BABY LAKE

URBAN LAKES FISHERIES STUDY 2014

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INTRODUCTION

Baby Lake (46°27'42" N, 80°51'55" W) is a 11.9 ha lake located near the abandoned Coniston smelter, but within the City of Greater Sudbury, in Neelon township. It has a single main basin with a maximum depth of 22.5 m (Figure 1). A complete summary of physical characteristics can be seen in Table 1.

Baby Lake is situated entirely within the Daisy Lake Uplands Provincial Park, and is accessed by private road and rough portage trail since there is no public access to the lake. However, unauthorized access by the public for recreational purposes is a common occurrence.

Limnological studies have been conducted on Baby Lake as early as 1968 (Kirk *et al*., 1990). Due to its close proximity to the Coniston smelter, Baby Lake was heavily impacted by air pollutants prior to 1972 when the smelter permanently ended its operations (Havas *et al*., 1995). Ministry of Natural Resources and Forestry (MNRF) records indicate that Baby Lake has never been stocked (Ontario Ministry of Natural Resources, 2013)

In 2014, as part of the Urban Lakes Study, field crews from Laurentian University's Cooperative Freshwater Ecology Unit surveyed Baby Lake, along with several other lakes around Greater Sudbury.

Table 1 Baby Lake location and physical description (Kirk *et al*., 1990).

Township	Neelon
Latitude/Longitude	46°27'42" N, 80°51'55" W
MNRF District	Sudbury
Watershed Code	2DB
Elevation (m)	224
Shoreline Development Factor	2.49
Number of Cottages/Lodges	0
Forest Type	Semi-barren
Shoreline Type	Bedrock/boulder and clay
Lake Surface Area (ha)	11.9
Maximum Depth (m)	22.5
Mean Depth (m)	9.59
Volume ($10^4 m^3$)	114.0
Secchi (m)	7.0 (July 16, 2014)
Access	Private road to Baby Lake via Lopes Ltd. property (formerly Coniston smelter) 3.5 km south of Coniston. 500 m portage trail to lake.

METHODS

Fisheries Community Assessment

The fish community of Baby 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 Baby Lake from July 14 to 17, 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; 3 nets in 3.0 - 5.9 m; 3 nets in 6.0 – 11.9 m; 3 nets in 12.0 – 19.9 m; 3 nets in 20.0 – 34.9 m). Figure 2 shows the locations of all gillnets set in Baby 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), *Chaoborus* sp. (*n*=300) and aquatic plants from Baby 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 Baby 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 Baby Lake and picked by hand. *Chaoborus* sp. were targeted by conducting vertical zooplankton hauls with a 30cm diameter net (150µm mesh) from the main basin of the lake, no earlier than 60 minutes after sunset.

Water Quality Assessment

A dissolved oxygen (mg/L) and temperature (°C) profile was measured in the main basin of Baby Lake on July 16, 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 Baby 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, metals and major ions.

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

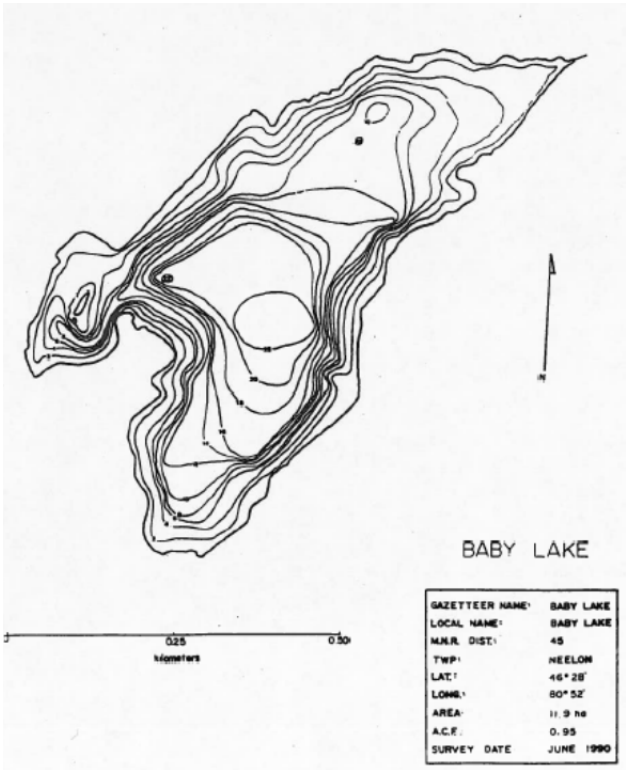

Figure 1 Bathymetric map of Baby Lake (Kirk *et al*., 1990).

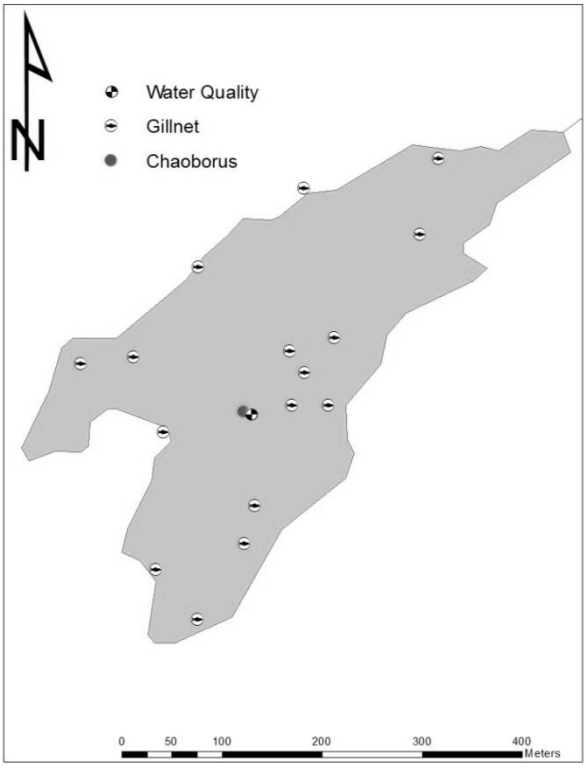

Figure 2 Outline map of Baby Lake showing the location of sampling gear or collected organisms.

RESULTS AND DISCUSSION

Fisheries Community Assessment

During the Nordic survey conducted from July 14 to 17, six different fish species were captured: white sucker (*Catostomus commersonii*), golden shiner (*Notemigonus crysoleucas*), common shiner (*Luxinlis cornutus*), creek chub (*Semotilus atramaculatus*), pumpkinseed (*Lepomis gibbosus*), and yellow perch (*Perca flavescens*). Other species observed in previous netting surveys including northen pike (*Esox lucius*) and brown bullhead (*Ameiurus nebulosis*) were not

captured in 2014 (Cooperative Freshwater Ecology Unit, 2014). Total catch, total weight (g) and catch-per-unit effort (CPUE) from the 2014 Nordic survey can be seen in Table 2.

Table 2 Catch summary and CPUE for all species captured in Baby Lake, July 14 - 17, 2014. Total weight (g) and CPUE (g/net) measurements for all species but white sucker are based on total net biomass for that species as fish were not individually weighed.

Fish Species	Total Catch	Sample Size	Total Weight (g)	CPUE (fish/net)	CPUE (g/net)
White Sucker	5	2	67.6	0.3	4.2
Golden Shiner	3	3	17.6	0.2	1.1
Common Shiner	22	11	91.5	1.4	5.7
Creek Chub	22	18	298.0	1.4	18.6
Pumpkinseed	17	15	181.5	1.0	11.3
Yellow Perch	532	424	7736.4	33.2	483.5
Total	601	473	8392.6	37.6	524.5

Yellow perch was the most numerically abundant fish species found in Baby Lake (Table 2). The 532 perch ranged in total lengths from 55 mm to 195 mm. A length frequency histogram for yellow perch is presented in Figure 3.

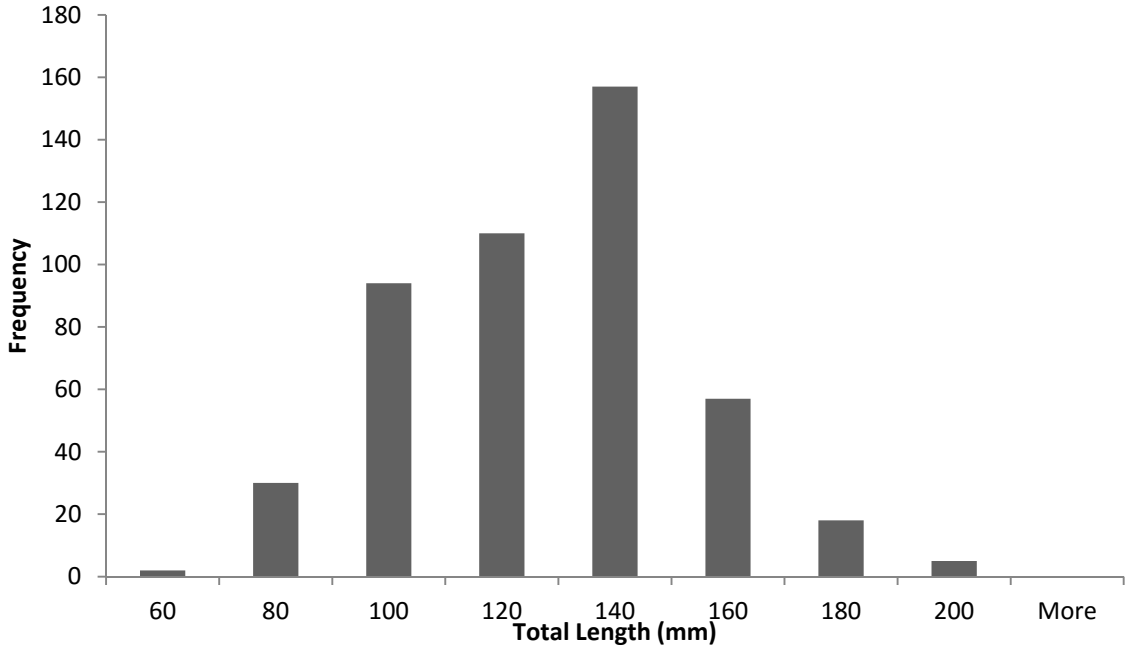

Figure 3 Length frequency histogram for yellow perch (*n*=424) captured in Baby Lake July 14 – 17, 2014.

Although the Nordic Index Netting protocol was not used at the time, the highest species richness (nine species) was observed back in the 1990 urban lakes survey that used a variety of gears. Perch was still the most abundant species at that time, accounting for 71% of the total

catch (Poulin *et al*., 1991). More recent Nordic surveys indicate that species richness has decreased from eight species in 2006 (Cooperative Freshwater Ecology Unit, 2014), to six species in 2014. Species richness and proportion of total catch can be seen in Table 3.

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

Survey Type	**Multi-Gear Survey**		**Nordic**		**Nordic**	
Year	**1990**[1]		**2006**[2]		**2014**	
Species	***n***	**%**	***n***	**%**	***n***	**%**
Northern Pike	-	-	3	0.84	-	-
White Sucker	-	-	36	10.11	5	0.83
Northern Redbelly Dace	1	1.72	-	-	-	-
Finescale Dace	1	1.72	-	-	-	-
Golden Shiner	3	5.17	2	0.56	3	0.5
Common Shiner	-	-	28	7.87	22	3.66
Mimic Shiner	1	1.72	-	-	-	-
Fathead Minnow	1	1.72	-	-	-	-
Creek Chub	-	-	6	1.69	22	3.66
Brook Stickleback	3	5.17	-	-	-	-
Brown Bullhead	6	10.3	1	0.28	-	-
Pumpkinseed	1	1.72	2	0.56	17	2.83
Yellow Perch	41	70.7	278	78.12	532	88.52
Total	**58**	**100**	**356**	**100**	**601**	**100**
Species Richness	9		8		6	

Although yellow perch was the most numerically abundant fish species observed in Baby Lake in each sample year, they only account for the majority of the total biomass in 2014, with a total weight of 8083 g. In 2006, northern pike accounted for the majority of the total biomass with a total weight of 4581 g, compared to 3046 g for yellow perch (Cooperative Freshwater Ecology Unit, 2014). Total biomass data can be seen in Figure 5.

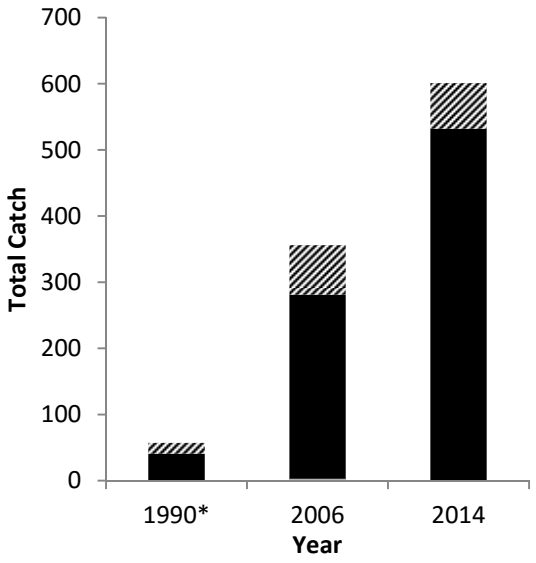

Figure 4
Total catch data from Baby Lake (*Nordic method was not used during the 1990 Urban Lakes Survey. Poulin *et al.*, 1991).

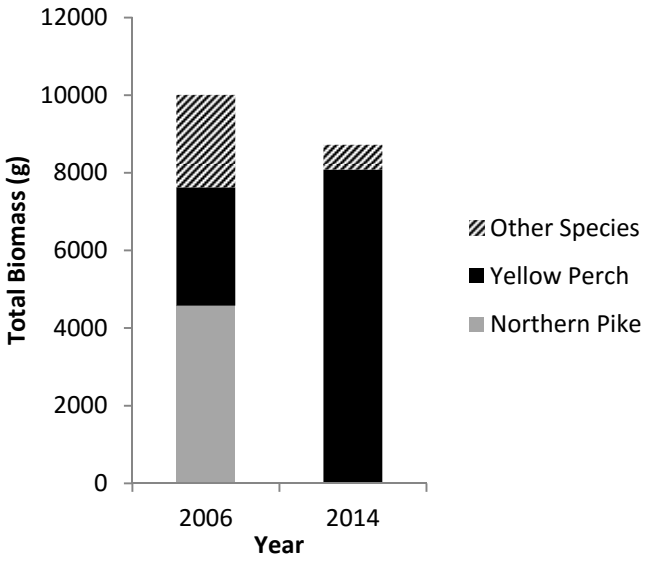

Figure 5
Total biomass (g) data from Baby Lake.

As the total catch of yellow perch has increased in Baby Lake, there have been fluctuations in the catches of other species. Since 2006 the total catch of white sucker has declined and that of pumpkinseed has increased. There has also been a loss of two species: northern pike and brown bullhead. As a result of these changes in species composition, there has been a decline in species diversity. When Baby Lake was first surveyed using the Nordic method, a "below average" Shannon H Diversity value of 0.8086 was calculated. As of 2014, this has declined to a "low" value of 0.5173 (Morgan and Snucins, 2005). Species diversity values can be seen in Figure 6.

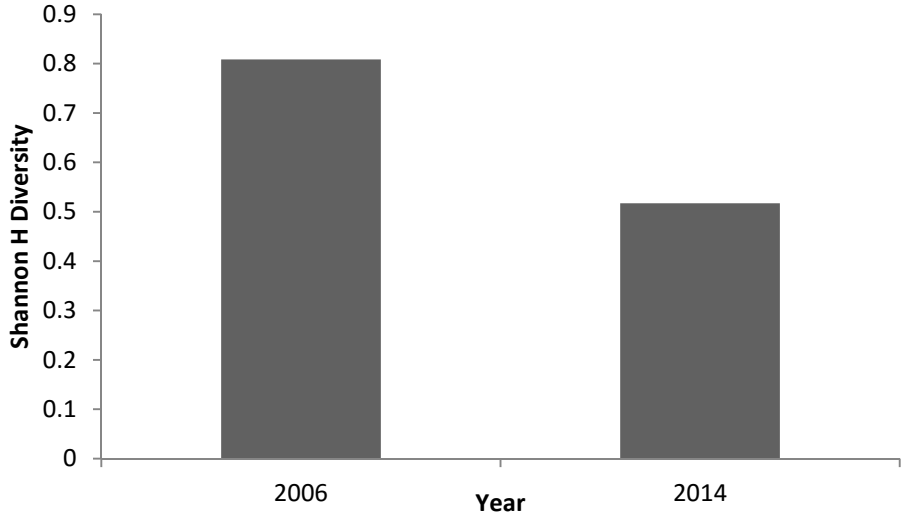

Figure 6 Species diversity (Shannon H Diversity) values from Baby Lake (Morgan and Snucins, 2005).

Baseline Organisms

No clams, snails or mayflies were found at Baby Lake. A total of 21 crayfish were captured in the traps placed at various locations around Baby Lake. Seven nighttime zooplankton hauls were conducted on July 21, 2014. Approximately 200 *Chaoborus* sp. were collected. A bulk sample of five Pipewort (*Eriocaulon aquaticum*) was collected from Baby Lake.

Water Quality Assessment

At the time of the Nordic Index Netting survey, Baby Lake was thermally stratified (Figure 7). A technical malfunction with the dissolved oxygen meter resulted in no readings past 20.5 m. Water temperatures ranged from 20.7 °C at the surface to 4.9 °C at 20.5 m. Dissolved oxygen levels ranged from 8.25 mg/L to 4.19 mg/L. Depth at the site of the temperature and dissolved oxygen profiles was 22 m and the secchi water clarity was 7.0 m.

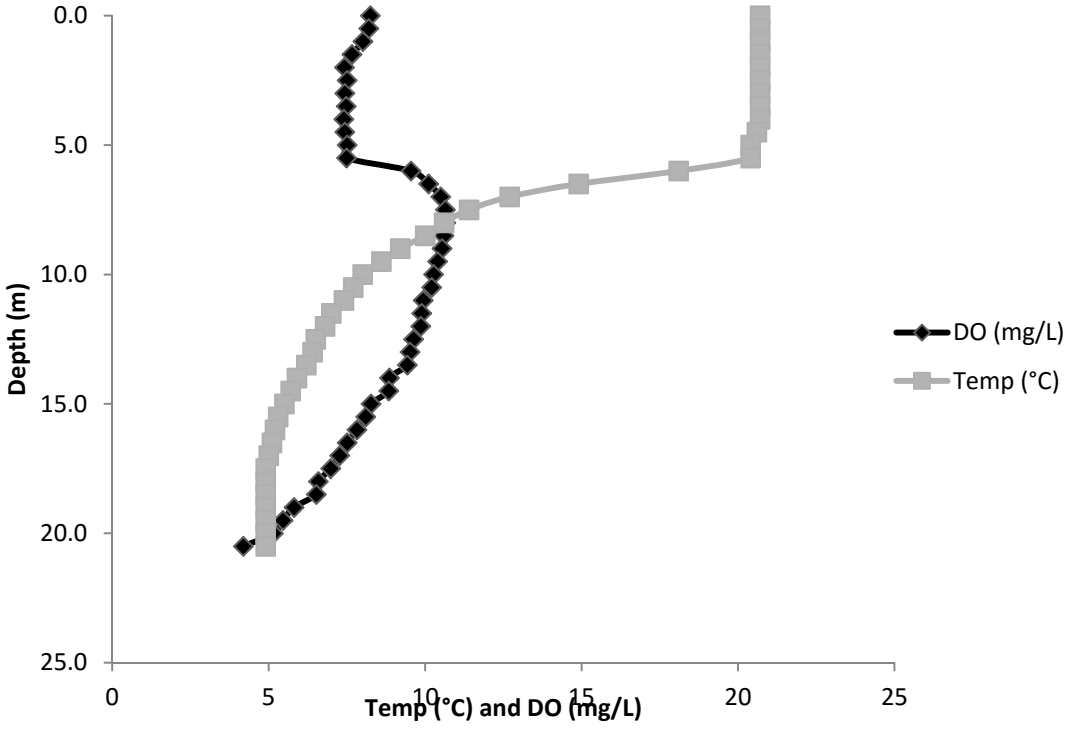

Figure 7 Temperature (°C) and dissolved oxygen (mg/L) profile for Baby Lake, measured July 16, 2014.

The water quality of Baby Lake appears to have improved considerably since 1990 (Table 3). Since then, pH has undergone a slight increase from 6.73 (Kirk *et al*., 1990) to 7.25. Conductivity has continued to decrease from 71 µS/cm to 42 µS/cm over the past two decades, as have concentrations of metals such as Copper (Cu), Nickel (Ni), Aluminum (Al), Iron (Fe) and Zinc (Zn). These improvements are likely a result of the closure of the Coniston smelter (Havas *et al*., 1995) as well as further reductions in emissions from smelters in Sudbury (Keller *et al*., 2007). However, Cu (7 µg/L) and Ni (63 µg/L) concentrations 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. Aluminum (6.9 µg/L), Iron (40 µg/L) and Zinc (2.7 µg/L) concentrations are below these criteria (Ontario Ministry of Environment and Energy, 1994).

Table 4 Water chemistry from Baby Lake (1. Ontario Ministry of Environment and Energy, 1994; 2. Kirk *et al*., 1990.)

Parameter	[1]PWQO	Year			
		[2]1972	[2]1985	[2]1990	2014
pH	6.5-8.5	4.05	5.8	6.73	7.25
TIA Alkalinity (mg/L $CaCO_3$)	-	-	-	3.60	8.24
Conductivity (µS/cm)	-	153	140	71	41.9
DOC (mg/L)	-	-	-	-	1.9
SO^4 (mg/L)	-	-	-	21.07	7.85
Total Cu (µg/L)	5	780	60	21.0	7
Total Ni (µg/L)	25	3200	410	240	63
Total Zn (µg/L)	30	180	60	18.0	2.7
Total Fe (µg/L)	300	-	-	45	40
Total Mn (µg/L)	-	-	-	38	5.9
Total Al (µg/L)	75	-	-	17	6.9

CONCLUSIONS

Although considerable water quality improvements have taken place over the past two decades in Baby Lake, concentrations of Cu and Ni remain above the threshold for the protection of aquatic life (Ontario Ministry of Environment and Energy, 1994). Metal concentrations have, however, declined by 98% for Ni and 99% for Cu since 1972. Sensitive invertebrates such as clams, snails and mayflies were not observed, however crayfish appear to be quite common. Baby Lake does support populations of six fish species, however no large-bodied sport fish were observed during the 2014 Nordic survey.

ACKNOWLEDGEMENTS

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