Habitat partitioning by hermit crabs (Paguridae) at Playa Sirena, Corcovado National Park, Costa Rica

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Abstract: Hermit crabs on Playa Sirena, Costa Rica are bimodally distributed, with peaks of abundance at the forest edge and low water mark. We hypothesized that competition and food preference influence habitat partitioning. We observed that average size (shell aperture length) of tide pool crabs was smaller than that of crabs at the forest edge. In experimental manipulations, forest edge crabs dominated competitive interactions over food and also attacked tide pool crabs. Neither tide pool nor forest edge crabs displayed a preference for aquatic or terrestrial food. We infer that competition is more important than food preference in habitat partitioning between tide pool and forest edge hermit crab populations.

Key Words: competition, food preference, life history, predation, scavengers, shell aperture

Introduction

Habitat partitioning within a species could result from intraspecific competition, food preference, or size or age-based social dominance. Earlier research at Corcovado suggests that hermit crab densities are bimodal with peaks at the dunes and the low water mark (Dudycha et al. 1992). Karlsberg et al. (1995) found that at low tide, crab distribution followed a size-specific pattern, with large crabs (shell aperture > 10 mm) in the forest adjacent to the beach, medium crabs (shell aperture 7-10 mm) at the forest edge, and small crabs (shell aperture <7 mm) in tide pools.

We sought to determine if the tide pool and forest edge populations were distinct, and if so, what factors cause such extreme habitat partitioning within the species. We predicted that marked crabs would not move between tide pools and the forest edge. Based on their smaller size, we predicted that tide pool crabs would be inferior competitors to forest edge crabs. Further, we predicted that tide pool crabs would prefer marine-derived food, while forest edge crabs, naturally exposed to both marine and terrestrial food sources, would not display a preference.

Methods

Observations: We established two 100 m transects parallel to the shoreline, one along the upper boundary between the intertidal zone and the "dry beach" and one at the forest edge. Along each transect, at five points ten meters apart, we measured the widest shell aperture of 25 individual crabs, using the nearest five crabs to each of the five points. Along the same transects, we marked 214 tide pool hermit crabs with yellow paint and 124 forest edge hermit crabs with red paint. Once a day, over the period 4 – 7 February 2003, we scanned each transect for marked crabs.

Experiments: Unmarked hermit crabs were collected from each habitat and used for all experiments. We conducted two experiments to test competition (Table 1) and one experiment to examine food preference (Table 2). Competition experiment 1 consisted of two trials, one using a "terrestrial" food source (bread) and the other using a "marine-derived" food (canned tuna). We used average-sized forest edge (12.9 ± 3.53 cm) and average-sized tide pool crabs (5.3 ± 0.32 cm). We recorded the number of times crabs from each habitat type made contact with the food source in

Table 1. Competition experiments between forest edge and tide pool hermit crabs at Sirena, Corcovado National Park, Costa Rica.

Competition Experiment Trial #	# Forest edge crabs	# Tide pool crabs	Size	Food source	n
1	5	5	Avg. forest edge (12.9 mm) vs. avg. tide pool (5.3 mm)	Terrestrial	4
2	5	5	Avg. forest edge (12.9 mm) vs. avg. tide pool (5.3 mm)	Marine-derived	4

Table 2. Preference experiments with forest edge and tide pool hermit crabs at Sirena, Corcovado National Park, Costa Rica.

Food preference experiment	# Forest edge crabs	# Tide pool crabs	Food source	# Replicates
Trial 1	0	5	Marine-derived and terrestrial	6
Trial 2	5	0	Marine-derived and terrestrial	6

two minutes.

In the food preference experiment (Table 2), we presented five average-sized tide pool crabs with both terrestrial and marine-derived food and counted the number of crab visits to each food type for five minutes (Trial 1). We then repeated the experiment using five average-sized forest edge crabs (Trial 2). We used fresh crabs for each replicate of both the competition and food preference experiments.

Analysis: We calculated the mean shell aperture length and range, and the mean density and range for crabs within both tide pool and forest edge habitats. We log transformed density to normalize distributions. Neither competition nor food preference data could be readily normalized, so they were analyzed with non-parametric statistics.

Results

No marked hermit crabs were found during surveys. Aperture length of tide pool crabs (n = 50) was 5.32 ± 0.32 mm (mean ± SE) and ranged from 1 – 10 mm. Aperture length of forest edge crabs (n = 50) was 12.90 ± 3.53 mm (mean ± SE) and ranged from 4 – 24 mm. Tide pool crabs were significantly smaller than forest edge crabs (Fig. 1; t = 12.22, df = 98, P < 0.0001).

Intake rates of aquatic (non-parametric median test P = 0.01) and terrestrial food (P = 0.01) were significantly greater for forest edge crabs than for tide pool crabs. During competition experiments we found that forest edge crabs attacked tide pool crabs but did not successfully pry them from their shells. Neither tide pool crabs nor forest edge crabs demonstrated preference for aquatic or terrestrial food (Wilcoxon signed-rank test P = 0.10, P = 0.15).

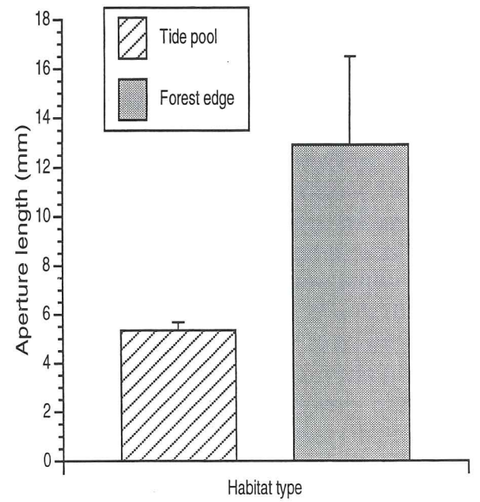

FIG. 1. Average aperture length of hermit crabs in tide pool (n = 50) and forest edge habitats (n = 50) at Estacion Biologica Sirena, Corcovado National Park, Costa Rica (t = 12.2, df = 98, P < 0.0001).

Discussion

Evidently, crab densities were so high that our marked crabs were a tiny proportion of the total population. As a result, we were unable to relocate any marked individuals or to draw a conclusion regarding migration between the two habitats. Our experimental results indicate that forest edge hermit crabs consistently out-compete tide pool crabs and probably prey on them. Size differences alone could explain the patterns in our results. It would be a simple matter to test this hypothesis experimentally. It seems clear that competition is more important than food preference in hermit crab habitat partitioning on Playa Sirena.

Literature Cited

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