Detection of invasive northern pike (*Esox lucius*) from environmental DNA

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Objective

Develop a protocol to test for the presence of fish species and to estimate fish biomass by detection of DNA fragments in water samples through species specific Polymerase Chain Reaction (PCR).

Introduction

Importance:

- Northern pike populations in south central Alaska are introduced and invasive.
- They may have a detrimental effect on native fish populations.
- They are an effective top predator that feeds on any species it can capture, including trout and salmon fry.

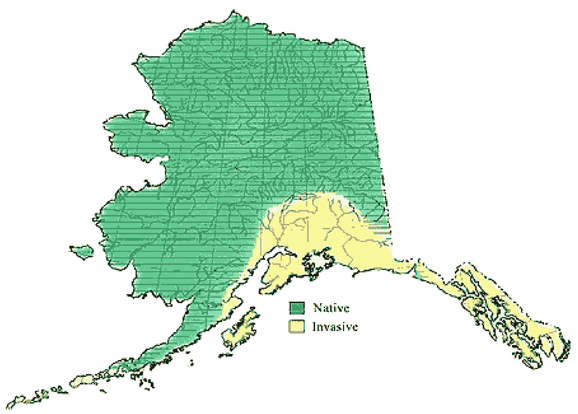

Figure 1. Map of Alaska indicating where pike populations are native and where they are invasive (From www.adfg.alaska.gov)

- Northern pike have been, and appear to continue to be, introduced illegally in waters south of the Alaska range.
- Management agencies are searching for ways to control the invasive populations to protect native fish populations.
- Detecting species in aquatic habitats from analyses of environmental DNA may prove a cost effective field survey technique.

Figure 2. Northern pike consuming a frog. Image from www.arkive.org.

Results

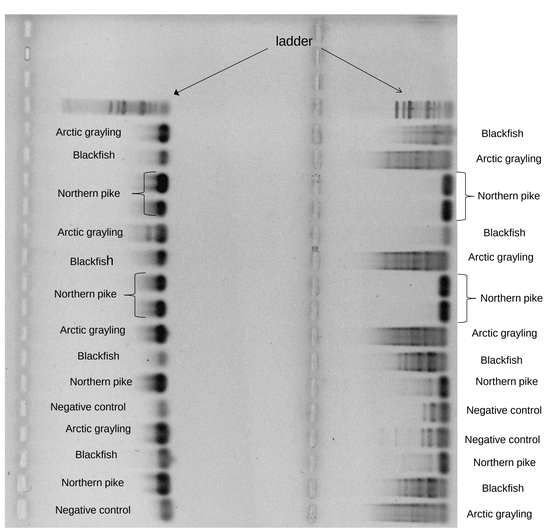

Figure 3. Electrophoresis gel visualizing the two primers tested with arctic grayling, northern pike, and blackfish. Indicates the distinguishing features in COI primer on non-pike species.

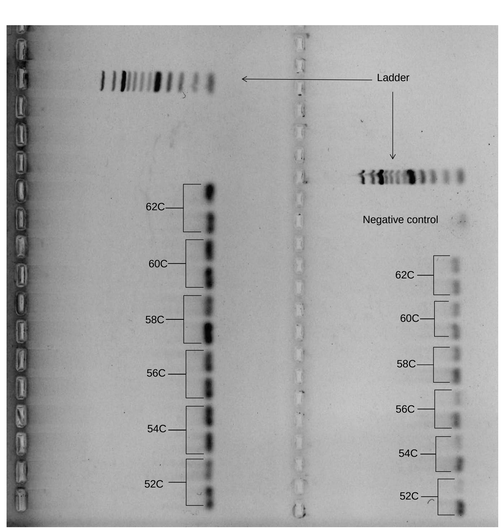

Figure 4. The visualization of pike DNA with each primer under an annealing temperature gradient.

Future Application

- Optimization of eDNA protocols as a tool to accurately estimate biomass of pike populations in Alaska will require testing the technique using controlled conditions:
  - Testing ability to detect pike presence from water samples from known fish species communities.
  - Testing sensitivity of technique with controlled dilutions of known samples.
  - Testing the influence of time and habitat characteristics on effectiveness of technique.
- Successful development of the technique will give natural resource managers a powerful tool for identifying water bodies where pike occur and to monitor the effect of pike population control interventions.

Methods

- Two different sets of primers to target the mitochondrial cytochrome oxidase I (COI) gene and the control region (CR) were tested under several different PCR conditions.
- The main variables manipulated were the annealing temperature and DNA concentrations.

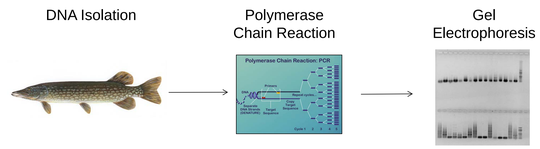

Figure 5. Methods flow chart. Images obtained from redorbit.com, sites.bergen.org.

Conclusions

- The primer targeting the COI region was able to produce a product at a much lower concentration of DNA template and when tested across other species distinguishing features were produced. COI also performs better at a higher annealing temperature then the CR primer.
- eDNA sampling could prove to be more efficient then traditional sampling techniques such as traps, nets, and hook and line.
- The COI primer functioned with an annealing temperature of 62°C. It was best visualized with a 2% agarose gel ran for 1 hour at 120 volts.
- Once an eDNA assay is finalized, detecting invasive pike populations in South Central Alaska will become more accurate and effective than past methods.

Acknowledgements

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