The Consequences of Connectivity – using an operating model and structured decision making to inform managers of potential fish community outcomes following barrier removal

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ABSTRACT:

Barrier removal and remediation are commonly used to restore physical stream processes and improve accessibility of critical habitats to migratory fishes. Increasing connectivity benefits stream systems and migratory fishes; however, decisions to increase connectivity can lead to tradeoffs between the benefits to desirable species and the potential increase in undesirable and invasive species, alongside a myriad of other ecological, social, and economic concerns. Furthermore, for some species, increasing connectivity may fail to restore migratory fish populations. This research used decision analysis to evaluate the ecological, social, and economic consequences and tradeoffs of enhancing connectivity for migratory fishes in the Great Lakes basin. We used structured decision making to elicit stakeholder objectives and values for increasing connectivity in the Great Lakes basin and identified the optimal management alternative for fish passage on the Boardman-Ottaway River, Michigan, USA. Individual-based models were developed to simulate the response of six species under five fish passage scenarios, and the response of lake sturgeon *Acipenser fulvescens* populations to different stocking scenarios. The optimal management alternative was passage of only native fishes unless stakeholder objectives for non-native Pacific salmonids were heavily weighted. Population response to barrier removal was species-specific and varied based on initial population size and distribution, the number of fish passed upstream, and species life history traits. Steelhead *Oncorhynchus mykiss* replaced brook trout *Salvelinus fontinalis* as the most abundant species with increasing passage of Pacific salmonids. Without stocking, a lake sturgeon population was not restored in 250 years. With stocking, lake sturgeon were predicted to be restored in 31 to 120 years depending on the stocking scenario. Our results will help inform decision-makers on management alternatives for fish passage and restoration in the Great Lakes basin that are ecologically and socially acceptable to stakeholders and that are likely to achieve their objectives.