

PhD Dissertation

Department of Environmental Science and Policy

George Mason University

Candidate: Catherine Jean (CJ) Carroll Schlick

Defense Date and Time: July 8, 2016, 10:00 am

Defense Location: Merten Hall Rm. 1204

Title: Life History Traits and Population Dynamics of River Herring, Alewife *Alosa pseudoharengus* and Blueback Herring *Alosa aestivalis*

Dissertation Director: Dr. Kim de Mutsert

Committee: Dr. R. Chris Jones, Dr. Changwoo Ahn, and Dr. Matthew B. Ogburn (Smithsonian Environmental Research and Education Center)

ABSTRACT

Anadromous river herring, alewife *Alosa pseudoharengus* and blueback herring *A. aestivalis*, were important fisheries that declined to such an extent that moratoriums were established through much of their range, including all of the Chesapeake Bay. The causes of decline are attributed to overfishing and habitat degradation. The goals of this research were to examine the life history traits of river herring in Potomac River tributaries and determine if the tributaries serve as successful spawning and nursery habitats after years of habitat alterations. I developed a stage-based, stochastic, difference model of populations in Potomac River tributaries with site-specific growth rates, mortality rates, and maturity schedules. Adults were collected in Pohick Creek, Accotink Creek, and Cameron Run, juveniles in Gunston Cove and Hunting Creek, and larvae in all locations. Otoliths were extracted to estimate age (adults in years and young-of-year (YOY) in days) and scales were collected from adults to estimate spawning age. Of the

eight growth models tested, the best-fit model was the logistic for adults and the von Bertalanffy for YOY; however models were less than 2% different between best and worst fit. Adult females grew faster, larger, and matured earlier than males for both species. Growth differed between years for YOY, and for blueback herring YOY also between monthly cohorts. Mortality was more variable for alewife than for blueback herring. The recruitment model was a good fit for YOY alewife but not for blueback herring. The model predicted that year class strength was variable for both species, with surviving juveniles replacing 13.8%, 130.4%, and 6.5% of spawning adult alewife, and 1.8%, 0.5%, and 0.4% of adult blueback herring each year from 2013 to 2015. However, blueback herring populations increased when lower juvenile mortality rates, more comparable to other Virginia rivers, was utilized, which resulted in 309.9% and 118.1% of adults replaced by juveniles in 2013 and 2014.

In chapter four, I compared adult river herring populations in different rivers of the Chesapeake Bay, with data provided by five scientific agencies. Most populations had more males than females but at different proportions. Spawning frequency was different between rivers with the Choptank River having more repeat spawners, and the Nanticoke and Potomac rivers having more virgin spawners. The median length and age were different between rivers, indicating that herring in the Susquehanna River were smaller individuals, while individuals in the Nanticoke River were older. All of these traits are important in estimating potential recruitment of populations, and understanding the differences would improve stock assessments.