CHARLES E. SCHMIDT COLLEGE OF SCIENCE

The role of chemical and visual cues in habitat location and selection by the Sargassum crab Portunus sayi

Lorin West and Dr. Randy Brooks

Department of Biology, Charles E. Schmidt College of Science, Florida Atlantic University, Boca Raton, FL

The *Sargassum* community consists of a unique and diverse assemblage of micro-, meio- and macro-fauna, making it an Essential Fish Habitat. Associated organisms presumably have adaptations to assist in finding this habitat. In this study the location and selection of habitat by the *Sargassum* crab *Portunus sayi*, a fundamental member of pelagic food chains, was investigated. Chemical detection trials were conducted using a two-chamber choice apparatus (devoid of visual cues) for the following odors: *Sargassum fluitans*, *Sargassum natans*, and *Thalassia testudinum*, a seagrass whose detached blades are commonly found floating with *Sargassum*. Trials using visual cues only in which crabs were given choices of *S. fluitans*, *S. natans*, artificial *Sargassum*, and *T. testudinum* were conducted. Finally habitat preference trials that combined chemical and visual cues were done using *S. fluitans*, *S. natans*, artificial *Sargassum*, and *T. testudinum*. Results showed that *P. sayi* can detect chemical odors from *Sargassum* species but not from *T. testudinum*. *P. sayi* visually located habitats in the absence of chemical cues; however, they were unable to visually distinguish between *Sargassum* species, artificial *Sargassum*, and *T. testudinum*. Habitat preference trials resulted in a preference of *S. fluitans* and *S. natans* over artificial *Sargassum* and *T. testudinum* by *P. sayi*. Conversely, there was no preference by *P. sayi* between *S. fluitans* and *S. natans*. These results suggest that crabs isolated from a *Sargassum* patch will initially use both vision and odor, but once closer may fine tune their selection using primarily chemical information.

The Role of Visual and Chemical Cues used by the Sargassum Crab *Portunus sayi* in Selecting and Locating Habitats

Lorin West and Dr. Randy Brooks
Department of Biological Sciences, Florida Atlantic University

Introduction

Pelagic *Sargassum* is a brown alga which creates a unique floating habitat commonly found in the western North Atlantic Ocean and in the Gulf of Mexico. Nearly all the floating pelagic macroalgae is comprised of two species, *Sargassum fluitans* and *Sargassum natans*[1]. *Sargassum* accumulates at the surface supporting a diverse community comprised of more than 100 species of invertebrates, over 100 species of fish, sea turtles, pelagic birds, and marine mammals, designating it as Essential Fish Habitat[2,3,4,5].

The distribution of *Sargassum* is highly variable in space and time[2] and associated organisms presumably have adaptations to assist in finding this habitat. In this study the location and selection of habitat by the *Sargassum* crab *Portunus sayi*, an abundant and fundamental member of pelagic food chains, was investigated.

The objectives of this study were to determine if 1.) *P. sayi* responds to chemical cues from *S. fluitans, S. natans*, and *Thalassia testudinum* (a seagrass whose detached blades are commonly found floating with *Sargassum*); 2.) *P. sayi* responds to visual cues from *S. fluitans*, *S. natans*, and *T. testudinum*; 3.) *P. sayi* has habitat preferences.

Materials and Methods:

Collection

All collections were made April -August, 2011, 4-12 km offshore from the Boca Raton Inlet in south east Florida with a fine mesh dip net. All specimens were quickly sorted and transported to the biological sciences laboratories at FAU.

In the laboratory, each Sargassum crab was placed in individual aquaria and acclimated for 24 hours until experimental trials. All aquaria were set-up with aged saltwater pumped from the Atlantic Ocean at Gumbo Limbo and were maintained with salinity at 32-35 ppt and a 12L:12D photoperiod.

Crab size was determined by measuring the carapace width. Crabs collected varied in size from 2-41 mm. Crabs tested were $\geq$ 5 mm, as smaller crabs were too difficult to handle without causing potential injury.

Chemical Cues

Chemoreception trials were conducted using a two-chamber choice apparatus (devoid of visual cues) for the following odor sources: *S. fluitans*, *S. natans*, and *T. testudinum* (Figure 1).

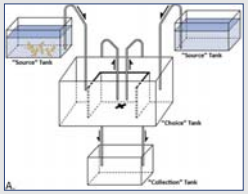

Figure 1. A. Chemoreception apparatus with "stimulus" tanks fed water through plastic tubes into the lower "choice" tank below. One "stimulus" tank contained aged seawater with chemical cues, while the other contained only aged seawater. B. Dye used in preliminary trials to show that minimal mixing occurred.

Trials ended when the crab chose a side compartment by crossing the opaque partition and a total of twenty trials were conducted.

Visual Cues

Trials using visual cues only were conducted in which crabs were given a combination of choices of *S. fluitans*, *S. natans*, artificial *Sargassum*, and *T. testudinum*.

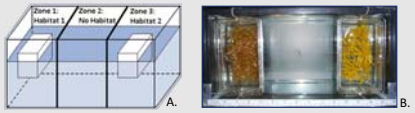

Figure 2. A. Aquaria setup for visual cues trials. Two different habitats were placed within plastic containers secured above the water line to avoid interference with chemical cues. Each of the twenty trials ended after 2 hours and crab selection was recorded based on which zone the crab was located. B. Aerial view of aquaria setup for *S. fluitans* vs. artificial *Sargassum*.

Habitat Selection

Habitat preference trials that combined chemical and visual cues were conducted in which crabs were given a combination of choices of *S. fluitans*, *S. natans*, artificial *Sargassum*, and *T. testudinum*.

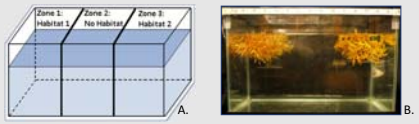

Figure 3. A. Aquaria setup for habitat preference trials. Habitats were placed within aquaria and crab selection was recorded based on which habitat the crab was located within after 2 hours. B. Side view of aquaria setup for *S. fluitans* vs. artificial *Sargassum*.

Results

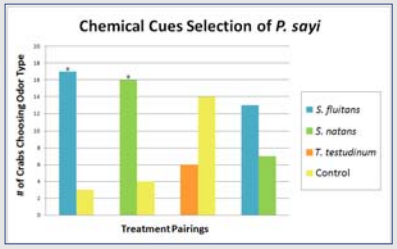

Figure 4. *P. sayi* showed a significant preference for chemical odors in two of the three chemoreception trials (indicated by *). *P. sayi* chose *S. fluitans* odors more than the control odors (17 out of 20 or 85%; p = 0.002) and *S. natans* odors more than the control (16 out of 20 or 80%; p = 0.007).

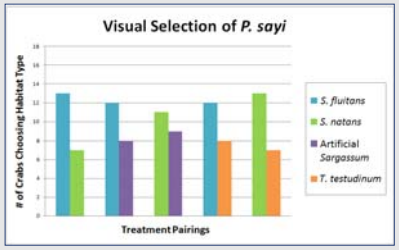

Figure 5. Results from the visual reception trials showed no significant response for any of the five treatments (p ≥ 0.05). However, crabs still were capable of selecting a habitat even though they showed no preference.

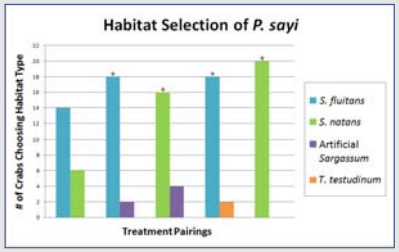

Figure 6. *P. sayi* showed a significant habitat selection for four of the five habitat pairings (Indicated by *). *P. sayi* chose *S. fluitans* more than artificial *Sargassum* (18 out of 20 or 90%; p = <0.001) , *S. natans* more than artificial *Sargassum* (16 out of 20 or 80%; p = 0.007), *S. fluitans* more than *T. testudinum* (18 out of 20 or 90%; p = <0.001) and *S. natans* more than *T. testudinum* (20 out of 20 or 100%; p = <0.001). There was no significant selection between *S. fluitans* and *S. natans* by *P. sayi*, although *S. fluitans* was chosen 14 out of 20 times (or 70%; p = 0.07).

Data from all trials showed that there was no significant effect of size or sex on crab selection.

Discussion

The results from this study show that *P. sayi* can detect chemical odors emitted from *Sargassum* species. Therefore, *P. sayi* could potentially locate a *Sargassum* patch using chemical cues alone. Similar results were shown by Forward et al.[6] in which megalopae of the blue crab, *Callinectes sapidus,* respond to chemical cues from aquatic vegetation by orienting toward these areas. It should be noted that heterospecific and conspecific odors from within a *Sargassum* mat may also play a role in habitat location and should be the focus of future studies.

Although *P. sayi* had no significant habitat preferences using visual cues only, *P. sayi* was still capable of finding a habitat. Therefore, it is conceivable for *P. sayi* to use visual cues to quickly find refuge and avoid potential predation even if that refuge isn't its preferred habitat.

Similar to the chemical cues and visual cues trials, habitat preference trials showed that there was no significant preference between *S. fluitans* and *S. natans*. A possible explanation could be that since both species are commonly found simultaneously in a single mat, *P. sayi* may not need to distinguish between the two *Sargassum* species.

As *Sargassum* is variable in space and time, the use of chemical and visual cues to relocate a habitat could be extremely beneficial to the organisms living in that habitat. It is suggested that crabs isolated from a *Sargassum* patch will initially use both vision and odor, but once closer may fine tune their selection using primarily chemical information.

References

1 Parr, A.D. 1939. *Bull. Bingham Oceanogr. Coll.* 6: 1-94.
2 Dooley, J.K. 1972. *Contrib. Mar. Sci.* 16: 1-32.
3 Butler, J.N., B.F. Morris, J. Cadwaller and A.W. Stoner. 1983. *Bermuda Biol. Sta. Spec. Publ.* 22: 1-85.
4 NOAA. 1996. Magnuson-Stevens Fishery Conservation and Management Act, as amended through Oct. 11, 1996. NOAA Tech. Mem. NMFS-F/SPO-23. 121 p.
5 Casazza, T.L. and S.W. Ross. 2008. *Fish. Bull.* 106: 348-363.
6 Forward, R.B., Jr., R.A. Tankersley, K.A. Smith and J.M. Welch. 2003. *Mar. Biol.* 142: 747-756.

Acknowledgments

Special thanks go to Dr. Randy Brooks for his guidance and supervision and for sacrificing his boat in order to make collections possible. Thanks to my committee members Dr. Brian Lapointe, Dr. Tammy Frank and Dr. Dennis Hanisak. Also, thanks to my labmates for moral support.