

# Benthic Biomonitoring on Hall's Lake to Assess Water Quality

## Purpose

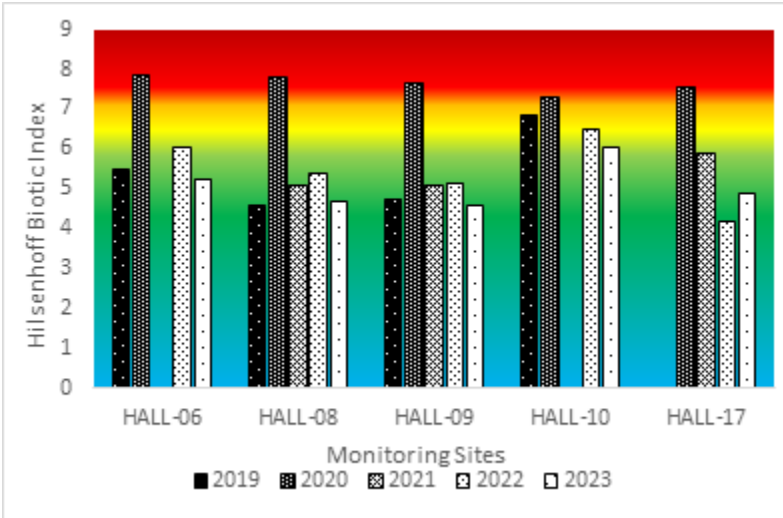
The Halls and Hawk Lakes Property Owners Association (HHLPOA) is a group that focuses on local environmental issues with the aim of maintaining and improving the overall quality of life on their lakes (HHLPOA, 2019). The HHLPOA partnered with U-links, a group dedicated to community-based research by working with multiple community partners to deliver research services to Haliburton County (U-Links, 2018). With additional support from undergraduate students from Trent University, this project aims to create an accessible report that will help understand the long-term changes in lake health at Halls Lake by using benthic macroinvertebrates to assess the water quality. This project will educate and provide recommendations to the HHLPOA on how to manage lakeshore properties and how to aid in preserving and enhancing Halls Lake water quality.

## Methods

For the collection and analysis of the benthic invertebrates, a modified version of the Ontario Benthic Biomonitoring (OBBN) methods was used. This is an established provincial standard which involved the “kick-and-sweep” method, where a person facing the opposite direction of the flow of water at the depth of 1 meters, starts by kicking into substrate up to depth of 5cm and simultaneously sweep the standard D-frame net with a 500 µm mesh side to side just above the floor of water body, this was done for 3 minutes along a transect perpendicular to the shoreline (Jones et al, 2007). Two replicates were done per site, with 2-3 transects per replicate. The benthic samples were then preserved in ethanol, subsampled with the teaspoon method and identified in the lab with microscopes to the 27-group level.

To analyse the data, five indices were used: %EOT, Hilsenhoff Biotic Index, and Simpson's diversity index, Hills Numbers as well as the %Amphipods vs %Insects. %EOT is a calculated index which uses the number of mayflies, damselflies, dragonflies and caddisflies as an indicator of pollution levels (as they are all sensitive to pollution) while the Hilsenhoff biotic index represents the water quality based on the types of benthic invertebrates found. The Simpson's diversity index and the Hill's numbers tell us how many different species there are and their numbers, which gives an impression of the lake's overall biodiversity.

## Results and Trends



interpretation of Fig 1.

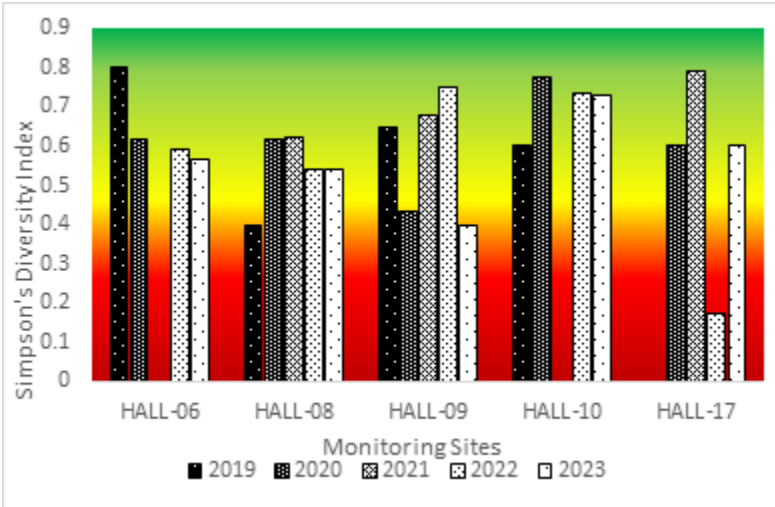
Table 1. Colour key for

Value	Water Quality	Colour Key
0.00 - 3.50	Excellent	Blue
3.51 - 4.50	Very good	Green
4.51 - 5.50	Good	Yellow-Green
5.51 - 6.50	Fair	Yellow
6.51 - 7.50	Fairly poor	Orange
7.51 - 8.50	Poor	Red

Figure 1. Hilsenhoff biotic index for five sites on Halls Lake from 2019 to 2023, depicting change in water quality over time.

The Hilsenhoff biotic index value mostly remains within the categories of fair-very good, with the exception of the year 2020 where it ranges from fairly poor-poor. The decrease in water quality during the year 2020 may have been due to an influx of city goers temporarily moving to the area, causing an increase in human disturbances to the lake (Butler, 2020).

Value	Interpretation	Colour
0	Absence of diversity	Dark Red
0.01-0.40	Poor	Red



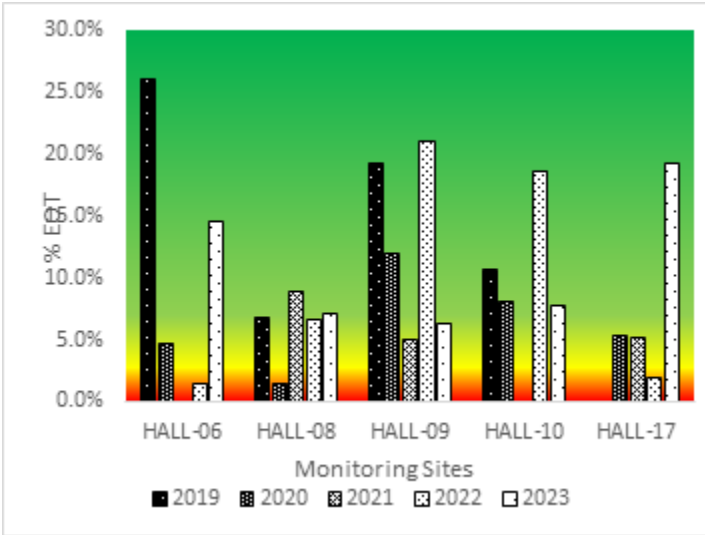
0.41-0.60	Fair	Yellow
0.61-0.80	Good	Green
0.81-0.99	Excellent	Dark Green

**Table 2.** Colour key for interpretation of Fig 2.

**Figure 2.** Simpson's diversity index for five sites on Halls lake from 2019 to 2023, depicting variety and proportion of macroinvertebrates over time.

The Simpson's diversity index for most of the sites stays within the range of fair-good. During the year 2022 site 17 has a noticeably large drop in diversity from good to poor, which might have been due to biased sampling as amphipods' colour allows them to stand out from the substrate they were collected in.

%EOT	Rating	Colour
4.18 - 37.12	Typical	Dark Green
2.62 - 4.18 and 37.12-54.41	Atypical	Yellow



<2.62 and >54.41	Extremely Atypical	
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**Table 6.** Colour key for interpretation of Fig 4.

**Figure 4.** %EOT for five sites on Halls Lake from 2019 to 2023 depicting the percentage of pollution intolerant groups present in the sample over time.

The %EOT varies atypical and typical for each site as well as between each year. The atypical value for Hall-17 in the year 2022 matches the decreasing trend seen in the Simpson’s diversity index for the site, representing a dip in the biodiversity. This “randomness” seen in %EOT can again be due to sampling bias as again amphipods stand out more than the EOT’s from the sampled substrate.

## Conclusion

Based on the data collected in 2023, the overall water quality of Halls Lake was fair, but there was a significant amount of organic pollution in the lake. This was reflected in the moderate biodiversity of the benthos found in the lake, which ranged from fair to good while the %EOT for the lake ranged from poor to good/fair. Between 2019 and 2022, the water quality was good, but it decreased in 2020 before improving in the following years. The benthos diversity was in the fair to good category, while the %EOT was random and widespread.

## Recommendations

As a homeowner, there are steps you can take to be a responsible shoreline steward. The most important of these is to create a natural shoreline which improves the water quality by filtering runoff, preventing erosion and providing a wildlife habitat (Government of Canada, 2000). Creating a natural shoreline can involve planting native shoreline plants which you can find on the Haliburton County Master Gardeners website (Haliburton County Master Gardeners, 2021). However, a simpler option can also be leaving a 3+ meter strip along the shoreline un-mowed (Government of Ontario, 2000). This has the added benefit of

detering Canada Geese, which can make a mess on your property and raise E. coli levels in the lake (Kawartha Conservation, 2020).

There are also actions that can be taken to reduce the chemicals carried in runoff. An overload of nutrients such as phosphorus can put the lake out of balance (Howard, 2023). Ensure that your septic system is well-maintained, and inspect it every three years, upgrading when needed (Kawartha Conservation, 2020). Refrain from using herbicides and using fertilizer on your natural shoreline. However, if you are using fertilizer elsewhere on your property, use it sparingly and for 20-0-10 fertilizer mixes, which contain no phosphorus.

## Acknowledgements

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## References

- Butler, C. (2020, April 5). People who live in Ontario's "cottage country" want city dwellers to stay home. CBC. Retrieved November 26, 2023, from <https://www.cbc.ca/news/canada/london/ontariocoronavirus-covid19-cottage-isolate-day-trip-1.5521187>.
- Government of Ontario. (2000). *Preserving and Restoring Natural Shorelines*. Queen's Printer for Ontario. [http://www.lronline.com/Extension\\_Notes\\_English/pdf/shrlns.pdf](http://www.lronline.com/Extension_Notes_English/pdf/shrlns.pdf)
- Haliburton County Master Gardeners. (2021, April). Native Plants for Your Property Including Shorelines. <https://www.haliburtonmastergardener.ca/wp-content/uploads/2022/02/Native-Plants-for-yourProperty-including-Shorelines-April-2021.pdf>
- Halls & Hawk Lakes Property Owners Association. (2019). About the HHLPOA. Halls & Hawk Lakes Property Owners Association (HHLPOA). <https://hallshawklakes.ca/about-us/>
- Howard, B. (2023, May 10). *Fertilizing tips for Shoreline Properties*. Tip of the Mitt Watershed Council. <https://watershedcouncil.org/green-infrastructure/fertilizing-tips-for-shoreline-properties-2/>
- Jones, C., K.M., Somers, B., Craig, T.B., Reynoldson. 2007. Ontario Benthos Biomonitoring Network: Protocol Manual. Queen's Printer for Ontario. Dorset, ON.
- Kawartha Conservation. (2020). Erosion and shoreline protection. <https://www.kawarthaconservation.com/en/landowner-services/erosion-and-shorelineprotection.aspx#Deter-Canada-Geese>
- Love Your Lake. (2020). Love Your Lake 2013-2019 Summary Report. Watersheds Canada. <https://watersheds.ca/our-work/love-your-lake/>

U-Links. (2018). Research That Connects Us. U-Links Centre for Community-Based Research.  
<https://www.ulinks.ca/>