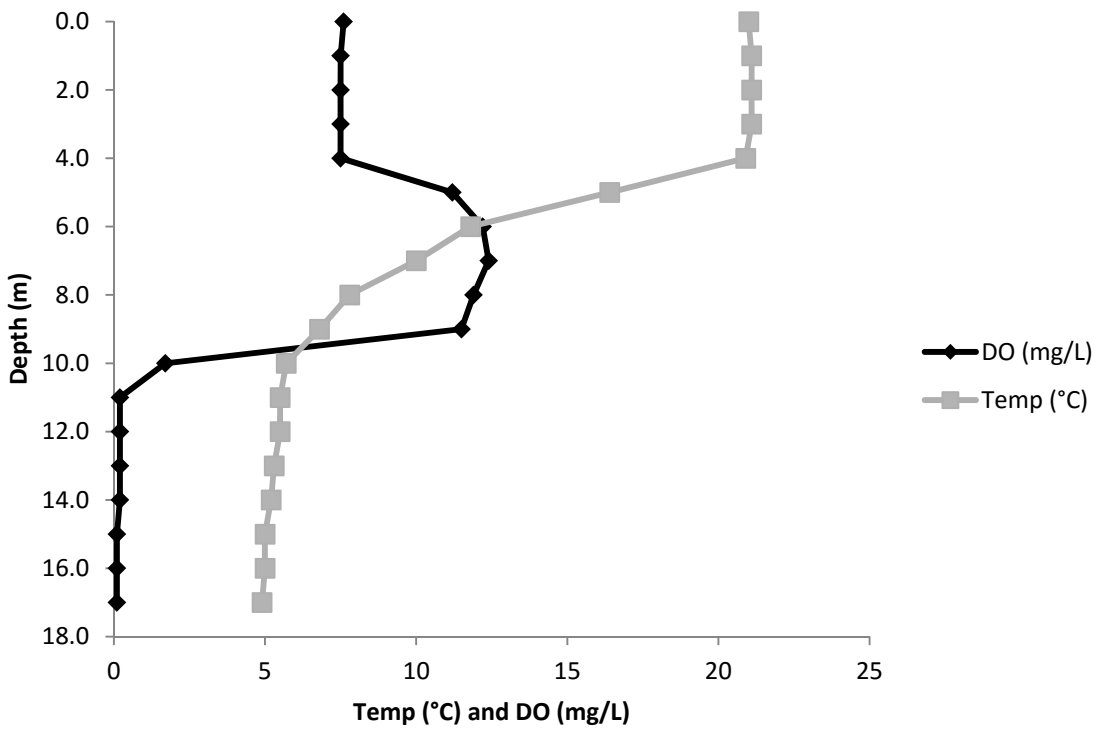

Figure 7 Temperature (°C) and dissolved oxygen (mg/L) profile for Sans Chambre Lake, measured August 13, 2014.

The water quality of Sans Chambre Lake has made a considerable recovery since 1981 (Table 4). During this time, the pH has increased from 5.38 to 6.5, along with an increase in TIA alkalinity from -0.16 mg/L $CaCO_3$ to 2.24 mg/L $CaCO_3$. Concentrations of metals such as Nickel (Ni), Copper (Cu), Iron (Fe) and Aluminum (Al) have declined over the past three decades. This improvement in water quality appears to be the result of reductions in emissions from smelters in Sudbury (Keller *et al*., 2007).

As of July 17, 2014, Sans Chambre Lake had a circumneutral pH reading of 6.5 and a TIA alkalinity of 2.24 mg/L $CaCO_3$. Metal concentrations have also improved. Concentrations of Nickel (4 µg/L), Copper (1 µg/L), Iron (40 µg/L) and Aluminum (17 µg/L) remain below these criteria.

Table 4 Water chemistry from Sans Chambre Lake (1. Ontario Ministry of Environment and Energy, 1994; 2. Keller *et al*., 2006)

Parameter	PWQO[1]	Year			
		1981[2]	1990[2]	2003[2]	2014
pH	6.5-8.5	5.38	5.92	6.39	6.5
TIA Alkalinity (mg/L $CaCO_3$)	-	-0.16	2.55	1.45	2.24
Conductivity (µS/cm)	-	40.0	32.4	16.8	17.6
True Colour (TCU)	-	-	10.5	-	15.7
DOC (mg/L)	-	1.8	2.2	2.8	2.8
Ca (mg/L)	-	3.60	2.80	1.70	1.38
Mg (mg/L)	-	0.900	0.720	0.805	0.462
Na (mg/L)	-	1.000	0.720	0.470	0.785
K (mg/L)	-	-	0.420	0.350	0.305
SiO_3 (mg/L)	-	0.550	1.420	0.680	1.2
SO_4 (mg/L)	-	12.5	8.7	5.5	3.6
Total Cu (µg/L)	5	6.0	3.0	2.2	1.3
Total Ni (µg/L)	25	25.0	8.0	5.8	4.5
Total Zn (µg/L)	30	18.0	6.0	7.0	1.9
Total Fe (µg/L)	300	190.0	440.0	61.5	40.0
Total Mn (µg/L)	-	84.0	48.0	25.5	12.7
Total Al (µg/L)	75	94.0	60.0	23.5	17.3

CONCLUSIONS

Sans Chambre Lake no longer exhibits signs of acidification as pH has increased from 5.38 in 1981 (Keller *et al*., 2006) to 6.5 in 2014. Metal concentrations have also improved with declines of 78% for Cu and 82% for Ni, and these metals now currently sit below PWQO criteria for the protection of aquatic life (Ontario Ministry of Environment and Energy, 1994). Sans Chambre Lake also exhibits signs of anoxia. Sensitive invertebrates such as clams, snails, crayfish and mayflies were not observed in the lake. However, Sans Chambre Lake supports populations of three fish species, including smallmouth bass, a predatory sport fish. Further sampling and monitoring initiatives will likely continue in order to track changes in species abundance as the yellow perch population continues to thrive.

ACKNOWLEDGEMENTS

The urban lakes fisheries monitoring program in Sudbury is conducted by staff and students of the Cooperative Freshwater Ecology Unit with support from OMNRF, OMOECC, City of Greater Sudbury, Vale and Glencore. Over the past 25 years the program has been led by Rod Sein, Rob Kirk, George Morgan, Ed Snucins, Michelle Gillespie and John Gunn, with technical support by Jason Houle, Lee Haslam, Andrew Corston and dozens of students (includes graduate students: Andreas Luek, Kelly Lippert, Elizabeth Wright, Scott Kaufman) and summer assistants. Data from water quality monitoring was provided by OMOECC through the

assistance of Jocelyne Heneberry, Bill Keller and John Bailey. We thank all who contributed, including the many land owners who provided access to these study lakes.

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APPENDIX I

Morphological data for smallmouth bass (*Micropterus dolomieu*) from Sans Chambre Lake, August 26 - 28, 2014.

Species	Fish #	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex 1-Male 2-Female 9-Unknown	Maturity 1-Immature 2-Mature 9-Unknown	Ageing Structure 0-None 2-Scales 4-Pectoral Ray 7-Dorsal Spine A-Otolith B-Operculum D-Cleithrum	Tissue 0-None 1-Flesh 8-Stomach 9-Gonads A-Whole Fish X-Genetic
Smallmouth Bass	1	365	388	606.8	2	2	A	1
Smallmouth Bass	2	267	288	270.6	1	2	A	1
Smallmouth Bass	3	204	216	110.5	2	1	A	1
Smallmouth Bass	4	161	172	58.6	2	1	A	1
Smallmouth Bass	5	199	210	98.1	2	1	A	1
Smallmouth Bass	6	220	225	144.5	1	1	A	1
Smallmouth Bass	7	258	272	216.9	1	2	A	1
Smallmouth Bass	8	222	238	145.4	1	2	A	1
Smallmouth Bass	9	190	200	88.5	1	1	A	1
Smallmouth Bass	10	188	200	91	2	1	A	1
Smallmouth Bass	11	168	178	62.7	1	1	A	0
Smallmouth Bass	12	151	160	43.6	9	1	A	0
Smallmouth Bass	24	253	268	215.4	2	2	A	1
Smallmouth Bass	25	230	245	152.8	1	1	A	1
Smallmouth Bass	26	183	195	81.7	2	2	A	1
Smallmouth Bass	27	195	206	99.6	1	1	A	1
Smallmouth Bass	28	229	245	148	1	1	A	1
Smallmouth Bass	29	206	218	113.4	2	1	A	1
Smallmouth Bass	30	207	219	109.7	2	1	A	1
Smallmouth Bass	41	190	201	89.3	9	1	A	1
Smallmouth Bass	42	177	188	77.7	1	1	A	1
Smallmouth Bass	43	176	187	70.9	1	1	A	1
Smallmouth Bass	44	165	177	64.8	1	1	A	0
Smallmouth Bass	45	103	109	15.2	9	1	0	0
Smallmouth Bass	50	246	260	186.3	2	2	A	0
Smallmouth Bass	51	252	270	221.7	1	2	A	0
Smallmouth Bass	52	166	175	60.3	2	1	A	0
Smallmouth Bass	53	249	264	197.1	1	2	A	0
Smallmouth Bass	54	200	213	104.2	2	2	A	0
Smallmouth Bass	55	197	208	96.4	2	2	A	0
Smallmouth Bass	56	297	319	330	1	2	A	0
Smallmouth Bass	57	184	194	74.8	2	2	A	0
Smallmouth Bass	58	305	321	357.9	2	2	A	0
Smallmouth Bass	59	254	270	214.7	2	2	A	0

Species	Fish #	Fork Length (mm)	Total Length (mm)	Weight (g)	Sex 1-Male 2-Female 9-Unknown	Maturity 1-Immature 2-Mature 9-Unknown	Ageing Structure 0-None 2-Scales 4-Pectoral Ray 7-Dorsal Spine A-Otolith B-Operculum D-Cleithrum	Tissue 0-None 1-Flesh 8-Stomach 9-Gonads A-Whole Fish X-Genetic
Smallmouth Bass	60	267	288	230.2	2	2	A	0
Smallmouth Bass	61	321	340	413.1	2	2	A	0
Smallmouth Bass	94	240	255	165.9	2	2	A	0
Smallmouth Bass	95	270	282	245.7	2	2	A	0
Smallmouth Bass	96	238	251	167.9	2	2	A	0
Smallmouth Bass	97	321	341	439.8	2	2	A	0
Smallmouth Bass	98	285	305	313	2	2	A	0
Smallmouth Bass	99	268	286	260.7	1	2	A	0
Smallmouth Bass	100	208	220	118.2	1	1	A	0
Smallmouth Bass	101	288	308	297.4	1	2	A	0
Smallmouth Bass	102	255	272	209.9	2	2	A	0
Smallmouth Bass	103	166	176	57.4	2	1	A	0
Smallmouth Bass	104	260	274	201.4	9	9	A	0
Smallmouth Bass	105	238	250	189.5	2	2	A	0
Smallmouth Bass	106	290	311	322.2	2	2	A	0
Smallmouth Bass	107	243	259	206.5	2	2	A	0
Smallmouth Bass	108	195	208	90.6	2	1	A	0
Smallmouth Bass	109	197	209	98	2	2	A	0
Smallmouth Bass	110	170	180	65.5	1	1	A	0
Smallmouth Bass	111	194	204	99.2	2	1	A	0
Smallmouth Bass	112	250	265	200.3	2	2	A	0
Smallmouth Bass	113	190	201	90.1	2	2	A	0
Smallmouth Bass	114	187	197	86.9	2	2	A	0
Smallmouth Bass	115	202	215	104.6	2	2	A	0
Smallmouth Bass	116	257	273	212.5	2	2	A	0
Smallmouth Bass	117	264	282	239.1	2	2	A	0
Smallmouth Bass	118	304	323	354	2	2	A	0
Smallmouth Bass	121	264	280	232.1	1	2	A	0
Smallmouth Bass	122	206	219	119.5	2	2	A	0
Smallmouth Bass	123	197	210	102.2	1	2	A	0
Smallmouth Bass	124	242	255	167.2	2	2	A	0
Smallmouth Bass	125	252	269	210.6	2	2	A	0
Smallmouth Bass	126	290	309	326.5	1	2	A	0
Smallmouth Bass	127	315	334	405.8	1	2	A	0
Smallmouth Bass	128	229	243	162.8	2	1	A	0
Smallmouth Bass	129	284	301	279.5	1	2	A	0