

Uses and Limitations of Environmental DNA (eDNA) in Fisheries Management

A science transfer project funded by:



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Purpose

Environmental DNA is the genetic material that can be detected in environmental (e.g., water, soil) samples to provide information about what organisms may be, are, or were recently present. Environmental DNA testing provides a unique opportunity to detect species at lower abundances than using conventional sampling approaches, without requiring their direct encounter or capture. A confirmed positive detection of eDNA means DNA from the species was present at that location at the time the sample was collected, but provides no information about the source of the DNA (e.g., live or dead animal, animal part). Ongoing research efforts have demonstrated the usefulness and limitations of the eDNA tool. When used to provide information about invasive species and species at risk, eDNA detections can help target conventional sampling methods to increase the probability of capturing species of interest. Detections provide new information that was previously not available, helping to reduce the uncertainty associated with natural resource management decisions regarding the presence of a target species. While this technique shows potential as a cost-effective alternative to traditional surveillance methods, it also has limitations. For example, the ability of eDNA technology to quantify the abundance of organisms in a body of water remains a contentious issue, as does the potential ramifications of false positive and negative results.

Although substantial science is available on the uses and limitations of eDNA and this science has been thoroughly reviewed in the literature (Goldberg et al. 2016), this information is often not easily accessible to fisheries managers (Darling and Mahon 2011). In addition, there is often a disconnect between the interpretation of positive/negative results in the laboratory setting (e.g., implementing proper controls to reduce the likelihood of false positives/negatives) and in the management setting (e.g., a positive eDNA result indicating the organism (and not just their DNA) is actually present).

At its March 2016 meeting, the Science Transfer Board of the Great Lakes Fishery Commission identified eDNA as an issue requiring focused science transfer efforts. Great Lakes fishery managers require an objective understanding of potential uses and limitations of eDNA surveillance, and tradeoffs of employing eDNA over more traditional survey methods. To meet these needs of managers, we created products that summarize potential uses and limitations of eDNA in fishery management and provide guidance to managers for the biological interpretation of positive eDNA results. This project was an effort to develop and provide managers with accessible information about current eDNA science and to bridge the gap between eDNA in the laboratory and eDNA in management.

Methods

An initial screening was conducted to identify the informational needs and gaps among fisheries managers in the Great Lakes regarding eDNA uses and limitations. Project leaders met with the Council of Lake Committees in April 2017. During the meeting, participants were asked about the information they needed to effectively communicate to biologists and the public, information they needed to make better informed decisions, levels at which communication seemed to break down, and skepticism regarding positive and negative eDNA results. Based on this information, a set of project deliverables was identified that would address the identified informational needs. During project development, feedback on products was provided by members of the Science Transfer Board, U.S. Fish and Wildlife Service eDNA biologists, and the Great Lakes Fishery Commission. Products were also sent to numerous peer reviewers. Revisions based on the peer reviews were then incorporated into the final products.



Description of Products

Infographics. Two professional-quality infographics were developed that can be used in flyers, presentations, and other informational materials. The first graphic depicts the uses of eDNA, including collection procedure and data collection. The second graphic highlights the deposition of DNA in the environment and the factors that can influence DNA degradation.

Fact sheets. Two fact sheets were created, with one targeting fisheries managers in the Great Lakes and the other targeting the general public.

Positive eDNA Management Support Tree. A flowchart was created to help evaluate the strength of a positive eDNA result. Through use of the tree, positive eDNA results are assigned to Level 1-4, with Level 1 suggesting that the target organism is likely not present and Level 4 suggesting the organism is present and may be in sufficient numbers to support a population. The levels are intended to help prioritize sites for management action.

Presentation. A PowerPoint presentation was created that can be used to provide general information on the uses and limitations of eDNA. Notes are included within the presentation, providing additional details and supporting references for information on the corresponding slide.

Guidance for environmental DNA sampling design and effort. General guidance was developed for eDNA sampling. The document provides guidance on the amount of water to collect, the time and location of collection, and the appropriate number of samples. References are included for additional information.

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