

## THE INTERTIDAL ZONE: CRABS AND THEIR COMMUNITY

Jeffrey L. Dudycha, John J. Stachowicz and Sheryl L. Soucy

**Abstract.** We censused all apparent fauna on a 40m strip of beach over 2 days. We then focused our observations on the abundance and distribution of three species of crabs to assess the potential for competition for resources during the tidal cycle. At low tide, green crabs inhabited the lowest level of the mudflats near the water, ghost crabs scavenged on the upper reaches of the sandy beach, and hermit crabs were distributed throughout. At high tide there appears to be competition for food between the hermit and ghost crabs. (SLS)

### INTRODUCTION (JLD)

Intertidal communities experience harsh and variable conditions to which inhabitants must adapt to survive. With observations of the biota we characterized the distribution, abundance and activity of life in the intertidal zone. In particular, we were interested in the spatial and temporal distribution of three common crabs: ghost crabs, green crabs and hermit crabs. We chose crabs as the main focus of this study because they were present throughout the intertidal zone and represented by several species.

### METHODS (JJS, JLD, SLS)

**Study site.** (JJS, JLD) We characterized ~1ha of intertidal zone, 100m wide, 500m south of the Rio Sirena estuary in Corcovado National Park, Costa Rica. This included two major substrates, a sandy beach and sedimentary rock flats. We divided this into six specific habitats:

- 1) *Dune.* Vertical sandy dropoff adjacent to forest, 50% shaded, interspersed with fallen trees and roots.
- 2) *Upper beach.* Fine-grain, periodically dry sand, 10% shaded, some rocks and jetsam.

3) *Lower beach.* Coarse, wet sand.

4) *Inner flats.* Smooth rock flats which dry off, some small (1-2cm) pits.

5) *Pools.* Stagnant water left by receding tide, water temperature greatly increases.

6) *Outer flats.* Rough rock flats, covered with pits to 3cm, cut through by rivulets, exposed 1-2hr.

We observed organisms occupying these 6 zones noting abundance, distribution and behavior (Appendix A).

**Crab Abundance.** (SLS) We recorded the abundance of three species of crabs along two line transects on 26 January 1992 from 1400 to 1800 and along three transects on 27 January from 0800 to 1430. The five transects covered 100m of beach and extended from the tree-line to the water's edge. Once per hour we estimated the density of each of the three species every 10m along the transects. The areas used to determine these densities ranged from 1m<sup>2</sup> to 5m<sup>2</sup> depending on abundance of the organisms in the area. We remained at each plot until repeated counts were consistent. We also recorded substrate types, general characteristics of the habitat and a sample of weights of crabs >1g.

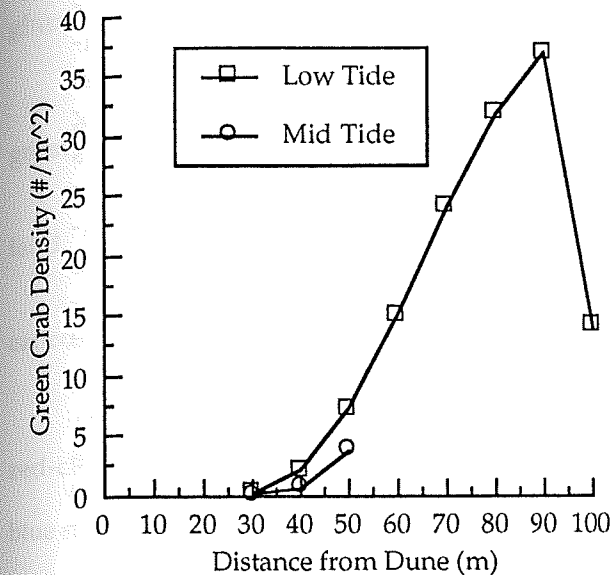


Figure 1. Green Crab density with distance from the dune at different tides (no crabs were observed at high tide).

### RESULTS (JJS)

The spatial distribution of each observed crab species is distinctly different. The green crabs are not found closer than 30-35m from the forest edge, and increase in abundance with proximity to the low water mark (Figure 1). Their distributional patterns do not shift with rising tide, they remain at the same location throughout the tidal cycle. The distribution of hermit crabs is bimodal with peaks at the dune and low water marks (Figure 2). These peaks do not shift with the tide, and there appear to be two distinct populations separated spatially along the study area. Ghost crabs were found mostly on the upper beach, but occasionally venture as far as 30m from the forest edge. At high tide, their distribution is compressed with a peak near the dune (Figure 3). Weights of both the green and hermit crabs were too small to be obtained accurately with our equipment, but the

ghost crabs had a mean weight of  $2.65 \pm 0.94$ g.

### DISCUSSION (JJS)

The distribution of green crabs can largely be explained by their foraging habits. They were observed feeding on algae, scraped from the rocks in which they live, and may have a foraging range as small as 100cm<sup>2</sup>. They do not migrate with tidal fluctuations (Figure 1), but rather retreat into their holes to avoid the surf. It is possible (we were unable to see what they feed on underwater) that the growth and distribution of this algae limits their distribution.

Rather than food availability, heat stress may be a factor limiting the distribution of hermit crabs. There are only two areas on the beach where exposure to high temperatures is minimized: under the shade of trees, or in the tidal pools on the rock. These are

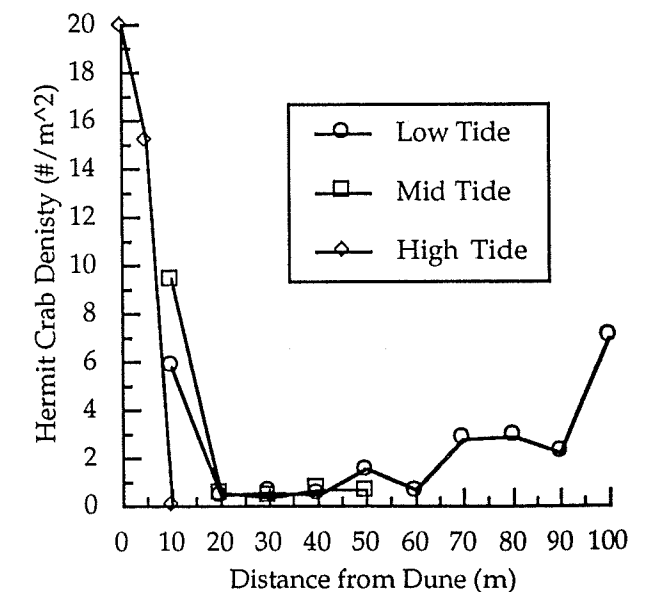


Figure 2. Hermit Crab density with distance from the dune at different tides.

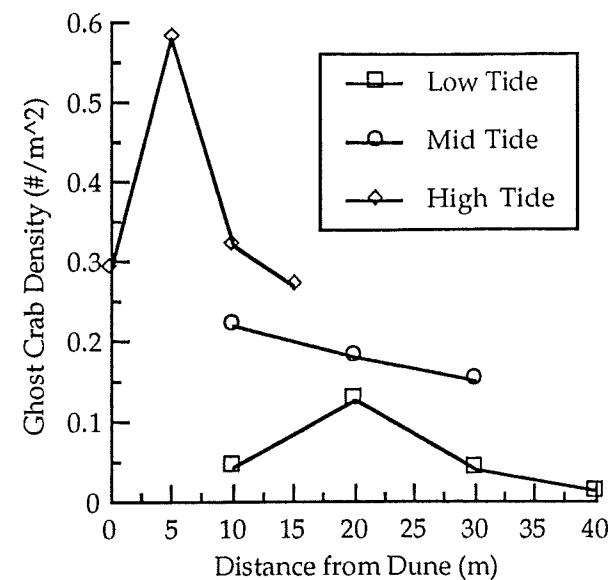


Figure 3. Ghost Crab distribution at different tides.

the only two areas inhabited by hermit crabs in any great numbers. A greater abundance of potential food for this scavenger around the high tide line may offer a reason for the apparently larger size of the hermit crabs there. Another possible reason for this apparent size difference could be that hermit crabs may breed in the water then spend their adult lives ashore where food is more abundant. Further research might help in clarifying the reasons for apparent size differences in the two populations.

The ghost crabs exhibited the most dynamic of the three distributions. At lower tides, they spread out through the width of the beach (Figure

3) as far as 30m from the dune. However, at high tide their range is compressed into the dry zone, as they prefer to stay out of the water, entering the surf only to escape predation. This distribution, and every other one mentioned above, is subject to the effects of temperature, and therefore the crabs may exhibit different patterns according to time of day. Since low tide during the study period was during the mid afternoon, heat was obviously a factor. Future studies examining nocturnal patterns of distribution might help in distinguishing the effects of heat and tide.

The only apparent resource overlap between these species is scavengeable food material. If limited, this resource could lead to interspecific competition between ghost and hermit crabs on the upper beach. This competition may not be strong as ghost crabs seem to occur at lower densities near the forest edge, where hermit crabs are most dense. However, at high tide, or when heat stress is less of a factor (i.e., at night) the potential for overlap increases. Scavengeable food resources may be partitioned by particle size, with ghost crabs using larger food items and hermit crabs utilizing the remnants. This potential for food resource overlap and the degree of partitioning of these resources might be clarified by further observations and food-choice experiments.

#### Appendix A. Species account of Playa Sirena.

| Organism     | Abundance | Area | Food      | Description                       | Behavior                            |
|--------------|-----------|------|-----------|-----------------------------------|-------------------------------------|
| <b>CRABS</b> |           |      |           |                                   |                                     |
| hermit       | v. common | 1-6  | scavenger | inhabit vacated shells ≤4 cm long | retreat into shells when threatened |

|             |           |     |                                  |   |   |
|-------------|-----------|-----|----------------------------------|---|---|
| ghost       | common    | 2-4 | scavenger and occasional insects | bright red, up to 4cm and 4g mass.  | dig holes in sand to live in, fast and agile when threatened. Also nocturnally active |
| green       | v. common | 4-6 | algae                            | small, 0.5g, very dark green/mud color. Roughly circular shell 11 cm wide, red to white at rear, purple foreclaws | very wary of motion, retreat into holes with incoming waves                           |
| land        | common    | 1   | scavenger                        | 8 cm long with pointed ends of shells. Roughly sand colored and very fast   | Nocturnal   |
| calico-blue | uncommon  | 5   | scavenger?                       | charcoal gray with red on underclaws, 2-5cm light blue, shaped like green, but much larger (4cm)                  | retreat when encountered, but will defend if cornered                                 |
| red-claw    | uncommon  | 6   | algae and other (?)              | red top w/one large claw and one small claw like ghost crab, but black  | less wary than green crabs  |
| blue stone  | rare      | 6   | ?                                | large 40cm diam., blue-grey with long, thin claws   | very aggressive   |
| red fiddler | uncommon  | 3   | scavenger?                       |   | nocturnal   |
| black sand  | common    | 2-4 | scavenger                        |   | nocturnal   |
| estuarine   | rare      | 4   | ?                                |   | at night in water   |

#### OTHER INVERTEBRATES

|             |                |      |                   |   |  |
|-------------|----------------|------|-------------------|---|--|
| bivalve     | common         | 4-6  | plankton          | 1-10 mm long, arc-shaped, found in old crab holes |  |
| anemones    | rare           | 5    | plankton/sm. fish | molasses color, 5cm diam. 4cm high                |  |
| snails spp. | v. common      | 4-5  | plankton/algae    | 5cm max. length, various spp.                     | crawling on pool bottom                |
| barnacles   | locally common | 4, 6 | plankton          | on mud & snails, 6mm max. diam.                   | closed                                 |
| sand shrimp | common         | 5    | ?                 | up to 4cm long, sand colored, quick darting       | tend not to hide, depend on camouflage |

#### FISH

|            |           |    |   |  |                       |
|------------|-----------|----|---|--|-----------------------|
| gobiidae   | v. common | 5  | ? | up to 6cm long, sand colored, fast swimming benthic fish                   |                       |
| red/yellow | uncommon  | 5* | ? | 12-14 cm long., yellow and black concentric circles when viewed from above | swim in flowing water |

#### REPTILES

|             |          |              |         |  |   |
|-------------|----------|--------------|---------|--|---|
| Ameiva sp.  | rare     | 1,2          | insects | ~6 cm SVL. Blue tail, green to brown body  | only in shady areas, usually around logs                                |
| sea turtles | uncommon | nests in 1-2 | aquatic | eggs round, up to 100 in nest, 3-4cm diam. | nests in upper beach at night, nests are often broken into by predators |

#### BIRDS

|                 |          |       |                         |  |   |
|-----------------|----------|-------|-------------------------|--|---|
| Ruddy Turnstone | common   | 3-6   | mollusks and crustacean | brown back, white belly, black and white face markings, orange legs    | flocks in groups of 10-20, forages in mudflats, can be approached closely   |
| Brown Pelican   | common   | 6     | fish                    | silvery brown above, dark neck, reddish bill                           | seen mostly in morning, solitary foragers often stand in the outer mudflats, flies in lines of ~15 low over water |
| herons          | uncommon | 3,4,6 | fish and crustacean     | tall shore birds, long bill; often Little Blue Herons, incl. juveniles | forage in intertidal for fish, crabs; usually solitary  |
| raptors         | rare     | 1     | vertebrate              | hooked bill, talons  | perch on edge of forest, soar out over water; Osprey and Common Blackhawk seen                                    |

#### INSECTS

|                  |          |         |            |   |  |
|------------------|----------|---------|------------|---|--|
| dragonfly A      | uncommon | 2,3,4,6 | insects(?) | red, 7cm body; clear white wings                  | flying around mudflats. Little hover time, presumably feeding;               |
| dragonfly B      | uncommon | 3,4,6   | insects    | brown, 5cm body, yellow wings with dark end spots | often, the two types were seen together                                      |
| yellow butterfly | common   | 1,2     | ?          | yellow wings, about 5cm across                    | seen frequently throughout the day, alight only on plants of the forest edge |
| sandflies        | common   | 1,2     | ?          | small, flea that is found in the shade            | active during low temperature times  |

+may actually include several spp. or subspecies with various colorations

\*these fish were seen in flowing rivulets, not stagnant pools.