GREAT LAKES FISHERY COMMISSION

Models for fish movement past migratory barriers: an overview of current methods and future directions

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ABSTRACT:
Understanding fish movement and response in relation to their environment near infrastructure and migratory barriers is crucial for developing sustainable fisheries management solutions. Intermediate-scale (time scales of minutes to days and spatial scales less than 2 km) movement models are a contemporary approach for understanding and predicting movement patterns of riverine fish in light of their changing environment, which is predominately water flow (i.e., flow direction, flow magnitude, and rates of change). These models can be complex and require interdisciplinary knowledge. For more than 60 years, different approaches have been developed for investigating, reproducing, and predicting the movement outcomes of fish decision making. Due to the breadth of model frameworks available, a systematic review is helpful to summarize the available knowledge including a description of general model properties, environment modeling, agent characteristics, and methods of data use, output, and validation. The analysis of 38 studies found a wide range of model frameworks and architectures. Despite the lack of consistency, each model imposed some combination of the following behaviors: response to flow direction (i.e., rheotaxis), response to flow velocity magnitude, response to turbulence, response to depth, and memory/experience of the individual. There is a clear need for more consistent modeling approaches, increased consideration of memory/experience, inclusion of a wider range of species, incorporation of more detailed environmental covariates, and use of time-dependent solutions in fish movement models.