CIGLR

Cooperative Institute for Great Lakes Research

Great Lakes Science for Society

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ENVIRONMENTAL DNA (eDNA) IN THE GREAT LAKES

Environmental DNA (eDNA) is an emerging technology that is transforming how scientists monitor aquatic ecosystems, including the Great Lakes. Organisms release small traces of DNA into the environment through skin cells, mucus, waste, and decaying material. By collecting and analyzing water samples, researchers can detect these genetic traces to identify species living in an ecosystem without the need to see or capture them.

Across the Great Lakes, eDNA helps monitor biodiversity, detect invasive species, track rare or elusive organisms, and study ecosystem changes, including complex food webs that support regional fisheries. Because eDNA sampling is fast, accurate, and cost-effective, it allows researchers to monitor large areas more frequently than traditional survey methods.

CIGLR uses eDNA and other advanced genetic tools to detect microorganisms, track harmful algal blooms, study food web dynamics, and develop new monitoring tools, supporting better forecasting, management, and protection of these vital freshwater resources.

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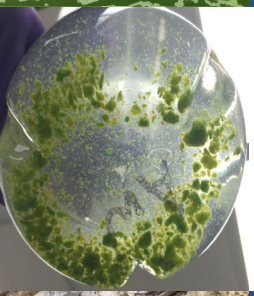
CIGLR advances eDNA research through:

MONITORING HARMFUL ALGAL BLOOMS

Scientists analyze eDNA from water samples to track cyanobacteria that can form harmful algal blooms. Genetic tools such as quantitative PCR (qPCR) and DNA sequencing help identify bloom-forming species and monitor how their composition changes over time.This genetic information helps scientists better understand bloom dynamics and improve bloom monitoring and forecasting for the Great Lakes.



DETECTING TOXIN-PRODUCING CYANOBACTERIA

eDNA analysis can reveal whether cyanobacteria carry genes to produce toxins like microcystin and track how toxin levels change throughout the bloom season. This approach also allows scientists to measure bloom toxicity, provide early warning of toxins, support safe drinking water management, and conduct surveillance for emerging cyanotoxins in the Great Lakes, including some paralytic neurotoxins.

IDENTIFYING NEW INVASIVE SPECIES

eDNA tools can detect invasive species by identifying species-specific genetic markers in water samples. CIGLR researchers are developing high-throughput quantitative PCR chips that enable scientists to test for a wide range of target organisms, including microbes, plants, fish, and invertebrates, in a single analysis. This high-tech tool allows scientists to find organisms even when populations are small, rare, or difficult to observe using traditional monitoring methods.

SUPPORTING GREAT LAKES FISHERIES

CIGLR researchers use eDNA to study early life stages of Great Lakes fish populations. eDNA provides information on the lower food web that forms the energetic foundation for Great Lakes fish and how this food source can be disrupted by invasive species. Because fish are sensitive to environmental conditions and difficult to sample with traditional methods during their early life stages, eDNA provides a non-invasive way to study factors that influence their survival and dispersal. Integrating eDNA data with traditional netting, plankton sampling, and environmental monitoring provides a more comprehensive assessment of Great Lakes fish populations and improves predictions of future adult fisheries.

SHARING GREAT LAKES DATA

The Great Lakes Atlas of Multi-Omics Research (GLAMR) is an online platform that collects, organizes, and shares genetic and molecular ('omics) data, including eDNA, along with associated environmental measurements from Great Lakes ecosystems. These resources, along with computational tools for analyzing the data, are freely available to help scientists use eDNA to protect drinking water, manage invasive species, and support Great Lakes fisheries.

Learn more

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