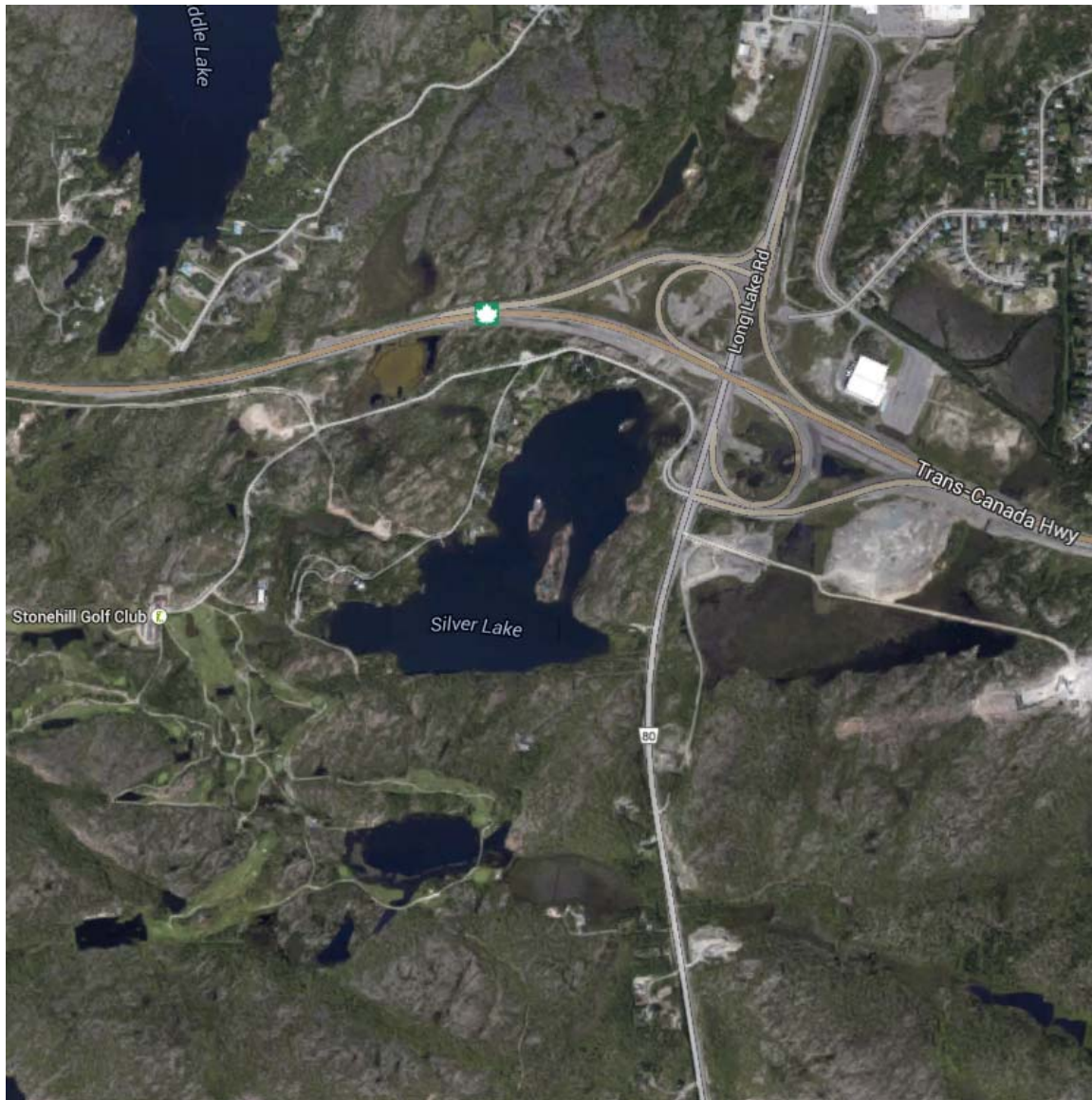


SILVER LAKE
URBAN LAKES FISHERIES STUDY 2014



Fisheries Assessment by:
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INTRODUCTION

Silver Lake (46°25'46" N, 81°00'50" W) is a 23.1 ha lake located within the City of Greater Sudbury, in Broder township. It has one main basin with a maximum depth of 10 m (Figure 1). A complete summary of physical characteristics can be seen in Table 1.

Silver Lake is publicly accessed at a gravel boat launch at the north end of the lake, off Silver Lake Rd. There are approximately 17 seasonal and permanent residences around the shoreline of the lake, as well as a golf course at the south end.

Silver Lake was a very acidic and metal contaminated lake in the 1970s. The City of Greater Sudbury began a watershed liming effort around this lake in 1983, 1985 and 2000 and tree planting occurred in 1998, 1999, 2001 and 2004 (T. McCaffrey, CGS pers. comm). Reports indicate that the lake was once stocked with smallmouth bass (*Micropterus dolomieu*) in 1952 (Kirk *et al.*, 1990) however as far as we know the lake was fishless for many decades prior to 2004. Water quality in Silver Lake has been monitored as early as 1981 as part of a continuation of the Sudbury Environmental Study's (SES) Extensive Monitoring Program. The SES program was investigating the effects of SO₂ 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).

In 2014, as part of the Urban Lakes Study, field crews from Laurentian University's Cooperative Freshwater Ecology Unit conducted fish surveys in Silver Lake, along with several other lakes around Greater Sudbury. The lake was previously sampled in 1990 and 2004.

Table 1 Silver Lake location and physical description (Keller *et al.*, 2006; Kirk *et al.*, 1990).

Township	Broder
Latitude/Longitude	46°25'46" N, 81°00'50" W
MNRF District	Sudbury
Watershed Code	2CF08
Elevation (m)	280
Shoreline Development Factor	1.66
Number of Cottages/Lodges	17
Forest Type	Birch transition
Shoreline Type	Bedrock/sand
Lake Surface Area (ha)	23.1
Maximum Depth (m)	10.0
Mean Depth (m)	4.8
Volume (x10⁴m³)	111
Secchi (m)	4.0 (June 27, 2005)

Access	Gravel boat launch at north end of lake, off Silver Lake Rd.
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METHODS

Fisheries Community Assessment

The 2014 netting survey followed 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 the population's status (Morgan and Snucins, 2005).

A total of eight multi-mesh gillnets were set in Silver Lake during September 10 - 11, 2014. Nets were set for approximately 12 hours at randomly selected locations on the lake across multiple depth strata (3 nets in <3.0 m; 3 nets in 3.0 - 5.9 m; 2 nets in 6.0 – 11.9 m). Figure 2 shows the locations of all gillnets set in Silver 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. All other small bodied fish were measured (total length only) and bulk weighed for each net.

Water Quality Assessment

Water samples were collected on July 16, 2014 from the surface of Silver 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 September 10-11, 2014, a total of eight nets were set and six species captured including: common shiner (*Luxinlis cornutus*), creek chub (*Semotilus atramaculatus*), pearl dace (*Margariscus margarita*), brown bullhead (*Ameiurus nebulosis*), pumpkinseed (*Lepomis gibbosus*), and yellow perch (*Perca flavescens*). Four species observed in the earlier 2004 survey netting survey were not captured in 2014. These included: northern pike (*Esox lucius*), finescale dace (*Phoxinus neogaeus*), northern redbelly dace (*Phoxinus eos*) and fathead minnow (*Pimephales promelas*) (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.

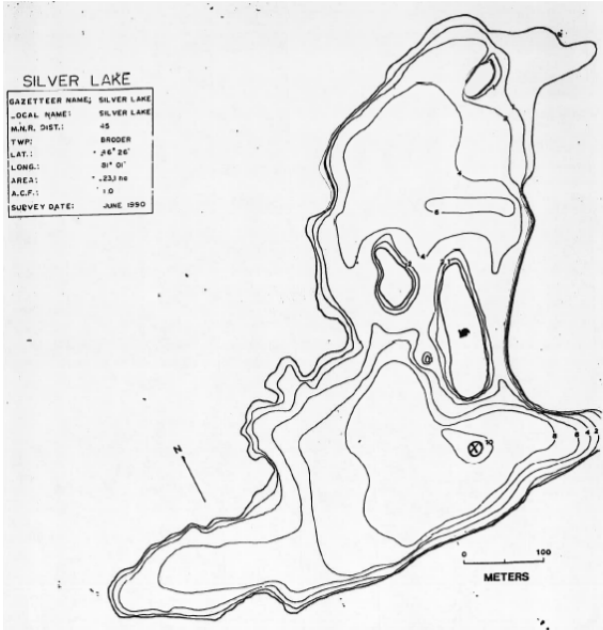


Figure 1 Bathymetric map of Silver Lake (Kirk *et al.*, 1990).

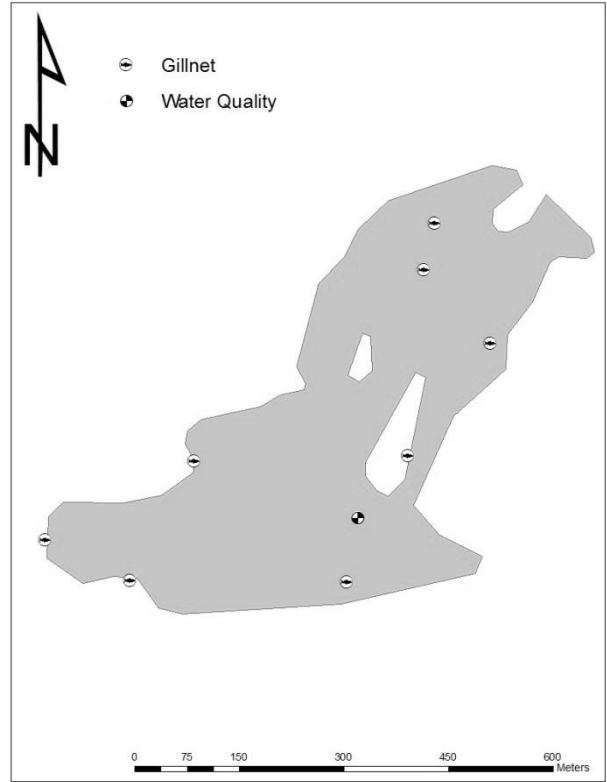


Figure 2 Outline map of Silver Lake showing the location of sampling gear or collected organisms.

Table 2 Catch summary and CPUE for all species captured in Silver Lake September 10-11, 2014. Fish were not individually weighed. Total weight (g) and CPUE (g/net) are based on total net biomass for that species.

Fish Species	Total Catch	Sample Size	Total Weight (g)	CPUE (fish/net)	CPUE (g/net)
Common Shiner	2	0	-	0.2	-
Creek Chub	21	16	602.5	2.6	75.3
Pearl Dace	3	3	39.3	0.4	4.9
Brown Bullhead	83	83	4512.4	10.4	564.0
Pumpkinseed	203	199	3865.7	25.4	483.2
Yellow Perch	722	679	15558.8	90.2	1944.8
Total	1034	980	24578.7	129.2	3072.3

Yellow perch was the most abundant species in Silver Lake, with total lengths ranging from 60 mm to 255 mm. A length frequency histogram can be seen in Figure 3.

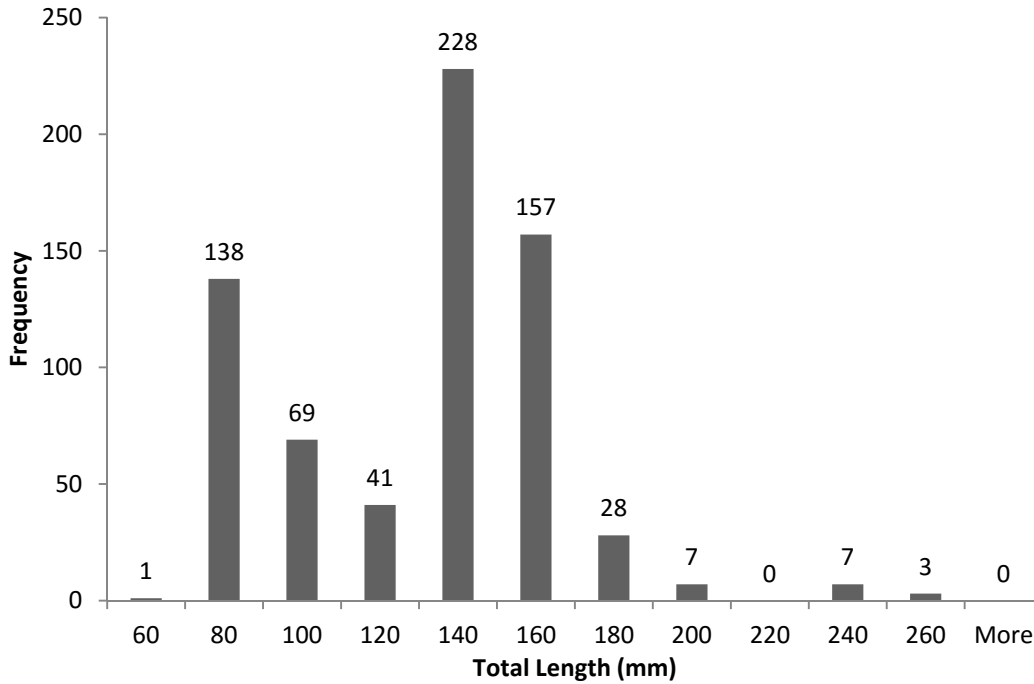


Figure 3 Length frequency histogram for yellow perch (n=679) captured in Silver Lake September 10 - 11, 2014.

Discussion

No fish were observed in Silver Lake during the 1990 Urban Lakes Survey (Poulin *et al.*, 1991) and it was considered one of the most acid and metal contaminated lakes in the City (Gunn pers. comm.). After the watershed liming, water quality improved dramatically. The first Nordic survey, conducted in 2004, indicated that the species composition was primarily made up of cyprinids (suggestive of bait fish introduction) with a few bullheads and a single small pike. Fathead minnow was the most abundant species at the time, accounting for 52% of the total catch (Cooperative Freshwater Ecology Unit, 2014). When the lake was resurveyed in 2014 only half the standard number of nets were used (Morgan and Snucins, 2005) however, total catch had increased to 1033 fish. Yellow perch was the most abundant species in 2014, accounting for 70% of the total catch. Catch records are presented in Table 3, Figure 4 and Figure 5.

Table 3 Species richness and proportion of total catch for Silver Lake (*Only half the required nets were set during this survey; 1. Poulin *et al.*, 1991; 2. Cooperative Freshwater Ecology Unit, 2014).

Survey Type Year	Multi-gear Survey 1990 ¹		Nordic 2004 ²		Nordic 2014*	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Species						
Northern Pike	-	-	1	0.13	-	-
Northern Redbelly Dace	-	-	2	0.25	-	-
Finescale Dace	-	-	2	0.25	-	-
Common Shiner	-	-	-	-	1	0.1
Fathead Minnow	-	-	411	51.6	-	-
Creek Chub	-	-	238	29.9	21	2.03
Pearl Dace	-	-	137	17.2	3	0.29
Brown Bullhead	-	-	6	0.75	83	8.03
Pumpkinseed	-	-	-	-	203	19.7
Yellow Perch	-	-	-	-	722	69.9
Total	0	0	797	100	1033	100
Species Richness	0		7		6	

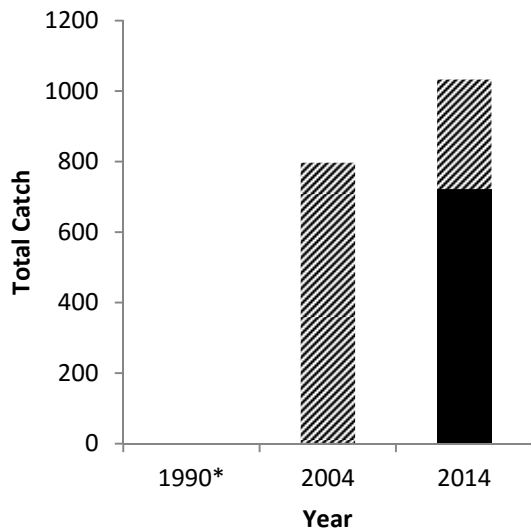


Figure 4 Total catch data from Silver Lake (*Nordic method was not used during the 1990 Urban Lakes Survey. Poulin *et al.*, 1991).

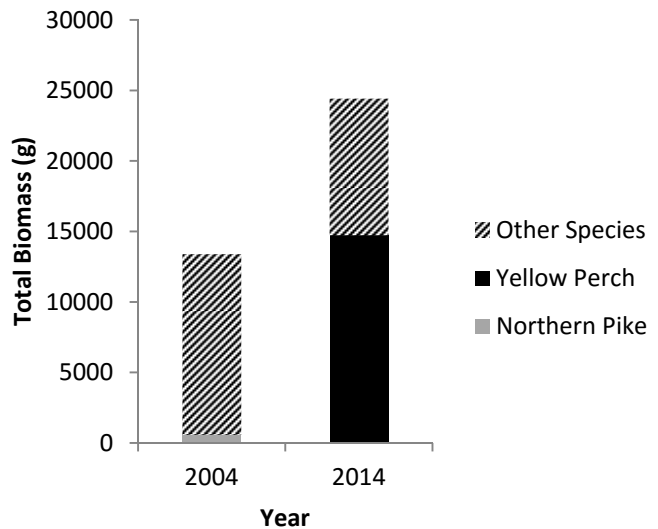


Figure 5 Total biomass (g) data for Silver Lake.

Water Quality Assessment

The water quality of Silver Lake appears to have made a remarkable recovery in recent decades (Table 3). Since 1981, the pH has increased from 4.13 to 6.97. 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 is due to the reductions of emissions from local smelting operations (Keller *et al.*, 2007) and the watershed liming.

As of July 16, 2014, Silver Lake has a circumneutral pH reading of 6.97 and a TIA alkalinity of 5.45 mg/L CaCO₃. Concentrations of metals have been declining dramatically, however Ni (64.2 µg/L) and Cu (8.6 µg/L) concentrations still remain slightly 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) and Iron (60 µg/L) concentrations remain below these levels (Ontario Ministry of Environment and Energy, 1994).

Table 4 Water chemistry from Silver Lake. Data from the Ont. Min. Environ. And Clim. Change. PWQO is the provincial water quality objective for this metal.

Parameter	PWQO	Year			
		1981	1990	2003	2014
pH	6.5-8.5	4.13	4.33	6.11	6.97
TIA Alkalinity (mg/L CaCO ₃)	-	-4.40	-3.10	1.06	5.45
Conductivity (µS/cm)	-	326.0	367.0	351.0	420
DOC (mg/L)	-	0.1	0.6	2.8	3.1
Ca (mg/L)	-	9.40	8.91	7.38	10.9
Mg (mg/L)	-	3.700	3.420	2.730	4.08
Na (mg/L)	-	34.000	47.200	55.500	56.9
K (mg/L)	-	1.250	1.410	1.490	1.74
SiO ₃ (mg/L)	-	2.100	2.160	0.120	0.5
SO ₄ (mg/L)	-	42.5	39.0	17.0	24.2
Total Cu (µg/L)	5	430.0	320.0	17.0	8.6
Total Ni (µg/L)	25	880.0	570.0	105.0	64.2
Total Zn (µg/L)	30	120.0	93.0	17.5	7.9
Total Fe (µg/L)	300	180.0	^T 80.0	89.5	60
Total Mn (µg/L)	-	240.0	160.0	87.5	14.5
Total Al (µg/L)	75	1200.0	820.0	13.7	11

ACKNOWLEDGEMENTS

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REFERENCES

- Appelberg M. 2000. Swedish standard methods for sampling freshwater fish with multi-mesh gillnets. *Fiskeriverket Information* 2000: 1 (3-32).
- Cooperative Freshwater Ecology Unit. 2014. New NORDIC Database – 2007. [Microsoft Access Database]. Laurentian University, Sudbury, Ontario.
- Keller W, Heneberry J, McLachlan E, MacPhee S. 2006. Data Report: 25 Years of Extensive Monitoring of Acidified Lakes in the Sudbury Area, 1981 – 2005. Laurentian University, Sudbury, Ontario. Cooperative Freshwater Ecology Unit. 146 pp.
- Keller W, Yan ND, Gunn JM, Heneberry J. 2007. Recovery of acidified lakes: lessons from Sudbury, Ontario, Canada. *Water, Air, and Soil Pollution: Focus* 7: 317-122.
- Kirk R, Drouin D. 1990. Silver lake Urban Lakes Study. Unpublished Report. Cooperative Freshwater Ecology Unit, Laurentian University, Sudbury, ON.
- Morgan GE, Snucins E. 2005. Manual of Instructions and Provincial Biodiversity Benchmark Values: NORDIC Index Netting. Ontario, Canada: Queen's Printer for Ontario.
- Ontario Ministry of Environment and Energy. 1994. Water Management Policies, Guidelines, and Provincial Water Quality Objectives. Queen's Printer for Ontario.
- Poulin DJ, Gunn JM, Sein R, Laws KM. 1991. Fish Species Present in Sudbury Lakes: Results of the 1989-1991 urban lakes surveys. Unpublished report. Cooperative Freshwater Ecology Unit, Laurentian University, Sudbury, Ontario.
- Selinger W, Lowman D, Kaufman S, Malette M. 2006. The Status of Lake Trout Populations in Northeastern Ontario (2000-2005). Unpublished report. Ontario Ministry of Natural Resources, Timmins, Ontario.