MICHIGAN STATE UNIVERSITY

Quantitative Fisheries Center (QFC) Completed Project Briefing

Predicting the Response of Fish Populations to Changes in River Connectivity using Individual-Based Models

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Funding Agency: Great Lakes Fishery Commission
Active Dates: 2021 – 2024

Caption: Mouth of the Boardman-Ottaway River in Traverse City, MI. Photo credit: Iulus Ascanius.

Goal: Develop an individual-based model (IBM) framework for forecasting responses of migratory fishes to changes in river connectivity and identify the preferred passage regime for the Boardman River FishPass project, an innovative fish passage project designed to reconnect the river with Lake Michigan

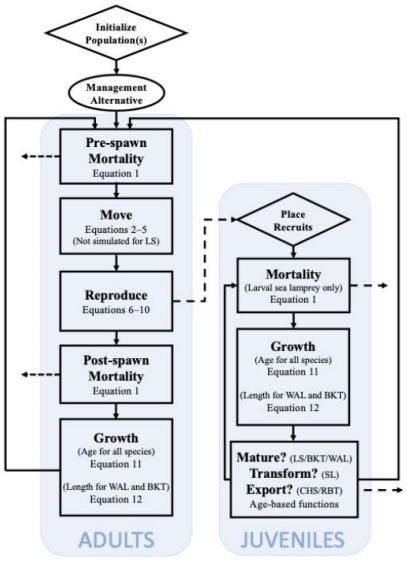
Objectives:

1. Develop an IBM framework for forecasting responses of migratory fisheries to changes in river connectivity that can be adapted/improved on by others
2. Forecast the response of brook trout, Chinook salmon, lake sturgeon, steelhead, sea lamprey, and walleye in the Boardman River, MI under alternative passage scenarios
3. Identify the preferred selective passage regime for FishPass across the evaluated species that optimizes stakeholder-valued performance metrics (e.g., abundance and distribution of native species, quality of fishing) while limiting outcomes, such as passage of invasive sea lamprey

Management Implications: While restoring river connectivity through barrier removal is often a priority for fishery agencies, it remains critical to understand how fish populations will respond to the renewed access to habitats and how stakeholders from diverse backgrounds and with differing perspectives on preferred outcomes, may be affected by the restoration.

Methods:

- Developed the IBM framework accounting for stage-/age-structured life histories, seasonal and spatial movement dynamics both within rivers and between lake and river habitats, density-dependent & density independent processes, etc.
- Structured-decision making workshops with stakeholders affected by Boardman River connectivity were used to identify passage scenarios, select focal species, and select performance metrics that informed model structure and evaluation criteria
- Stochastic simulations were conducted to forecast population responses to different passage scenarios



Caption: Conceptual diagram of the IBM framework developed for forecasting responses of migratory fishes to changes in river connectivity

Key Findings:

- Restoring connectivity in the Boardman River was predicted to alter population trajectories, but responses differed by species with some native species benefitting from increased access and others experiencing neutral or negative responses
- Selective fish passage outperformed full connectivity in meeting multiple objectives, allowing gains in native fish populations while limiting passage of invasive species
- Stakeholder-defined objectives influenced which passage scenario was considered optimal, demonstrating that biological outcomes and social preferences jointly shape management decisions

Deliverables: Flinn, S., T.O. Brenden, and K.F. Robinson. 2025. Predicting the response of fish populations to changes in river connectivity using individual-based models. Journal of Great Lakes Research 51:102463. Download here

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