

**LINTON LAKE**  
**URBAN LAKES FISHERIES STUDY 2014**



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## LINTON LAKE

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#### INTRODUCTION

Linton Lake (46°22'32" N, 80°59'05" W) is a 27.7 ha lake located within the City of Greater Sudbury, in Broder township. It has one main basin with a maximum depth of 18 m (Figure 1). A complete summary of physical characteristics can be seen in Table 1.

Linton Lake is located approximately 13 km from Sudbury and is accessed via portage trail from Crowley Lake. There are no permanent or seasonal residences on Linton Lake and it appears to receive very little angling pressure.

Sampling records for Linton Lake exist as far back as 1990 when the lake had a pH of 5.41 (Keller *et al.*, 2004). Regular fisheries netting surveys began occurring in 2005 and records show that predatory species such as northern pike (*Esox lucius*), walleye (*Sander vitreus*) or bass (*Micropterus dolomieu*) have not inhabited the lake since that time (Lippert *et al.*, 2007; Cooperative Freshwater Ecology Unit, 2014). As a result, Linton Lake has been used as a predator free reference lake in many experiments using fish biomass and species diversity as a factor of lake recovery or food web shifts (Lippert *et al.*, 2007; Luek *et al.*, 2010; Luek *et al.*, 2013). Records from the Ministry of Natural Resources and Forestry (MNRF) show that Linton Lake has never been stocked (Ontario Ministry of Natural Resources, 2013).

**Table 1** Linton Lake location and physical description (Poulin *et al.*, 1991).

<b>Township</b>	Broder
<b>Latitude/Longitude</b>	46°22'32" N, 80°59'05" W
<b>MNRF District</b>	Sudbury
<b>Watershed Code</b>	2CF
<b>Elevation (m)</b>	274
<b>Shoreline Development Factor</b>	2.46
<b>Number of Cottages/Lodges</b>	0
<b>Forest Type</b>	Deciduous
<b>Shoreline Type</b>	Bedrock/sand
<b>Lake Surface Area (ha)</b>	27.7
<b>Maximum Depth (m)</b>	18.0
<b>Mean Depth (m)</b>	6.4
<b>Volume (x10<sup>4</sup> m<sup>3</sup>)</b>	175.87
<b>Secchi (m)</b>	4.5 (July 3, 2014)
<b>Access</b>	60 m portage trail from Crowley Lake.

## **METHODS**

### **Fisheries Community Assessment**

The fish community of Linton 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 the population's status (Morgan and Snucins, 2005).

A total of 16 multi-mesh gillnets were set in Linton Lake from July 2 - 5, 2014. Nets were set for approximately 12 hours at randomly selected locations on the lake across multiple depth strata (5 nets in <3.0 m; 5 nets in 3.0 - 5.9 m; 3 nets in 6.0 – 11.9 m; 3 nets in 12.0 – 19.9 m). Figure 2 shows the locations of all gillnets set in Linton 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.

### **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 Linton 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 Linton 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 Linton Lake and picked by hand.

### **Water Quality Assessment**

A dissolved oxygen (mg/L) and temperature (°C) profile was measured in the main basin of Linton Lake on July 3, 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 15, 2014 from the surface of Linton 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 and inorganic carbon, metals and major ions.

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

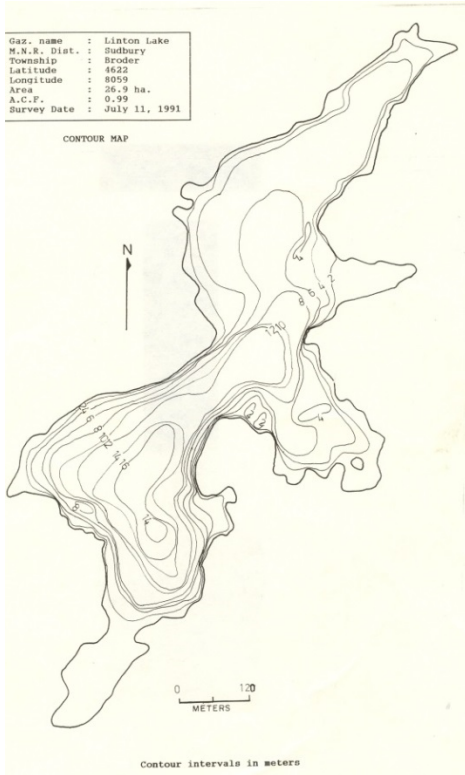


Figure 1 Bathymetric map of Linton Lake.

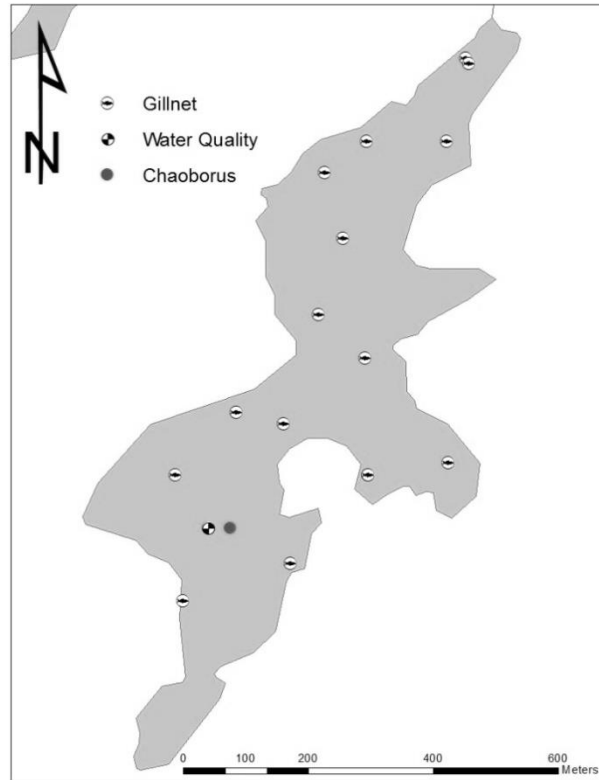


Figure 2 Outline map of Linton Lake showing the location of sampling gear or collected organisms

## RESULTS AND DISCUSSION

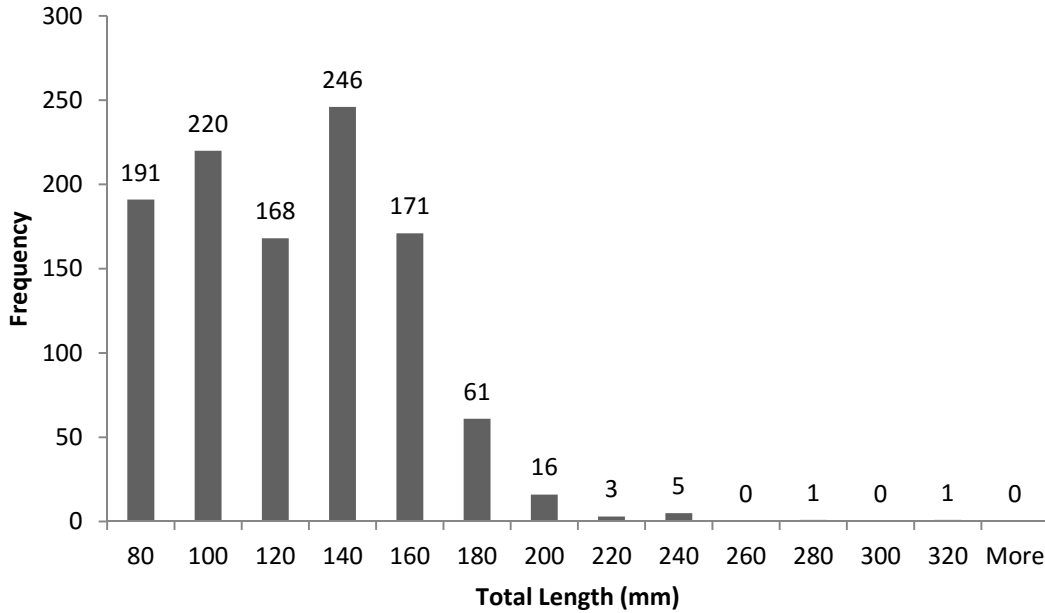
### Fisheries Community Assessment

The 2014 netting survey captured three species: creek chub (*Semotilus atromaculatus*), yellow perch (*Perca flavescens*) and Iowa darter (*Etheostoma exile*). 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 Linton Lake July 2 – 5, 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)
Creek Chub	2	2	104.3	0.125	6.5188
Yellow Perch*	1093	1083	19038.9	68.3125	1189.9313
Iowa Darter*	1	1	1.4	0.0625	0.0875
<b>Total</b>	<b>1096</b>	<b>1086</b>	<b>19144.6</b>	<b>68.5</b>	<b>1196.5376</b>

Yellow perch was by far the most abundant fish species in Linton Lake (Table 2) and the population ranged in body size (total length) from 70 mm to 305 mm. A length frequency histogram for yellow perch can be seen in Figure 3.

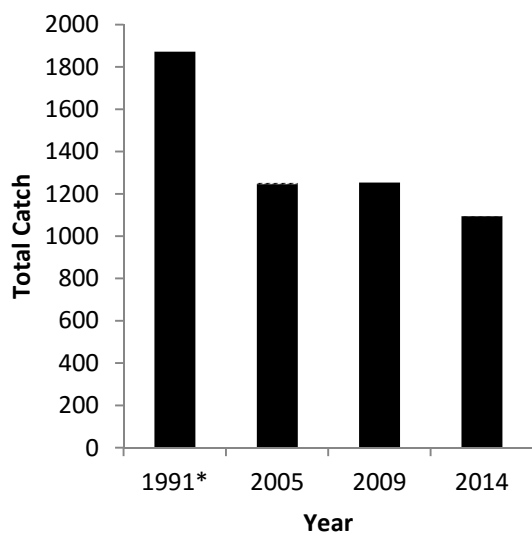


**Figure 3** Length frequency histogram for yellow perch (n=1083) captured in Linton Lake July 2 – 5, 2014.

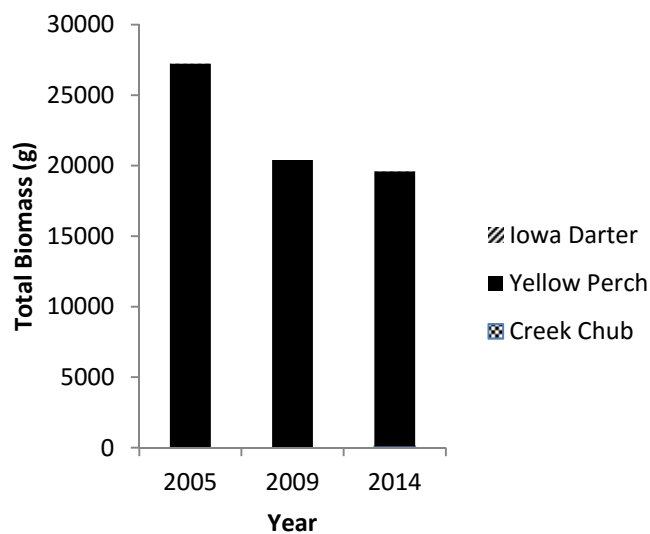
Yellow perch have always been the most abundant, if not the only species inhabiting Linton Lake, accounting for > 99% of the total catch in both number (Figure 4) and biomass (Figure 5). The occasional creek chub and Iowa darter has also been observed over time. Species richness and proportion of total catch can be seen in Table 3.

**Table 3** Species richness and proportion of total catch for Linton Lake (1. Poulin *et al.*, 1991; 2. Cooperative Freshwater Ecology Unit, 2014).

Survey Type	Multi-Gear Survey		Nordic		Nordic		Nordic	
	1990		2005		2009		2014	
Year	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Species								
Creek Chub	-	-	-	-	-	-	2	0.18
Yellow Perch	1873	100	1247	99.5	1143	100	1093	99.7
Iowa Darter	-	-	6	0.48	-	-	1	0.09
<b>Total</b>	1873	100	1253	100	1143	100	1096	100
<b>Species Richness</b>	1		2		1		3	



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

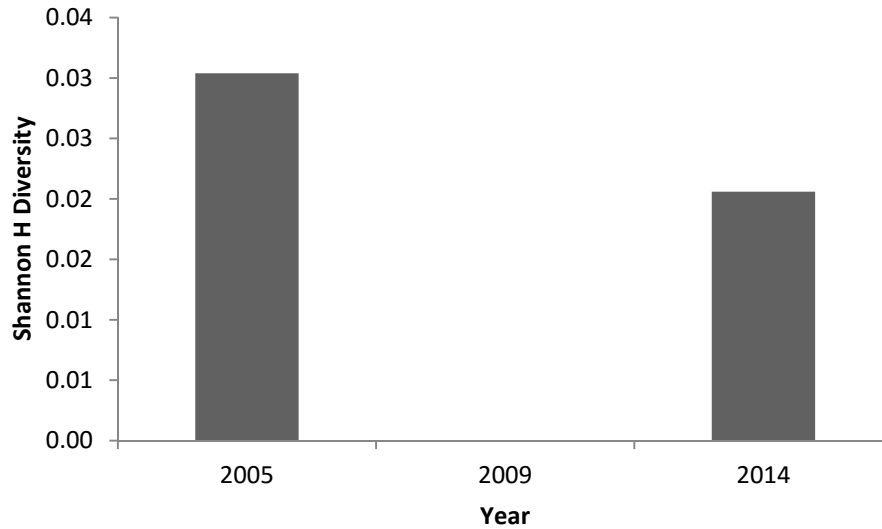


**Figure 5** Total biomass (g) data from Linton Lake.

With a very simple species composition throughout all survey years, the species diversity of Linton Lake has always been classified as “below average”. In 2005, with two species recorded, a Shannon H Diversity value of 0.0304 was calculated. This declined to zero in 2009 when only yellow perch were observed. However, improvements in diversity occurred in 2014 when Iowa darter and creek chub were observed in the lake, resulting in a diversity value of 0.0206 (Morgan and Snucins, 2005). Species diversity values can be seen in Figure 6.

### Baseline Organisms

No clams, snails or crayfish were collected from Linton Lake. Approximately 30 mayflies were captured from Linton Lake. Twelve night time zooplankton hauls were conducted at Linton Lake on July 22, 2014. A sufficient stable isotope sample (approx. 50-300 individuals) of *Chaoborus* sp. was collected. No aquatic plants were collected from Linton Lake.

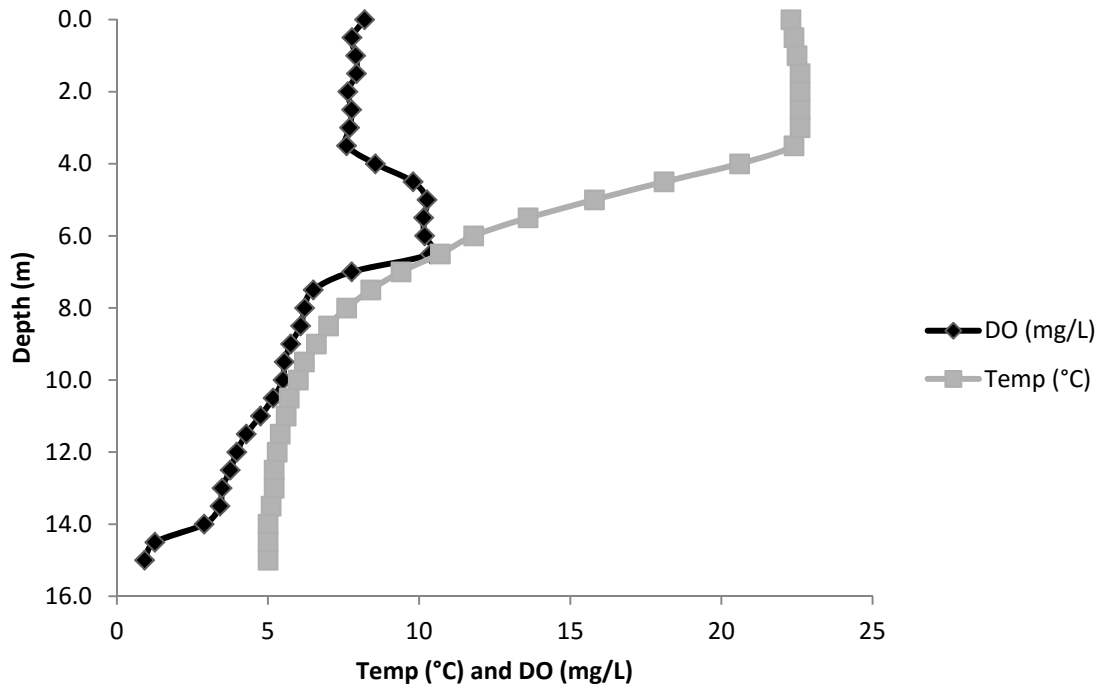


**Figure 6** Species diversity (Shannon H Diversity) values for Linton Lake.

### **Water Quality Assessment**

At the time of the Nordic Index Netting survey, Linton Lake was thermally stratified (Figure 7). Water temperatures ranged from 22.3 °C at the surface to 5.0 °C at 15 m. Dissolved oxygen levels ranged from 8.2 mg/L to 0.92 mg/L. Depth at the site of the temperature and dissolved oxygen profiles was 15.5 m and the secchi water clarity was 4.5 m.

The recovery process of Linton Lake appears to be ongoing (Table 4). Since 2003, pH has made a slight improvement to a value of 6.55, however TIA alkalinity has decreased to 2.14 mg/L CaCO<sub>3</sub>. Concentrations of metals such as Copper (Cu), Nickel (Ni), Iron (Fe), and Aluminum (Al) have been decreasing since 1990. Concentrations of these metals, Copper (9 µg/L), Nickel (41 µg/L), Iron (30 µg/L) and Aluminum (25 µg/L) remain above criteria set by the Ministry of Environment and Climate Change’s (MOECC) Provincial Water Quality Objective (PWQO) for the protection of aquatic life (Ontario Ministry of Environment and Energy, 1994) but show decreasing trends.



**Figure 7** Temperature (°C) and dissolved oxygen (mg/L) profile for Linton Lake, measured July 3, 2014.

**Table 4** Water chemistry of Linton Lake (1. Ontario Ministry of Environment and Energy, 1994; 2. Keller *et al.*, 2004)

Parameter	PWQO <sup>1</sup>	Year		
		1990 <sup>2</sup>	2003 <sup>2</sup>	2014
pH	6.5-8.5	5.41	6.16	6.55
TIA Alkalinity (mg/L CaCO <sub>3</sub> )	-	3.43	3.23	2.14
Conductivity (µS/cm)	-	40.2	24.0	23.5
True Colour (TCU)	-	-	-	18.4
DOC (mg/L)	-	2.9	3.0	3.4
Ca (mg/L)	-	3.20	2.08	1.9
Mg (mg/L)	-	0.94	0.71	0.684
Na (mg/L)	-	1.02	0.98	0.97
K (mg/L)	-	0.52	0.37	0.35
SiO <sub>3</sub> (mg/L)	-	0.88	0.66	0.84
SO <sub>4</sub> (mg/L)	-	12.97	8.11	5.6
Total Cu (µg/L)	5	19	10	9
Total Ni (µg/L)	25	100	59	41
Total Zn (µg/L)	30	11	7	3
Total Fe (µg/L)	300	<90	50	30
Total Mn (µg/L)	-	61	25	8.4
Total Al (µg/L)	75	<80	34	25



## CONCLUSIONS

Although the water quality of Linton Lake appears to be improving with time, concentrations of Ni and Cu remain above PWQO criteria for the protection of aquatic life (Ontario Ministry of Environment and Energy, 1994). However, as pH has improved to above 6.0, metal concentrations have declined by 59% for Ni and 54% for Cu. Clams, snails and crayfish were not observed in the lake, however acid-sensitive mayflies appear to be common. Linton Lake supports populations of three small-bodied species but no sport fish species

## ACKNOWLEDGEMENTS

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