

Annual Report Summary

Period Covered by the Report: 8/01/02 – 12/31/02

Date of Report: 1/25/03

EPA Agreement Number: R82-7072-010

Title: DETERMINANTS OF SMALL-SCALE VARIATION IN THE ABUNDANCE OF THE BLUE CRAB *CALLINECTES SAPIDUS*

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Research Category: Small Grant for Exploratory Research (SGER)

Project Period: 8/01/02 – 12/03/03

Objectives of the Research Project:

Our long-term goal, of which this preliminary study is a part, is 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 prey abundance. The abundance of blue crabs on large scales is influenced in different situations by such factors as larval supply, post settlement mortality, predation, competition, cannibalism and food supply, separately and in combination. Since the predatory fishes that eat blue crabs range over large spatial scales, one simple *a priori* hypothesis to explain differences in abundance at this small scale is that abundance is related to the availability of food; at this scale, bottom-up effects should be more important than top-down effects.

This project will test one trophic linkage for bottom-up control of blue crab abundance on small spatial scales: the relationship of *Callinectes* and *Littoraria*, one of its principal prey species in the intertidal salt marshes of Mobile Bay (West and Williams 1986) and elsewhere (Hamilton 1976; Schindler et al. 1994 and references therein). The study proposed here will (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.

In order to articulate formally the hypotheses to be tested in this study, it is necessary to define two aspects of predator-prey relationships: predation potential and predation pressure (Aronson 1987, 1989). Predation potential is defined as the rate at which the prey of interest—*Littoraria* in this case—would be consumed were they readily available to predators. Predation pressure is defined as the natural frequency of attacks by predators on their prey. Predatory attacks can be further categorized as lethal or sublethal, a point that will become important when it comes to assessing predation pressure. If predation by blue crabs on *Littoraria* is density-dependent, then dense populations of periwinkles should, *on a per capita basis*, experience greater predation potential and greater predation pressure than sparser populations. Predator abundance, predation potential and predation pressure should, therefore, be correlated with each other. This would mean that predation potential and predation pressure, which are relatively simple to measure, should predict the abundance of *Callinectes*, which is more difficult to assess accurately (e.g., with baited traps that can attract crabs from outside the habitat).

The hypotheses to be tested in this study are as follows.

I. Abundances of blue crabs and marsh periwinkles.

Hypothesis: Population densities of *Callinectes* are positively related to population densities of *Littoraria*.

Null Hypothesis: Population densities of *Callinectes* and *Littoraria* are not positively related.

II. Predation potential and predation pressure.

Hypothesis: Per capita predation potential and predation pressure on *Littoraria* are greater in habitats with higher population densities of *Callinectes*.

Null Hypothesis: Predation potential and predation pressure are not positively related to predator abundance.

To test these hypotheses, we will measure five parameters: population densities of *Callinectes*; population densities of *Littoraria*; predation potential, which will be assessed by tethering experiments with *Littoraria*; predation pressure, which will be estimated from sublethal injuries (repaired shell cracks) in *Littoraria* populations; and densities of *Spartina* shoots as they serve as an escape route for *Littoraria* from the water, and thus, predators. These parameters will be measured at two locations, Airport Marsh, Dauphin Island and Point aux Pines, Bayou la Batre. Each location will consist of a putatively high and low predation site (four study sites in all).

Progress Summary/Accomplishments:

The fieldwork is due to start March, 2003. The proposed methodology has been tested and refined to ensure the effectiveness of the sampling techniques and equipment. The experimental and sampling design of this study require that blue crabs are present within the study sites in high abundance and will be carried out from March, 2003 to November, 2003.

Supplemental Keywords: Bottom-up effects; Abundance; *Callinectes sapidus*; *Littoraria irrorata*; Salt-marsh; *Spartina alterniflora*; Predation; Sublethal Injury; Trophic linkage