VARIABILITY IN HONEY HARBOUR WATER QUALITY

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Water quality in the Great Lakes experiences some natural variability which is related to factors such as climatic influences and physical lake processes and features, like the degree of exposure to wind and wave action. This variability is reflected in water quality patterns in the Honey Harbour area, through both time and space.

The Severn Sound Environmental Association has been monitoring water quality at three locations in the Honey Harbour area since 1998, collecting biweekly samples over the ice free season. Samples are analyzed for water quality variables such as nutrients and basic chemistry, as well as algae communities. Water column profiles of temperature, dissolved oxygen, conductivity and algae pigments are also taken from the surface to just above the lakebed.

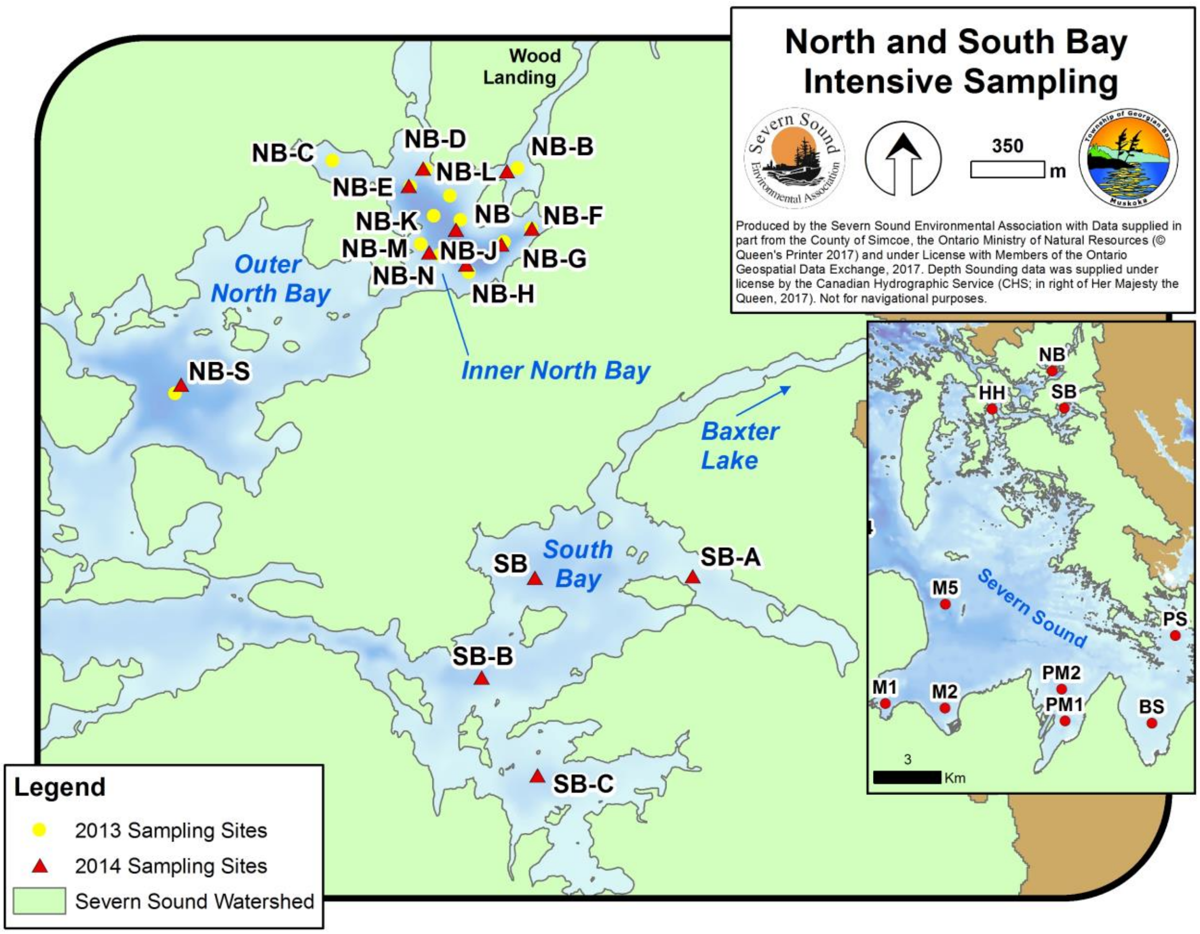

Figure 1. Map showing sites sampled during 2013 and 2014 intensive sampling in North and South Bays of Honey Harbour. Inset map shows long term Honey Harbour area

sites as well as other Severn Sound sites, including M5 which was used as a deep water reference.

Water Quality Patterns Through Time
There are many ways to look at water quality. The variables discussed below (table 1) are commonly used to assess the nutrient or *trophic status* of a water body. In Honey Harbour there has been fluctuation but no significant steady increase or decrease in **total phosphorus**. **Total nitrogen** however has been decreasing at all locations except South Bay.

Water clarity is decreasing at all locations except at the open water station M5, although it has been decreasing at other sites around Severn Sound over a comparable period. Table 2 shows long term mean values (± 95% confidence limits, indicating the spread of the data), as well as 2016 means for comparison. Results show that in 2016, some indicators are higher and some are lower than long term means, and these patterns are not always consistent for each location (e.g. TP is slightly lower in NB but higher in SB).

Table 1. Summary of trophic status indicators used data up to 2016. Arrows with an asterisk indicate where 2016 data is not yet available. The summary is based on Mann Kendall trend tests.

Trophic Status Variable	North Bay	South Bay	Honey Harbour	Open Water (M5)
Tot. Phosphorus	⇔	⇔	⇔	⇔
Tot. Nitrogen	⇩	⇔	⇩	⇩
Water Clarity	⇩	⇩	⇩	⇔
Chlorophyll *a*	⇔*	⇔*	(insuff. data)	⇔*
Algae Counts	⇔	⇧	⇧*	⇔*
Min. Bottom DO	⇩	⇔	⇔	⇔

Table 2. Long term mean values, ± 95% confidence limits, as well as 2016 means for trophic status indicators. Long term mean values include data going back to 1981 for North and South Bays, 1998 for Honey Harbour and 2003 for open waters (M5).

Location		Tot. Phosphorus (ug/L)	Tot. Nitrogen (ug/L)	Water Clarity (m)	Algae Counts (mm^3/m^3)	Min. Bottom DO (mg/L)
North Bay	LT Mean	13.3	359	3.1	1467	0.37
	95% CL	0.8	16	0.2	319	0.21
	2016 mean	**12.6**	**314**	**3.0**	**1742**	**0.06**
South Bay	LT Mean	15.4	381	3.1	1056	0.21
	95% CL	1.4	18	0.3	400	0.06
	2016 mean	**17.4**	**350**	**2.5**	**2133**	**0.14**
Honey Harbour	LT Mean	10.0	344	2.8	809	6.17
	95% CL	0.4	17	0.2	200	0.74
	2016 mean	**9.9**	**301**	**2.5**		**6.84**
Open Waters	LT Mean	10.3	380	3.5	553	4.29
	95% CL	0.4	21	0.2	86	0.86
	2016 mean	**10.5**	**321**	**3.3**		**3.84**

Better than long term mean (blue) 2016 data not yet available (grey)
Worse than long term mean (red)

Water Quality Patterns Through Space

Just as variability occurs through time, it also occurs over different embayments, and sometimes even within the same embayment. In late August of 2013 and 2014, SSEA crews sampled multiple locations in North Bay (inner and outer) and South Bay. Various profiling devices were used to measure temperature, light levels, concentrations of particles in different size ranges, algae pigment levels, conductivity and dissolved oxygen concentrations. The goal was to obtain data with high spatial coverage, both horizontally across the bays, and vertically at a minimum of 1 m depth intervals, in order to describe patterns in water quality variation.

"Fishing" for particles using the particle scanner.

Scanning for algae pigments using a Fluoroprobe.

Some interesting results arose from using the concentration of different ranges of particle sizes. In inner North Bay, small algae-sized particles were depleted at 6-8 m depth while zooplankton-sized particles where found in abundance (Figure 2 and 3). These observations suggest that zooplankton are selectively feeding on algae in this depth range at this time of day. Profiles of total chlorophyll *a* (green line) follow the same pattern as small particle concentrations, giving further evidence that this size range includes algae.

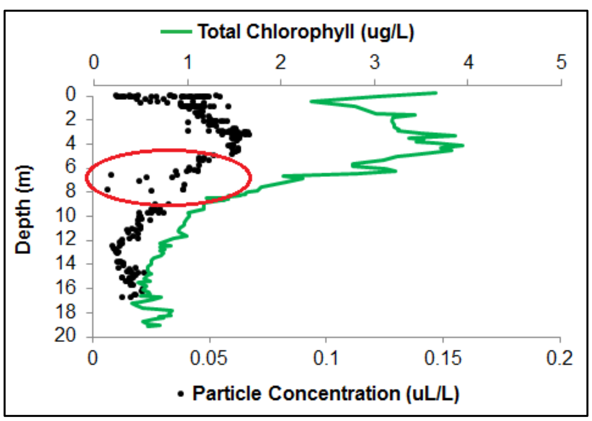

Figure 2. Concentrations of particles between 3.98-4.7 µm were depleted between 6-8 m at stn NB in 2013.

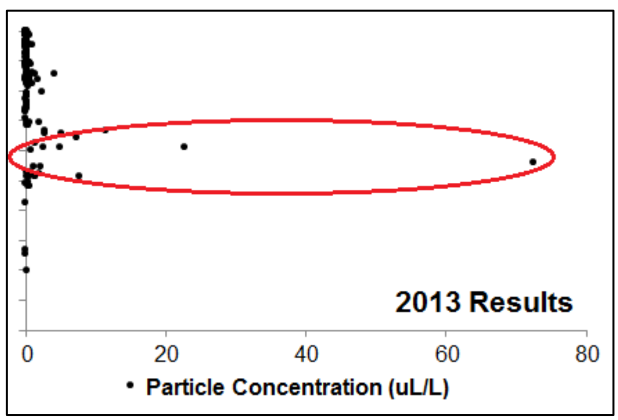

Figure 3. This 6-8 m layer could be where zooplankton feed, as indicated by high concentrations of 211-250 µm particles (size of zooplankton) at that depth.

Conductivity is a measure of dissolved ions in the water, and can give information about sources of water to a water body. Tributaries can have higher dissolved ion content in the summer compared to the open waters, and this is evident in the higher conductivity values in the shallow waters at the mouth of the channel to Wood Landing (NB-B on map) and at sites closer to the outlet of Baxter Lake (fed by the Severn River; SB-A and SB, figure 4). Conversely, conductivity is lower where there is greater exchange with open water as seen in outer North Bay (NB-S) and at 4 m depth across all of South Bay, where an open water intrusion likely occurred.

Vertical distributions of **dissolved oxygen** were consistent across inner North Bay while outer North Bay had a distinct profile that didn't show a mid-water column drop in concentration (figure 5). This mid-water column drop seen in inner North Bay is uncommon, and is likely related to oxygen being consumed as golden algae that bloom in the upper waters die off and break down. Oxygen levels then recover somewhat in the lower depths. In South Bay, oxygen decline was evident across the basin, despite some variation, and matched the pattern of decline seen in outer North Bay. Dissolved oxygen is important for the health of aquatic life, and in determining the chemical states of nutrients and metals.

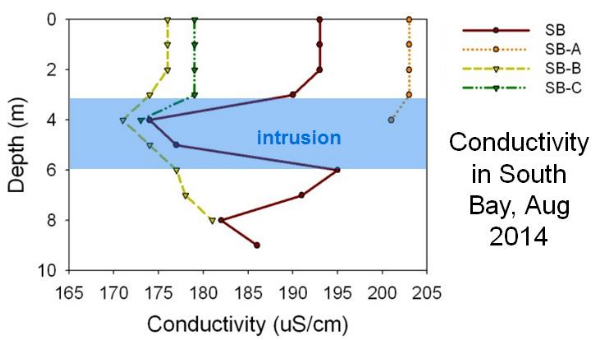

Figure 4. Conductivity profiles at sites across South Bay in 2014. The blue rectangle indicates the depth range of a likely open water intrusion.

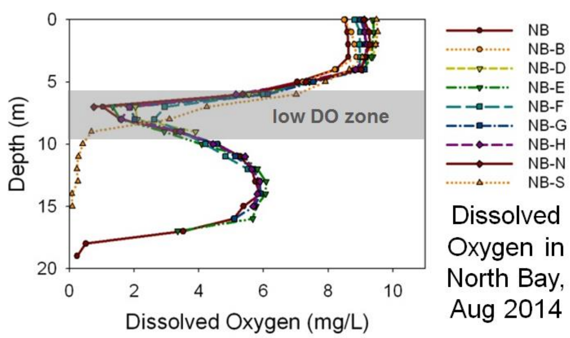

Figure 5. Dissolved oxygen profiles at sites across North Bay in 2013. The grey rectangle indicates the depth range of a low oxygen zone in the upper waters.

For more information, visit our website, www.severnsound.ca. To report a suspected algae bloom, call the Spills Action Centre at 1-800-268-6060 and our Midland office at (705) 527-5166. Funding from our municipal members, especially Township of Georgian Bay, and the Ministry of Environment and Climate Change through the Canada-Ontario Agreement is gratefully acknowledged.