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Risk Reduction Study Fact Sheet
Environmental DNA (eDNA)

Chicago Sanitary and Ship Canal – Aquatic Nuisance Species Dispersal Barrier

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Overview: Fishes, including Asian carp, release DNA into the environment in the form of mucoidal secretions, feces, and urine. DNA degrades in the environment, but this process is not instantaneous, and DNA can be held in suspension and transported. The presence of species can be detected by filtering water samples, and then extracting and amplifying short fragments of the shed DNA. In contrast to other surveillance methods, the environmental DNA (eDNA) method does not rely on direct observation of Asian carp to evaluate presence.

Scope: Laboratory and field studies using eDNA methods confirm that Asian carps can be detected in 2 liter water samples from sites that electrofishing indicates have high, moderate, and low densities of carp. Water samples are collected in the field and filtered in the lab. DNA is extracted from the filtrate, and any DNA from bighead and silver carp is amplified with PCR using genetic markers that are unique to bighead and silver carp. The eDNA approach uses standard genetic identification methods in a novel application – the extraction of low concentrations of DNA from water sampled in the field that allows for species-specific detection (Plate 1).

The objectives of this study are to locate the invasion front using the eDNA and provide an early detection tool to inform rapid responses and other management. We will complete a longitudinal study of CSSC, sampling both the main-stem and different microhabitats where eDNA may accumulate, resulting in an increased probability of detection. From this information, locations above the current detection front, at the electric barrier, and above the electric barrier, that are identified as optimal eDNA detection sites, will be targeted for continual surveillance.

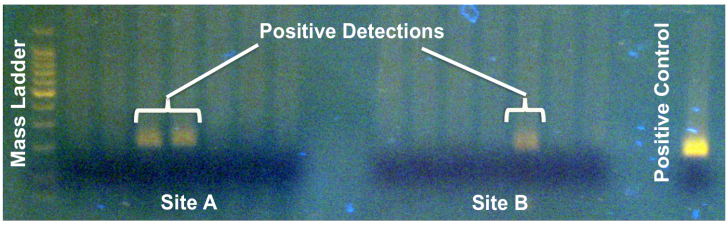

Plate 1: Gel electrophoresis including positive detections. Site A is at the confluence of the CSSC and the Des Plaines River in the Brandon Road pool and Site B is near a power plant in the Dresden Island Pool where water temperature exceeded 90F.

How will this improve our current monitoring?

The eDNA approach to surveillance will allow greater geographic coverage throughout the CSSC and connected waterways, and is more sensitive at detecting low abundance of fish than the methods currently employed. Adult and juvenile eDNA can be detected using this technique, and while the former is more likely, the method does not allow size or sex of fish to be differentiated. Water sample collection can be accomplished from boats, bridges, shorelines, and in habitats that are difficult to sample with the current approaches (such as shallow channels of the Des Plaines River or deep sections of the CSSC where electrofishing can be ineffective and where high boater traffic precludes the application of nets).

Current Results: As of 17 September 2009, the eDNA method has detected silver carp DNA approximately 1 mile south of the electric barrier. All analyzed CSSC samples above the electric barrier have been negative for silver carp eDNA. Testing for bighead eDNA in the Lockport pool is underway.

Authority: The Water Resources Development Act of 2007, Section 3061, Chicago Sanitary and Ship Canal Dispersal Barriers Project, Illinois, and a Cooperative Ecosystems Study Unit (CESU) with the Engineer Research Development Center (ERDC), authorized this project.

The current budgetary support covers eDNA surveillance methods as part of a larger and ongoing CESU agreement through June 2010.

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For additional project information please visit our websites
http://www.nd.edu/~lodgelab/
http://aquacon.nd.edu/