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iological Border Patrols: does inter-specific competition exclude bio-invaders from otherwise optimal habitat?

Background

he Asian shore crab, *Hemigrapsus sanguineus,* is native to the acific Ocean ranging from the southern coast of Russia to Hong ong, including Japan. This grapsid crab is usually found in ocky intertidal habitat, however invasive populations have been ound subtidally. **In 1988, a single female bearing eggs was ound in Stone Harbor, NJ. Since then, the Asian shore crab as spread southward to North Carolina and northward to laine** (Figure 1). *H. sanguineus* has also been found on the est coast of France, the Netherlands, and the Mediterranean. In ome areas, the density of shore crabs can reach 320 m^{-2} cDermott 1998). As the populations of *H. sanguineus* crease, the numbers of native crabs, and even the invasive uropean green crab, are declining (Lohrer and Whitlatch 2002).

Rationale

is well established that highly invasive pecies have certain characteristics: igh fecundity, broad diet, lack of redators, etc. But when are these haracteristics not sufficient for stablishing a new community? **The xclusion of a potential invader is undamental to the understanding of ioinvasions**, and is another erspective from which to study non-ndigenous species.

Figure 1. Range of H. *sanguineus* on the East Coast of North America. (Image courtesy of USGS)

Overview

The goal of my research is to **determine the factors that are delaying the Asian shore crab, *Hemigrapsus sanguineus,* from invading favorable habitat on the west coast of North America**. This information will be of immediate relevance in understanding the dynamics of successful bioinvasive populations of *H. sanguineus*, and also will provide insight into basic ecological interactions that can be used to predict the vulnerability of any particular habitat to the establishment of bioinvasive populations of a given species.

H. sanguineus has not established populations on the west coast of North America despite the following:

- There is an abundance of rocky intertidal habitat
- It is much closer to Asia with more shipping contact and potential for larval transportation via ballast water.
- Studies show that the shore crab is able to outcompete the European green crab on the east coast (Lohrer and Whitlatch 2002). However, the green crab has recently had a burst of success invading the west coat.

Literature Cited:
Lohrer, AM and RB Whitlatch. 2002. Interactions among aliens: Apparent replacement of one exotic species by another. Ecology 83: 719-732
McDermott, JJ. 1998. The western Pacific brachyuran (*Hemigrapsus sanguineus*:Grapsidae), in its new habitat along the Atlantic coast of the United States: geographic distribution and ecology. ICES Journal of Mar Sci 55: 289-298.

Scientific Approach

My research will test the hypothesis that ***Hemigrapsus sanguineus* has been unable to establish populations** along the west coast of North America **because of its inability to compete successfully with two native species of *Hemigrapsus*** (*H. nudus* and *H. oregonensis*) that also occur in this otherwise favorable habitat.

Since the most likely vector for invasion is as plankton via ballast water transfer, this research will focus mainly on early life stages (Figure 2), and will investigate three types of ecological interaction between *H. sanguineus* and each of the native species of *Hemigrapsus*:

1) effects of chemical cues produced by adults of native species of *Hemigrapsus* on settlement and metamorphosis of the postlarval stage of *H. sanguineus*;

2) space competition between juveniles of *H. sanguineus* and each of the native species of *Hemigrapsus*;

3) competition for food among juveniles of the respective species.

Figure 2. Life stages of *H. sanguineus*. a) five zoeal stages that are entirely planktonic; b) one megalopal stage during which the larvae prepare for settlement and metamorphosis; c) juvenile stage; d) adult stage.

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