Torch Lake Trend Analysis

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Revised August 16, 2018

Summary

Great Lakes Environmental Center, Inc. (GLEC) completed an analysis of the Torch Lake water quality data provided for two locations: Torch Lake, North and Torch Lake, South. The analysis consisted of the review and plotting of data from two data sources: Volunteer Torch Lake data.exl (source: Thomas Clement: District Manager - Antrim Conservation District) and Cooperative Lake Monitoring Data from 1976-2017: (source Trish Narwold, Torch Conservation Center, Inc.).

The data included secchi disk transparency depth, chlorophyll a concentrations, total phosphorus concentrations, water temperature, and air temperature. Data was measured multiple times per year between 1976 and 2017. The majority of the data collected was from the years 1990 through 2017. Data collected by GLEC in July 2017 as part of the Torch Lake Assessment using USEPA National Lake Assessment 2017 protocols was added to the Torch Lake, North data set. The GLEC 2017 data also included, total phosphorus, secchi disk transparency depth, chlorophyll a and water temperature. For data reported as less than the minimum detection limit (MDL), we assigned a value that was 0.5x the MDL, for example, chlorophyll a values reported as <1.0 were assigned a value of 0.5 for graphing purposes. These data are summarized in the following table (Table 1) and figures (Figures 1-10).

Table 1 highlights minimum and maximum values and the year in which they were recorded, and averages for each parameter for years where multiple measurements per year were provided to GLEC (1990 to 2003). The Cooperative Lake Monitoring Data provided for the years 2004 to 2017 could not be incorporated into boxplots because of the lack of a minimum dataset for that analysis. Those data were, however, were included with the line plot figures for both the North and South basins of Torch Lake figures for secchi disk transparency depth, chlorophyll a, and total phosphorus (Figures 1-6).

TABLE 1. SUMMARY OF WATER QUALITY PARAMETERS FOR THE NORTH AND SOUTH BASINS OF TORCH LAKE: 1976-2017

Parameter	Location	Minimum value (date recorded)	Maximum value (date recorded)	Average	Number of data points
Total Phosphorus (µg/L)	Torch Lake, North	1.5 (12 events)	14 (September 2004)	3.3	23
	Torch Lake, South	1.5 (13 Events)	(2004)	3.5	26
Secchi Disk Depth (feet)	Torch Lake, North	12 (September 2004)	45 (June 2007)	27	323
	Torch Lake, South	11 (September 1995)	52 (June 2017)	25	356
Chlorophyll a (µg/L)	Torch Lake, North	0.12 (June 1996)	1.20 (July 1990)	0.45	105
	Torch Lake, South	0.05 (July 1995)	1.40 (June 1990)	0.43	128
Water Temperature (°C)	Torch Lake, North	11.7 (June 2003)	21.6 (August 2003)	17.7	12
	Torch Lake, South	16.0 (June 2003)	28.3 (June 2001)	21.5	22
Air Temperature (°C)	Torch Lake, North	14.4 (September 1997)	26.7 (September 1996)	23.0	23
	Torch Lake, South	15.6 (June 1994)	31.1 (August 1995)	21.6	59

A yearly average for secchi disk depth, chlorophyll a concentration, and total phosphorus concentration was calculated for Torch Lake, North and Torch Lake, South by plotting the yearly average data points provided for a given year. Those yearly averages are plotted over time in Figures 1 and 4. The seasonal variation in secchi disk transparency for Torch lake North and Torch Lake South were plotted by showing the individual measurements made within a given year (Figures 2 and 3). Seasonal variation in total phosphorus concentration for the north and south basin of Torch Lake are plotted for the years 2004 through 2017 in Figures 5 and 6.

FIGURE 1. SUMMARY OF SECCHI DISK TRANSPARENCY FOR THE NORTH AND SOUTH BASINS OF TORCH LAKE: 1976-2017

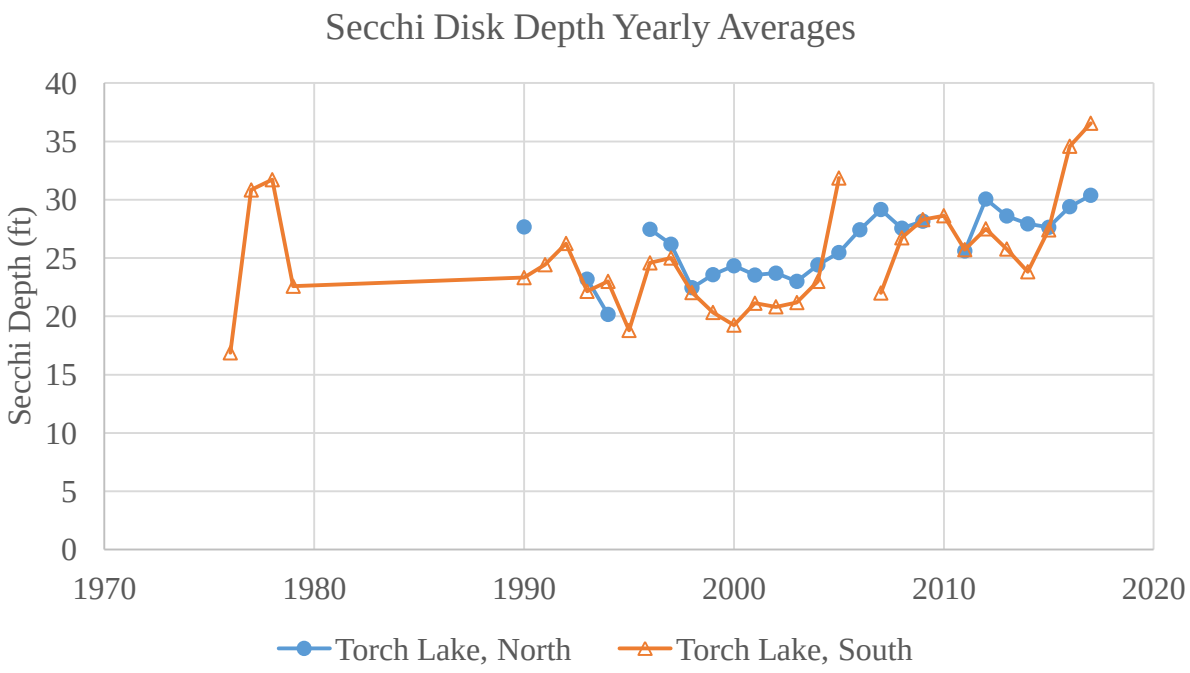


FIGURE 2. SEASONAL VARIATION IN SECCHI DISK TRANSPARENCY DEPTH FOR THE NORTH BASIN OF TORCH LAKE: 2004-2017

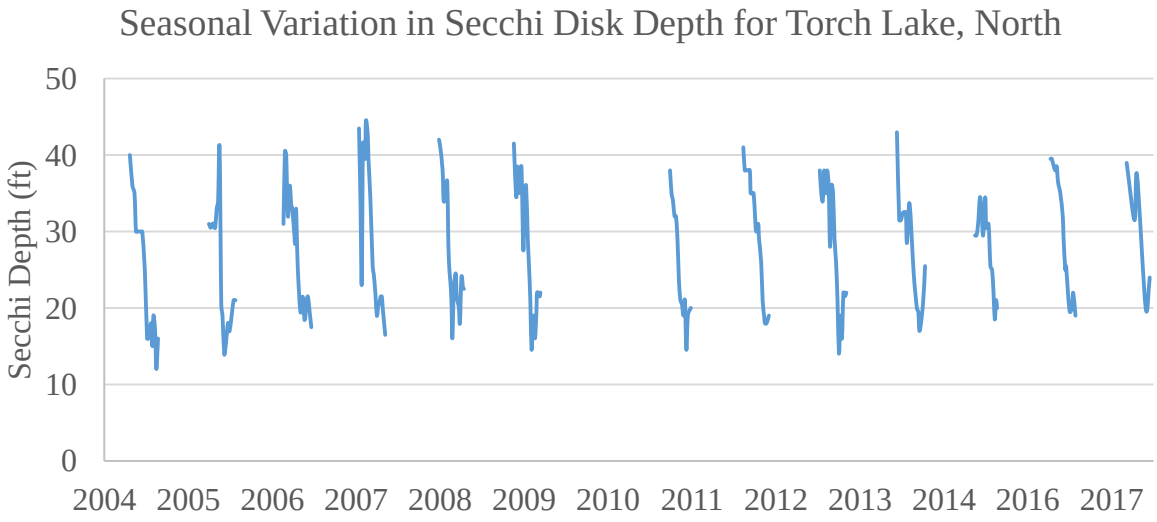


FIGURE 3. SEASONAL VARIATION IN SECCHI DISK TRANSPARENCY DEPTH FOR THE SOUTH BASIN OF TORCH LAKE: 2004-2017

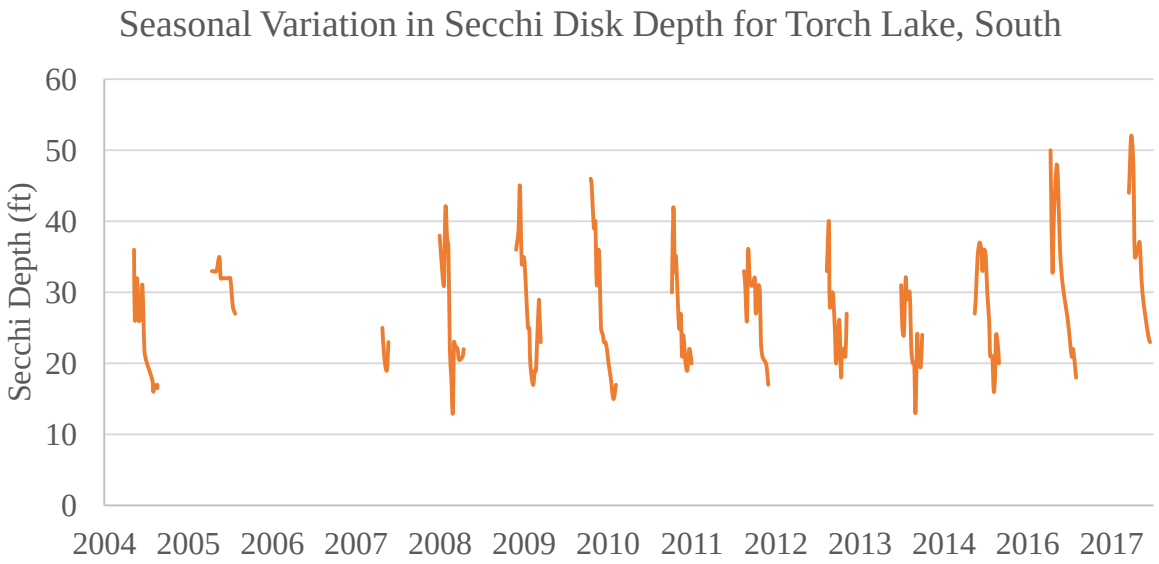
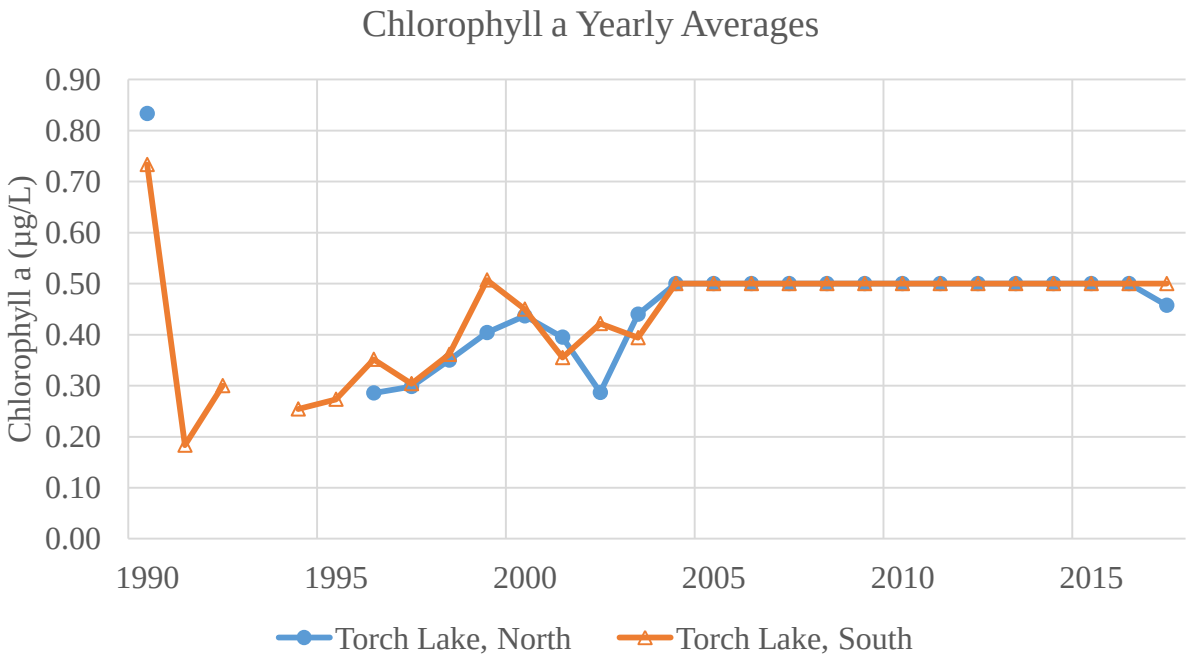


FIGURE 4. SUMMARY OF CHLOROPHYLL @ DATA FOR THE NORTH AND SOUTH BASINS OF TORCH LAKE: 1990-2017



GLEC's 2017 data point included in the average for North which is why the North trendline dips down slightly for 2017. For 2004-2016, both locations had an average Chlorophyll a concentration of 0.5µg/L (so the trendline for South obscures the trendline for North). This is half of the reported value of <1.0.

FIGURE 5. SEASONAL VARIATION IN TOTAL PHOSPHORUS CONCENTRATION FOR THE NORTH BASIN OF TORCH LAKE: 2004-2017

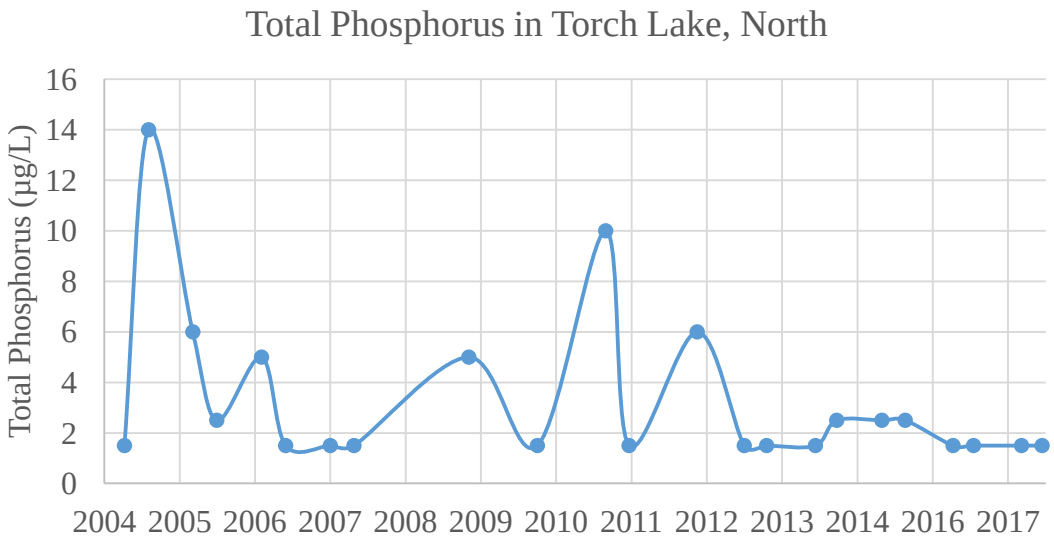
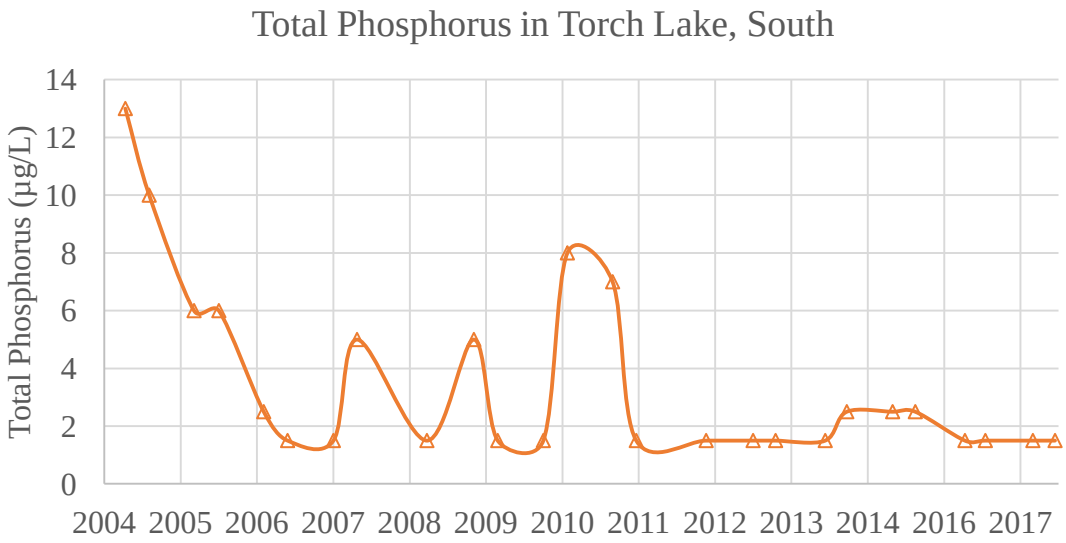
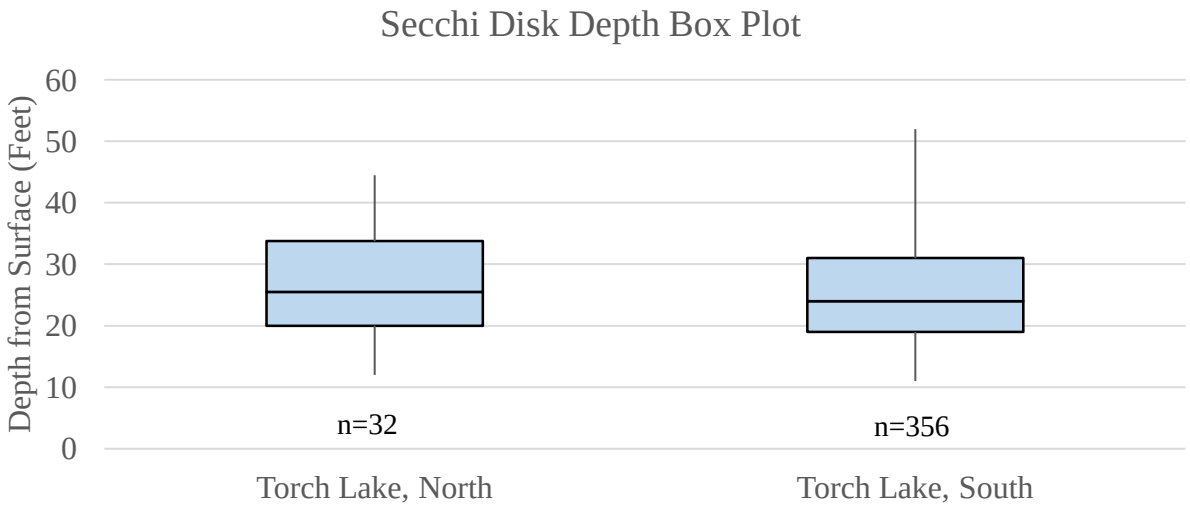


FIGURE 6. SEASONAL VARIATION IN TOTAL PHOSPHORUS CONCENTRATION FOR THE SOUTH BASIN OF TORCH LAKE: 2004-2017



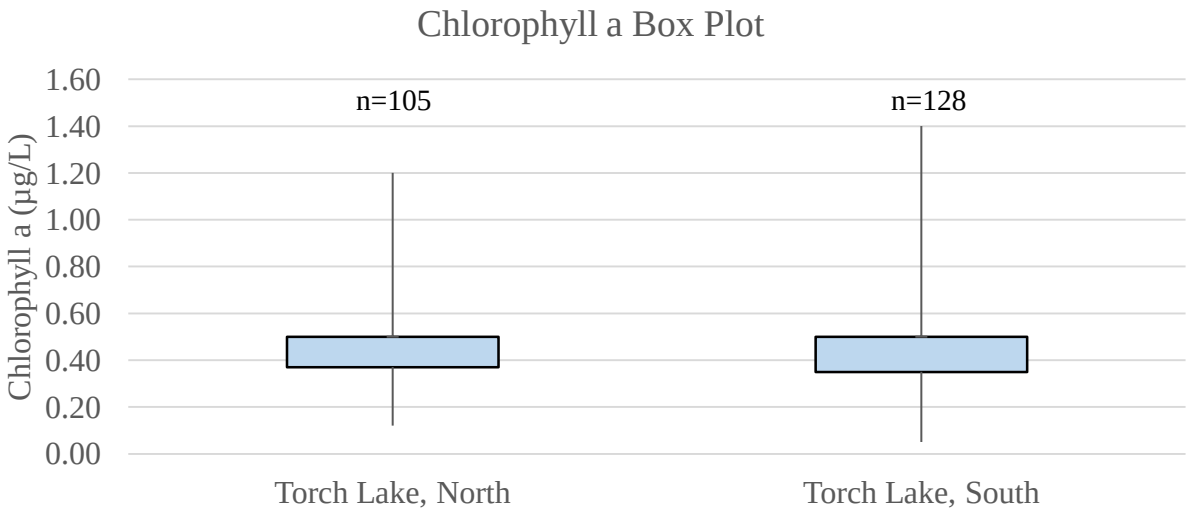
Lastly, box and whisker plots were developed for each set of data for years where multiple measurements per year were provided (1990 to 2003). In a box and whisker plot, the bottom of the lower whisker represents the minimum value. Similarly, the top of the upper whisker represents the maximum value. The bottom, middle, and top line of the box represent the first quartile, median value, and third quartile of the data, respectively. Twenty five percent of the data lies below the first quartile line and 75 percent of the data lies below the third quartile line.

FIGURE 7. BOX PLOT OF SECCHI DISK TRANSPARENCY DEPTH DATA FOR THE NORTH AND SOUTH BASINS OF TORCH LAKE: 1976-2017



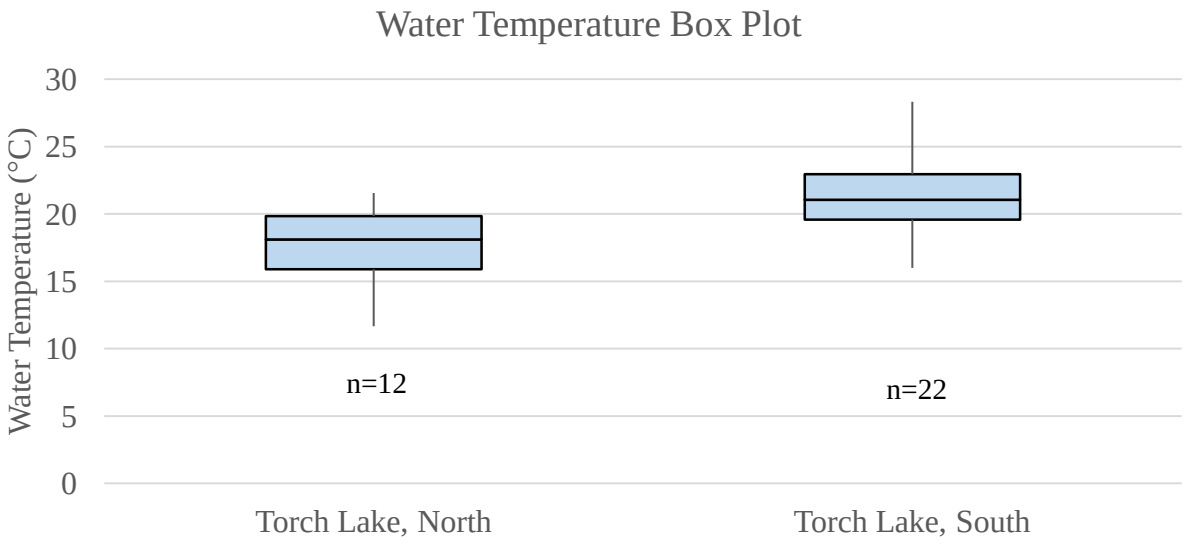
Data points for Torch Lake, North from 1990-2017. GLEC's 2017 data point included in the North dataset.
Data points for Torch Lake, South from 1976-2017.

FIGURE 8. BOX PLOT OF CHLOROPHYLL A DATA FOR THE NORTH AND SOUTH BASINS OF TORCH LAKE: 1990-2017



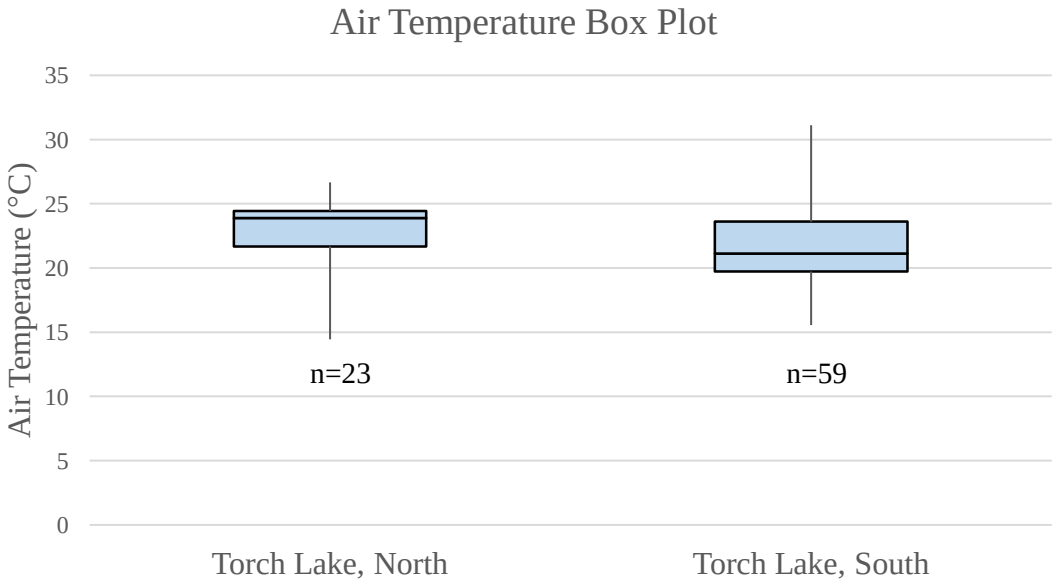
Data points for Torch Lake, North from 1990-2017. GLEC's 2017 data point included in the North dataset.
Data points for Torch Lake, South from 1990-2017.
For both boxplots, the median and the third quartile are the same value (0.5µg/L).

FIGURE 9. BOX PLOT OF SURFACE WATER TEMPERATURE DATA FOR THE NORTH AND SOUTH BASINS OF TORCH LAKE: 2001, 2003, AND 2017



Data points for Torch Lake, North from 2003 and 2017. GLEC's 2017 data point included in the North dataset.
Data points for Torch Lake, South from 2001 and 2003.

FIGURE 10. BOX PLOT OF AIR TEMPERATURE DATA FOR THE NORTH AND SOUTH BASINS OF TORCH LAKE: 1991-1997



Data points for Torch Lake, North from 1996-1997.
Data points for Torch Lake, South from 1991-1997.