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Title: Early detection of non-native fishes using next-generation DNA sequencing of fish larvae

Abstract: Our objective was to evaluate the use of fish larvae for early detection of non-native fishes, comparing traditional and molecular taxonomy based on next-generation DNA sequencing to investigate potential efficiencies. Our approach was to intensively sample a Great Lakes non-native species introduction hotspot and then compare the success and efficiency of fish larvae taxonomic characterization between traditional taxonomy and community level DNA sequencing, a relatively novel molecular taxonomic method. We intensively sampled the Duluth-Superior harbor, the Great Lakes largest freshwater port, using a spatially balanced design to equally allocate catch effort across the harbor. To maximize the number of species encountered, we sampled at different time periods throughout the spring spawning period and used multiple types of sampling effort: diurnal tucker trawls, diurnal beach seining, nocturnal neuston tows, and nocturnal light traps. DNA based-taxonomy produced higher species richness than morphological taxonomy, including an additional (albeit established) non-native species. The encounter probability of non-native species at the larval stage was similar and up to 10-fold greater compared to surveys of juveniles and adults. On a sample basis, non-native species detection probabilities were different between DNA-based and morphological taxonomy. The results suggest that larval fish may provide a more efficient target for early detection than adult fish, and that DNA-based taxonomy can provide a more accurate characterization of the species present than morphological taxonomy.