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Early detection monitoring approaches for non-indigenous species in vulnerable Great Lakes coastal ecosystems.

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Great Lakes harbors/embayments are vulnerable to introductions of non-indigenous species (NIS). Early detection of new NIS is desirable so as to allow for a timely management response, raising the question of how to accomplish this in a consistent, cost-effective manner. To that end, we conducted intensive sampling of fish and benthic macroinvertebrates in the Duluth/Superior harbor. This water body is subject to heavy propagule pressure, and our sampling detected a variety of both old and new NIS (e.g., rainbow smelt, tubenose goby, quagga mussel, New Zealand mud snail). Our deliberately oversampled data set provides the basis with which to evaluate strategies. Analyses confirm that early detection using traditional sampling techniques is inherently inefficient -- improved detection probability comes at significant sampling cost. Detection probability varied substantially across species depending on abundance, spatial distribution, habitat use, and gear vulnerability. Species acquisition curves and composition patterns differed among sampling designs and gears/habitats, as did the perception of invasion "status". Since the identity, introduction point, and habitat preference of the next NIS cannot be known, monitoring should cover a diversity of taxa and locations. Our analyses suggest that efficient strategies would bias benthos sampling towards shallow vegetated over deep/bare habitats and bias fish sampling towards fyke and electrofish over trawl samples. Other Great Lakes case studies are being planned, with the ultimate goal of defining monitoring designs for a broad detection network. [This abstract does not necessarily reflect U.S. EPA policy]