Effects of increased conspecific density on food preference by hermit crabs

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Abstract: Hermit crabs have a patchy distribution along the upper beach. Theoretically, when foraging, crabs should choose foods with the highest energy content. In patches of high conspecific density, individual foraging success may decrease if a higher proportion of crabs are forced to feed on less preferred food items than when foraging alone. In enclosure experiments, we found that crabs preferred coconut in single-crab trials, but at higher densities they were more likely to choose fish. Also, at high densities, crabs were less likely to exhibit a food preference. The certainty of having some food, even if less preferred, may be more important to these scavengers than the possibility of finding higher energy food.

Key Words: coconut, competitive interference, Paguridae

INTRODUCTION

Hermit crabs (Paguridae) are beach-combing scavengers that feed opportunistically on a variety of food items that wash up on shore. Crabs are often found in shaded refuges under rocks and logs during the day and are active foragers at night. Aggregations of crabs have been observed both during the day and at night, and these may be caused by the patchy distribution of food.

We predicted that when presented with a variety of food items, crabs would select foods that maximize their energy intake. We also examined the effects of high hermit-crab densities on individual foraging success and food preference. Such conditions may result in competitive interference when individuals share a requirement for a resource in limited supply, possibly reducing the foraging success of individual crabs (Begon et al. 1990). We predicted that at increasing densities, crabs would be more likely to settle for a less preferred food item and would be less likely to abandon a food item once they began feeding.

METHODS

Hermit crabs were studied on Playa Sirena at Corcovado National Park, Costa Rica, within an area extending 200 m on either side of the base of the airstrip and 5 m down from the forest edge. Experiments and sampling were conducted on the nights of 6 and 7 February 1999 during low tide. Natural densities of hermit crabs were quantified by counting all individuals >2cm in shell length within a 1 m band along 16 randomly located 10 m transects, 3 m from the forest edge. Randomly selected, naive hermit crabs with shells ranging between 2-5 cm were used in all trials.

To determine single crab food preference, we used coconut, fish, land crab meat, and citrus, as all were eaten in preliminary trials. Test arenas were 0.25 m^2 by 50 cm tall and constructed of 1 cm wire mesh. We placed 2 cm pieces of the four food items in a 10 cm square in the center of the arena and then introduced individual crabs and immediately began each trial. To control for possible directional preference, the placement of food items was rotated randomly between trials. Food items selected by individual crabs and the time spent eating were recorded during a 5 min trial (n= 20 trials). Food preference was determined when a food item was eaten for more than 30 sec and no further items were selected within the 5 min period.

To test for the effects of intraspecific density on food preference, trials were conducted with 3, 5, and 7 randomly selected hermit crabs in each enclosure (n= 8 replicates at each density). These densities represent approximations of extremely clumped aggregations found in natural conditions. In high density trials, food items were secured with wooden stakes in the 10 cm square to prevent crabs from hoarding the item, possibly denying access by other crabs.

RESULTS

The average natural density of hermit crabs was 3.6 ± 0.44/m^2 (mean ± SE, n=16 transects) and ranged from 1.3 to 7.3/m^2. We used the average density of 4/m^2 for our single crab preference trials.

In the majority of single-crab preference trials coconut was chosen over the other three food items (X^2=13.1, df=2, P=0.001, Fig. 1); citrus

was never chosen. At higher crab densities, preferences changed and a larger percentage of individuals made fish their choice than would be predicted from the single-crab preference trials. In trials with densities of 3, 5, and 7 crabs, fish was chosen 58.3%, 27.9%, and 31.3% of the time respectively compared to only 15% of the time in single crab preference trials. In fact at increased hermit-crab densities, fish was chosen even before coconut was chosen by another crab in 8 of 24 trials. Citrus was chosen once in a trial with three individuals.

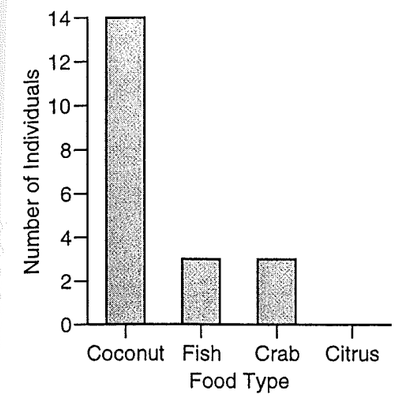

Fig. 1 Food preferences for solitary hermit crabs after 5 min trials at Corcovado National Park, Costa Rica (n=20).

At increased hermit crab densities, a greater percentage of crabs made no food choice than when individuals were tested alone (ANOVA; F=4.6, df=3,29, P=0.009, Fig. 2). However, there was no difference in the percentage of food items abandoned between different crab densities (Kruskal-Wallis; X^2=13.8, df=19, P=0.79). Additionally, the first food item was abandoned 5 times at densities of 1 and 3 crabs and 1 time at densities of 5 and 7. No more than three individuals were observed simultaneously on any food item in any of the trials.

DISCUSSION

Coconut, which is high in fat and carbohydrates, may have been the preferred food choice in single crab preference trials because of its high energy content. Citrus, which is acidic and has a negligible fat content, was the least preferred. These findings suggest that individuals preferred foods that maximized their energy gain.

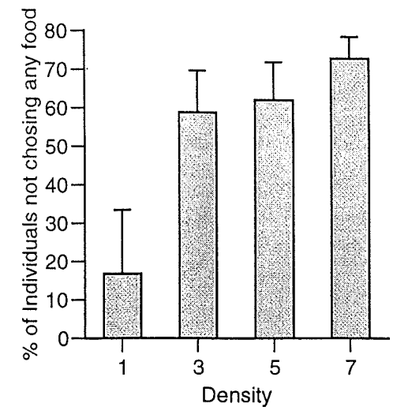

Fig 2. Percent of hermit crabs at each of four conspecific densities that did not chose any food item after 5 minutes, at Corcovado National Park, Costa Rica (mean ± SE)(n=20 for the lowest density, and n=8 for the three higher densities).

As predicted, less preferred food items, particularly fish, were more frequently chosen by crabs at high conspecific densities than when individuals were alone. Since fish and crab were chosen before coconut in the high density trials, this did not seem to be the result of competitive interference in which one or more hermit crabs actively prevented others from gaining access to the preferred food resource.

Since fewer hermit crabs sought food as density increased and were observed to disperse away from one another, group composition of natural aggregations may not have been simulated in the trials. Aggregations on food observed in natural conditions seemed to be composed of similar sized crabs; consequently the mixed-sized groups in our trial might be expected to behave differently. For instance, the presence of larger individuals may have induced subordinate behavior in smaller individuals, which could include searching for refuge sites. Karlsberg and Hubbard (1995) found that crabs, when presented with a choice between driftwood refuge and food, including coconut, preferentially chose refuge.

For all trials, the first food item encountered was seldom abandoned for another food. This suggests that the certainty of having some food, even if less preferred, is more important than the possibility of finding higher energy food.

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