Title

Evaluation of Pre-Spawning Movements of Anadromous Alewives in the Ipswich River Using Radiotelemetry

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Abstract

Conserving and restoring anadromous fish populations is an important research and management priority. For conservation to be effective, researchers must understand the behavior of the fish they seek to restore. Telemetry has allowed researchers to understand the upstream migrations of these fish in freshwater, how migration patterns vary, and if there is a relationship between behavior and environmental variables. In the northeastern United States, alewife (Alosa pseudoharengus), one of two species collectively referred to as river herring, has historically been an important component of coastal rivers. However, populations of these fish have experienced recent declines, and a commonly used method to restore river herring is stocking. In this thesis, I summarize research that seeks to understand anadromous alewife behavior with the goal of providing insights that will help manage and conserve this species and the coastal systems in which they live.

My thesis has a primary research chapter (Chapter 1), a second ancillary research chapter (Chapter 2), and four appendices that summarize related information as part of the funding proposal. First, to examine if fish origin (native or stocked) and fish release location (upstream or downstream) affected the pre-spawning movements of fecund alewives, I undertook a reciprocal experiment. In Chapter 1, for fish of both origins and release locations, I examined how long fish were in the river, where they spent their time, and how much and how fast they moved. For this, I gastrically tagged alewives with Lotek Nanotags NTC-6-1 radio tags and monitored movements in the lower 30 km of the Ipswich River (northeastern Massachusetts) using an array of 9 Lotek SRX_400 receivers. Based on these movement trajectories I concluded that in 2007, origin affected the total time fish spend in the river and release location affected where they spend their time.

Downstream movements of upstream migrating fish have typically been viewed as a behavioral assay of adverse tag effects. For this reason, alosine telemetry studies rarely release tagged fish upstream of the capture site. However, fisheries managers often release fish upstream near spawning grounds during stocking. In Chapter 2, I re-evaluated whether downstream movements of upstream stocked fish were consistent with an adverse tag effect. By combining physiological experiments with select movement trajectories, I showed that pre-spawning migrations of alewife included an array of up and downstream directed movements with various interpretations. In my research, these downstream movements were unlikely to be related to tagging stress (Chapter 2), as the cortisol, glucose, and chlorides of tagged fish were not different from untagged fish (Appendix A, Physiology). Furthermore, I suggested metrics that should be recorded in telemetry studies to standardize how downstream fish movements are measured.

In 2006, native fish were released at a downstream site (river km 6) and stocked fish were released upstream (rkm 25). I compared the behaviors of these same treatments across years. I showed that the behaviors of fish released in different years may differ based on temperature and discharge (Appendix B, Across Year Comparison).

To determine the amount and location of potential spawning habitat, I undertook a habitat study that utilized a geographic information system (GIS) to maps the size and distribution of habitat types. I located multiple mainstem pools in the Ipswich River that may serve as suitable spawning grounds for alewife. Tagged fish were primarily located in these habitats (Appendix C, Habitat).

To determine if juveniles were produced, I sampled various sites in the river for the presence of juveniles, using active and passive sampling techniques. Juveniles were not captured during these surveys (Appendix D, Juvenile Sampling).

Before this research, little was known about the pre-spawning migrations of river herring. While river herring are assumed to be a generalist species, I found their behaviors to be complex. I have identified a number of gaps in the current knowledge of how these fish behave in the field. Restoration efforts must take into account the behavior of the fish, as well as the capacity of a system to accommodate those needs. Within the context of understanding fish behavior, protecting habitat, and providing regulatory restrictions on the fishery, stocking may contribute to broader management and restoration goals.

First Advisor

Martha E Mather