Next Generation Solutions
to Ensure Healthy Water Resources for Future Generations

Can emerging technologies enhance our ability to detect species and assess ecosystems?

The Need

In a rapidly changing world, regulators, scientists, and local communities face significant challenges in meeting their mandates to protect aquatic ecosystems, predict future trajectories for these ecosystems, and foster sustainable development. Successful accomplishment of these mandates requires reliable and rapid detection of changes in environments within the context of natural variability and prediction of future trends to be able to maintain and enhance sustainability of ecosystems.
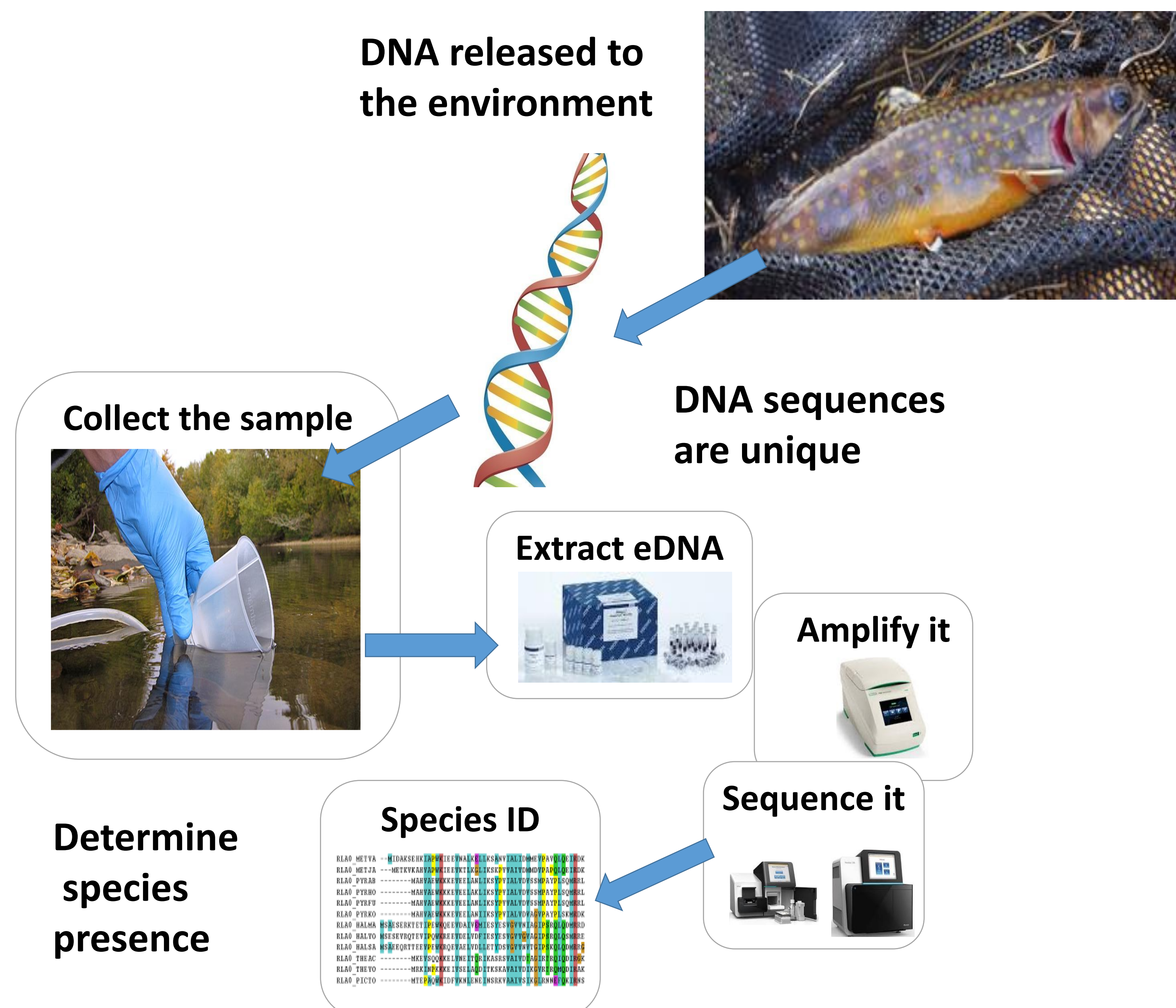

Objective

This research program applies emerging and transformative technologies in biology and bioinformatics to address urgent needs of diverse end-users to significantly advance and improve biomonitoring of aquatic environments in Canada. Specifically, advanced technologies, such as environmental DNA (eDNA) and next generation sequencing (NGS), are applied to monitor current status and predict future trends of structures and functions of environments exposed to stressors.

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DNA released to the environment

Collect the sample

DNA sequences are unique

Extract eDNA

Amplify it

Sequence it

Species ID

Determine species presence

Progress Toward GWF Goals

Solution Development

Establish eDNA as a reliable tool for biomonitoring of aquatic ecosystems:

- Developing genetic libraries for selected Canadian aquatic species and watersheds,
- Assessing rates, reliability, and variability of detection of eDNA for key species defined by end-users,
- Benchmarking eDNA metabarcoding for biomonitoring of multiple aquatic communities.

Solution Validation

Compare eDNA methodologies to conventional methods at monitoring sites across Canada, including boreal lakes, rivers and streams of Saskatchewan, Manitoba and Ontario, and lab experiments.

Solution Application

Apply eDNA for biomonitoring in watersheds with collaborators:

- Characterization of the eco-genomic baseline of watersheds in cold regions,
- Determination of the ecological effects of human activities in controlled experiments and monitored sites,
- Biogeographical comparison of aquatic communities of Canadian lakes, rivers and streams,
- Detection of invasive and threatened species at various sites of interest.

Relevance

This program exploits rapidly emerging technologies in biology and environmental sciences to provide managers with rapid and reliable new approaches to monitor the changing aquatic communities. Developed and validated eDNA tools will create opportunities to better assess and predict changes in the Canadian environment. These emerging technologies have implications for contributing to international effort to improve water quality and promote better management of our aquatic resources globally, as well as to "protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes" (UN Sustainable Development Goal 6).