ACES Final Report Executive Summary

Period Covered by the Report: 1/08/02 – 12/31/03
Date of Final Report: 1/30/04
EPA Agreement Number: R-827072-01-3
Title: Determinants of Small-Scale Variation in the Abundance of the Blue Crab *Callinectes sapidus*
Investigators: Dr. Richard B. Aronson[1,2] and Ryan M. Moody[2,1]
Institution: [1]Dauphin Island Sea Lab and [2]University of South Alabama
Research Category: Small Grant for Exploratory Research
Project Period: 1/08/02 – 12/31/03

Summary of Findings:

Estuarine ecosystems support a variety of commercially important fish and invertebrate species. Understanding what controls the abundance of these species has immediate practical value in enabling us better to estimate the levels of exploitation that constitute sustainable harvests. Taking a longer view, if we can determine the manner in which trophic transfer occurs in estuarine food webs, then we will be better able to predict how natural and anthropogenic perturbations will affect ecosystem function and, hence, the stock sizes of commercially important species. The primary goal of this study was to determine if local variations in the population densities and predatory activities of the blue crab *Callinectes sapidus* in the Mobile Bay Estuary can be explained by local abundances of the marsh periwinkle *Littoraria irrorata*. The specific objectives of this study were to: (1) test whether densities of *Callinectes* are positively related to densities of *Littoraria*, (2) test whether predation by *Callinectes* on *Littoraria* is density-dependent, and (3) evaluate two simple, indirect methods of population estimation for blue crabs, which are based on the effects of the crabs on *Littoraria* populations.

We conducted bimonthly assessments of sublethal damage, in the form of repaired sublethal cracks, and biweekly tethering experiments on the marsh periwinkle *Littoraria irrorata* for six months (May to October 2003) in two salt marshes along the coast of Alabama. The blue crab *Callinectes sapidus* is by far the most important predator of *Littoraria* in these marshes. We detected a strong positive relationship between the proportion of large *Littoraria* with sublethal injuries and the proportion of tethered snails attacked. The shells of large snails represent a highly integrated, multi-year record of past predation events and are therefore reliable indicators of crab predation. There was no significant seasonal variation in the rate of attacks on tethered snails, but there was a significant correlation between crab abundance and attacks in the experiments. Repaired shell cracks were randomly distributed in *Littoraria*, indicating that the snails are randomly attacked by crabs and that an attack does not predispose a snail to more or fewer attacks in the future.

The mean proportion of large, scarred snails was not related to prey:predator density ratios although mean crab density was negatively correlated with snail densities. Therefore, density-dependent foraging was not detected. Both crabs and snails were negatively correlated with *Spartina* density. Given that attacks are random, we interpret

these results to indicate that *Spartina* density controlled crab access into the marsh and foraging rates, and that encounter rates were independent of snail density.

In this system, sublethal injuries and tethering experiments provided accurate information about the natural rate of predator-prey interactions. Predator abundance was not as accurate in predicting predation intensity although it did reflect extremes among the highest- and lowest-predation sites. *Spartina* density significantly affected crab activity in the marsh and, in the case of one low-predation site, imposed a filter on crab size. Proportions of scarred adult snails and mortality in tethering experiments incorporated these differences in predation and habitat structure, and provided an accurate relative indicator of crab activity. Blue crabs are ubiquitous in salt marshes along the Gulf and Atlantic coasts and are an important commercial species in both regions. Measures of both predation potential and predation pressure on *Littoraria* can be used as independent estimators of marsh utilization by blue crabs.

Presentations

Ryan M. Moody, Dr. Richard B. Aronson. Tethering experiments measure predation potential after all. Oral Presentation. Benthic Ecology Meeting. Mobile, AL. March 2003.

Supplemental Keywords: Alabama; AL; *Callinectes sapidus*; Density-dependent predation; Gulf Coast; *Littoraria irrorata*; Predation potential; Predation pressure; Salt marsh ecology; Sublethal injury; Tethering