M.L. 2013 Minnesota Aquatic Invasive Species Research Center Subproject Abstract
For the Period Ending June 30, 2019

SUBPROJECT TITLE: MAISRC Subproject 21: Early detection of zebra mussels using multibeam sonar
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SUBPROJECT BUDGET AMOUNT: $96,549
AMOUNT SPENT: $96,175
AMOUNT REMAINING: $374

Sound bite of Subproject Outcomes and Results
This project tested the utility of a swath mapping system (multibeam sonar) to detect the presence/abundance of zebra mussels. Acoustic backscatter data was collected and machine-learning was used to identify what is present in the substrate. Researchers were able to differentiate by mussel type (native vs. invasive) and density.

Overall Subproject Outcome and Results
Zebra mussels pose a serious threat to Minnesota lake and river ecosystems. However, monitoring zebra mussel populations is challenging because current methods for detecting and counting zebra mussel colonies rely on time consuming and expensive diving surveys, video imaging, or sampling of veligers (larvae), which limits the areas surveyed. Remote sensing techniques have been shown to quickly and efficiently gather spatially extensive information. Using this technology to detect zebra mussels would likely be much more efficient and more effective than traditional methods and could be used for early detection and warning in rivers, lakes and reservoirs and to track changes in zebra mussel density.

This project was the first phase of research designed to test the utility of a swath mapping system, multibeam sonar, for detecting the presence and abundance of invasive mussels. Laboratory experiments were conducted to test the feasibility of using multibeam sonar to distinguish zebra mussel containing substrates. Acoustic backscatter data were collected in a two meter deep tank over sand, gravel, and mixed substrate containing high and low densities of zebra mussels and with native mussels using combinations of different sonar settings (frequencies and pulse lengths). Machine-learning was used to differentiate the acoustic backscattering signatures in a data-driven substrate classifier approach. Using these methods, we were able to classify substrate by size and mussel density. Classification errors decreased with more sonar settings. For minimum errors of less than 20%, 8 sonar settings are required, and for minimum errors of 10% or less for all substrates, 12 sonar settings. Each sonar setting corresponds to a separate boat survey of an area with a multibeam sonar in the field. Therefore, the next phase of this research is to further develop and test multibeam sonar monitoring approaches in the field (MAISRC Subproject 21.2: Field validation of mulitbeam sonar zebra mussel detection).

Subproject Results Use and Dissemination
Research results from Phase I will be disseminated through a peer-reviewed publication (in preparation) and will inform Phase II field testing starting July 2019 (MAISRC Subproject 21.2: Field validation of mulitbeam sonar zebra mussel detection). During this one-year project, we participated in MAISRC Fellows meetings and presented our project to the public at the annual MAISRC Research & Management Showcase. The Minnesota

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