ST. CHARLES LAKE

URBAN LAKES FISHERIES STUDY 2014

Vale Living with Lakes Centre, Laurentian University, Sudbury, Ontario
For further information, please contact Dr. John Gunn (jgunn@laurentian.ca).

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INTRODUCTION

METHODS

Fisheries Community Assessment

In 2014 the fish community of St. Charles 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 eight multi-mesh gillnets were set in St. Charles Lake from September 8 - 10, 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). Figure 2 shows the locations of all gillnets set in St. Charles 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 of each 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.

Water Quality Assessment

A dissolved oxygen (mg/L) and temperature (°C) profile was measured in the main basin of St. Charles Lake on September 9, 2014, using a YSI Model 52 dissolved oxygen – temperature meter. Readings were taken at 0.5 m intervals through the water column.

Water samples were collected on July 16, 2014 from the surface of St. Charles 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.

RESULTS AND DISCUSSION

Fisheries Community Assessment

During the September 2014 survey, a total of five species were captured: northern pike (*Esox lucius*) brown bullhead (*Ameiurus nebulosis*), pumpkinseed (*Lepomis gibbosus*), yellow perch (*Perca flavescens*) and walleye (*Sander vitreus*). Iowa darter (*Etheostoma exile*) a species captured in earlier surveys were not captured in 2014 (Cooperative Freshwater Ecology Unit, 2014). Total catch, total weight (g) and catch-per-unit effort (CPUE) from 2014 are seen in Table 2.

Figure 1 Bathymetric map of St. Charles Lake (Kirk and Drouin, 1990).

Figure 2 Outline map of St. Charles Lake showing the location of sampling gear or collected organisms.

Table 2 Catch summary and CPUE for all species captured in St. Charles Lake September 8 to 10, 2014. *Fish were not individually weighed. Total weight (g) and CPUE (g/net) measurements are based on total net biomass for that species.

Fish Species	Total Catch	Sample Size	Total Weight (g)	CPUE (fish/net)	CPUE (g/net)
Northern Pike	9	8	6226	1.1	778
Brown Bullhead	3	3	1901	0.4	237
Pumpkinseed*	41	40	298	5.1	37
Yellow Perch*	199	159	2533	24.9	316
Walleye	10	10	6081	1.2	760
Grand Total	262	220	17040	32.8	2130

The eight northern pike sampled had total lengths ranging from 469 mm to 556 mm. The ten walleye had total lengths ranging from 135 mm to 559 mm. A summary of morphological information for these two species can be seen in Appendix I.

Yellow perch was the most numerically abundant species in St. C

this survey occurred prior to the use of the Nordic protocol, it resulted in the highest total catch of 3985 fish (Poulin *et al*., 1991). Since more recent Nordic surveys began in 2004, species richness has improved to five or six species. Yellow perch have remained the most abundant species, however their proportion of the total catch has declined by 13% in ten years (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 from St. Charles Lake (1. Poulin *et al*., 1991; 2. Cooperative Freshwater Ecology Unit, 2014).

Survey Type	**Multi-gear Survey**		**Nordic**		**Nordic**		**Nordic**	
Year	**1990**[1]		**2004**[2]		**2009**[2]		**2014**	
Species	***n***	***%***	***n***	***%***	***n***	***%***	***n***	**%**
Northern Pike	-	-	7	1.64	2	0.72	9	3.44
Brown Bullhead	27	0.68	20	4.67	22	7.94	3	1.15
Pumpkinseed	-	-	14	3.27	28	10.1	41	15.6

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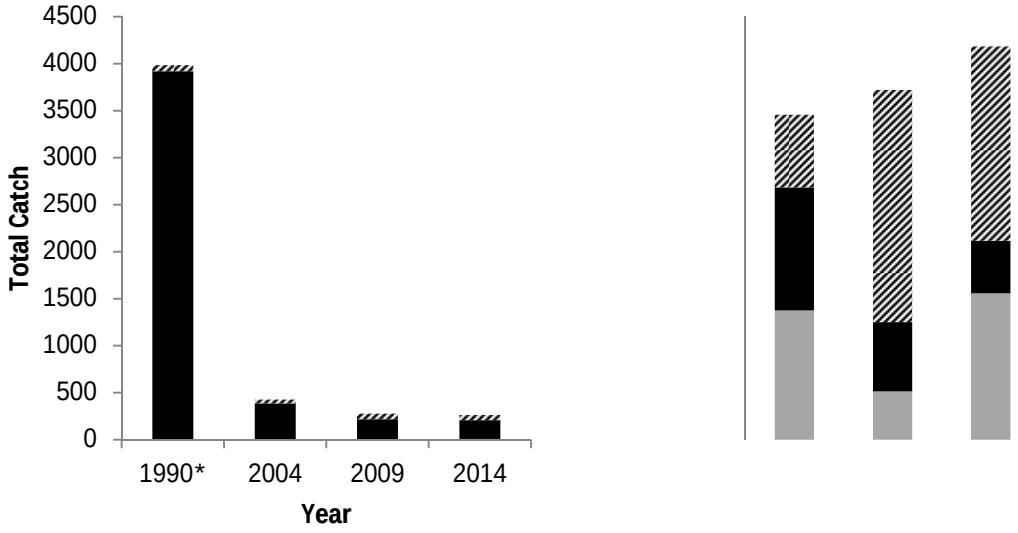

As catch numbers of predators increased and species composition have changed since 2004 in St. Charles Lake, species diversity has increased as well. When the first Nordic survey was conducted in 2004, a "low" Shannon H Diversity value of 0.4952 was calculated. Diversity improved to a "below average" value of 0.7851 in 2009, and remains "below average" with another improvement in 2014 to a value of 0.7908 (Morgan and Snucins, 2005). Species diversity values can be seen in Figure 6.

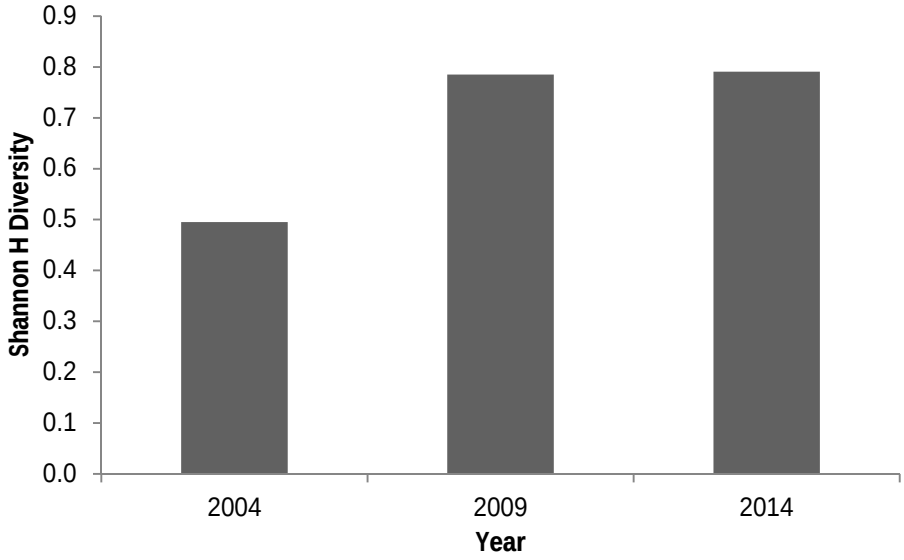

Figure 6 Species diversity (Shannon H Diversity) values from St. Charles Lake.

Water Quality Assessment

At the time of the Nordic Index Netting survey, St. Charles Lake was isothermal (Figure 7). Water temperatures ranged from 19.4 °C at the surface to 18.0 °C at 5.5 m. Dissolved oxygen levels ranged from 7.6 mg/L to 0.1 mg/L. Depth at the site of the temperature and dissolved oxygen profiles was 6.0 m and the secchi water clarity was 3.67 m.

The water quality of St. Charles Lake has made a considerable recovery since 1962 when the pH was 5.2 (Table 4). Records indicate that the lake recovered from acidity in the early- to mid-1980s, and has made further improvements to 7.48 in 2014. TIA alkalinity has also increased from -4.40 mg/L $CaCO_3$ to 5.45 mg/L $CaCO_3$. Concentrations of metals such as Nickel (Ni), Copper (Cu), and Aluminum (Al) have been declining since 1990 (no data prior to 1990). This improvement in water quality is perhaps mainly the result of reductions of emissions from local smelting operations (Keller *et al*., 2007), however watershed liming by the City of Greater Sudbury may also be contributing to the improving water quality.

As of July 16, 2014, St. Charles Lake has a circumneutral pH reading of 7.48 and a TIA alkalinity of 20.8 mg/L $CaCO_3$. Concentrations of metals have been declining, however Nickel (64.2 µg/L) and Copper (8.6 µg/L) concentrations remain above criteria set by the Ministry of Environment and Climate Change's (MOECC) Provincial Water Quality Objectives (PWQO) for the protection of aquatic life. Aluminum (11 µg/L) concentratilumprm ria ! M p

Table 4 Water chemistry from St. Charles Lake (1. Ontario Ministry of Environment and Energy, 1994; 2. Kirk and Drouin, 1990; 3. Keller *et al*., 2004).

Parameter	PWQO[1]	Year					
		1962[2]	1982[2]	1985[2]	1990[3]	2003[3]	2014
pH	6.5-8.5	5.20	6.8	6.9	7.11	7.22	7.48
TIA Alkalinity (mg/L $CaCO_3$)	-	-	-	-	7.66	14.70	20.8
Conductivity (µS/cm)	-	176.00	-	-	210.0	243.0	238
True Colour (TCU)	-	-	-	-	-	-	28.8
DOC (mg/L)	-	-	-	-	4.8	4.8	4.9
Ca (mg/L)	-	-	-	-	10.60	9.24	9.12
Mg (mg/L)	-	-	-	-	3.94	3.38	3.52
Na (mg/L)	-	-	-	-	19.50	29.10	31.9
K (mg/L)	-	-	-	-	1.800	1.550	1.69
SiO_3 (mg/L)	-	-	-	-	0.86	0.32	0.62
SO_4 (mg/L)	-	-	-	-	29.15	18.13	11.3
Total Cu (µg/L)	5	-	-	-	27	21	12.9
Total Ni (µg/L)	25	-	-	-	190	95	38.1
Total Zn (µg/L)	30	-	-	-	15	6	1.7
Total Fe (µg/L)	300	-	-	-	120	76	100
Total Mn (µg/L)	-	-	-	-	50	18	19.3
Total Al (µg/L)	75	-	-	-	<60	16	9.9

CONCLUSIONS

St. Charles Lake has not been acidic for at least 32 years and had a pH of 7.48 in 2014. Metal concentrations have also improved with a decline of 52% for Cu and 80% for Ni since 1990. However, these concentrations remain above PWQO criteria for the protection of aquatic life (Ontario Ministry of Environment and Energy, 1994). Despite this, St. Charles Lake supports populations of five species, including northern pike and walleye as predatory sport fish. These two predators have occurred in St. Charles Lake since the first Nordic survey in 2004 (Cooperative Freshwater Ecology Unit, 2014). .

ACKNOWLEDGEMENTS

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APPENDIX I

Morphological data for northern pike (*Esox lucius*) and walleye (*Sander vitreus*) from St. Charles Lake, September 8 - 10, 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
Northern Pike	26	525	556	925	2	2	A D	1
Northern Pike	50	441	472	584.4	1	2	A D	1
Northern Pike	143	477	511	773.7	2	2	A D	1
Northern Pike	144	518	553	961.4	2	2	A D	1
Northern Pike	145	472	500	741.8	2	2	A D	1
Northern Pike	146	436	469	595.2	2	2	A D	1
Northern Pike	157	502	535	910.8	2	2	A D	1
Northern Pike	158	485	510	734.3	2	2	A D	1
Walleye	1	485	514	1326.8	1	2	A	1
Walleye	48	512	543	1375.6	1	2	A	1
Walleye	99	121	135	20.1	2	1	A	1