Fishing For Genes: Can the implementation of environmental DNA sampling increase the efficiency of aquatic conservation programs?

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Background

What is Environmental DNA?

Environmental DNA (eDNA) utilizes the genetic material found in an organism's environment from shed cells, tissues, or blood to identify or confirm the presence of that species in the ecosystem (Moyer et al 2014).

This eDNA can be captured by filtering water and replicated to generate enough genetic material to perform various analyses, and from this data we can determine which species are present and the abundance of this species in the sample area.

The eDNA sampling technique can be tailored to target a single species of interest, or an entire ecosystem. (Miya et al, 2020). In this way, it is possible to sample all species present in an environment using the eDNA extracted from a single sample.

Image courtesy of FISHBIO via US National Park Service

Significance

Climate change is rapidly changing environments all over the world. It is vital to ensure that we can accurately determine where species at risk are found so that we can ensure their protection. eDNA sampling is an additional tool to achieve this goal and better protect aquatic species.

Methods

Field Sampling

Five lakes in Northeastern Ontario were sampled in July and August of 2021. These lakes were previously sampled by Ontario's Broadscale Monitoring (BsM) program, which provided reference data for which species were known to be present in these lakes.

Figure 1. Sampling locations in Northeastern Ontario
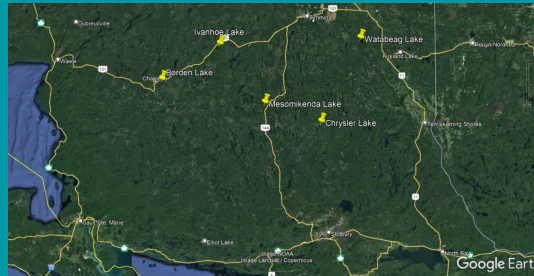
From multiple sites on each lake, one litre of water was filtered at varying depths. The filters were then sealed to preserve them for transport to the lab.

Extraction of eDNA

Once at the lab located at the University of Toronto Scarborough, the filters from each site were broken down and the eDNA was removed and suspended as a liquid. This liquid was frozen and stored until it could undergo reactions to replicate the genetic material present in the sample so that analyses could be run to determine what species were present in the sample.

Data Analysis

Comparisons were made between the results of the eDNA sampling, and sampling done by the BsM program of the same lakes in previous years. At the time of this poster's creation, eDNA results have not yet been completed, and discussion of expected results will be based on past eDNA studies. ,

Results and Discussion

Sampling Effort

Across the 5 lakes included in the 2021 eDNA survey, 41 sites were sampled resulting in the generation of 236 individual samples.

Expected Results

While unforeseen events have prevented the generation of data from the eDNA survey conducted, studies using similar methodology have found that the eDNA sampling technique has been particularly effective in the detection of elusive or rare species (Deiner et al., 2020).

Application to Conservation programs

While current monitoring programs are relatively effective in their current state, climate change will create a need for more efficient sampling programs able to detect species at low concentrations. This could be done by implementing eDNA sampling.

Acknowledgements

Works Cited

Deiner K, Yamanaka H, Bernatchez L. 2020. The Future of Biodiversity Monitoring and conservation utilizing environmental DNA. Environmental DNA 3:3–7.

Miya M, Gotoh RO, Sado T. 2020. Mifish metabarcoding: A high-throughput approach for simultaneous detection of multiple fish species from environmental DNA and other samples. Fisheries Science 86:939–970.

Moyer GR, Diaz-Ferguson E, Hill JE, Shea C. 2014. Assessing environmental DNA detection in controlled lentic systems. PLoS ONE 9.