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Feeding Activity Patterns and Carrion Removal by Terrestrial Hermit Crabs at Enewetak Atoll, Marshall Islands[1]

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ABSTRACT: Terrestrial hermit crabs (*Coenobita* spp.) were observed feeding on a variety of food items corresponding with observations on the genus worldwide. A field experiment was conducted which examined (1) the feeding activity of *Coenobita* in two habitats and (2) their potential impact on the removal of carrion and on the colonization of carrion by fly maggots. Habitat and time of day influenced the size and species of *Coenobita* feeding. Large *C. perlatus* fed only at night and had the greatest impact on the carrion. Although small *Coenobita* had little effect on the carrion, their feeding activity did reduce the number of fly maggots in the carrion. The scavenging activity of hermit crabs may serve a useful role on inhabited islets. The rapid removal of carrion would reduce potential fly breeding sites.

TERRESTRIAL HERMIT CRABS, primarily *Coenobita perlatus*, *C. rugosus*, and *C. brevimanus*, are the principal native terrestrial fauna on many islets at Enewetak Atoll (11°30′ N 162°10′ E). Few studies are available concerning the feeding habits of these crabs, despite their great numbers on some islets (Page and Willason 1982), the alleged importance of hermit crab feeding activity to atoll terrestrial ecology (Niering 1956, 1963; Degener and Gillaspy 1955), and the potential importance of hermit crabs to man as consumers of carrion (Wiens 1962). Studies of the feeding habits of *Coenobita* have been confined primarily to observations of food items eaten (e.g., Seurat 1904, Ball 1972, De Wilde 1973, Alexander 1979). Little information is available concerning *Coenobita* feeding patterns or their potential impact on food resources.

This study records natural food items eaten by *Coenobita* at Enewetak and compares these with observations on the genus worldwide. In addition, a preliminary field experiment was conducted to (1) examine hermit crab feeding activity patterns and (2) assess the impact that the feeding activity of hermit crabs might have on carrion removal and on the colonization of carrion by fly larvae.

MATERIALS AND METHODS

Notes were made on the types of food items eaten by *Coenobita* at two uninhabited southern islets, Mut and Ikuren, during September and October 1979. These islets were relatively undisturbed by man and had lush vegetation and large hermit crab populations (Page and Willason 1982).

Preweighed amounts of raw chicken or reef fish (simulating natural carrion) were enclosed in cages on Mut Islet on 2 October 1979. The 25 × 25 × 25-cm cages were constructed of 5-mm mesh galvanized screen and were sunk 10 cm into the ground. Carrion was secured to a stake driven through the center of each cage. Chicken and fish were used at beach stations, which were located on sand slightly above the mean high water mark on the lagoon side of the islet. At the interior station, located 30 m inland in a *Pisonia–Cocos* forest, only chicken was used.

Three experimental treatments were estab-

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TABLE 1

SUMMARY OF WORLDWIDE OBSERVATIONS ON FOOD ITEMS EATEN BY SPECIES OF *Coenobita*

LOCATION	SPECIES	FOOD ITEMS	REFERENCE
Pacific Ocean			
Canton Island	*Coenobita* sp.	*Lepturus repens* (grass) *Sesuvium portulacastrum* flowers (stamens, ovaries), seeds *Portulaca lutea* flowers (stamens, ovaries) *Morinda citrifolia* seedlings *Cordia* bark	Degener and Gillaspy 1955
Central America	*C. compressus*	fruit (manzanillo tree, banana peelings) wood fragments, roots crustacean or fish eggs bracket fungus dead wasp copra feces	Ball 1972
Kapingamarangi Atoll	*Coenobita* sp.	*Pandanus* fruit *Barringtonia* seedlings *Calophylum* *Hibiscus tiliaceus*	Niering 1956, 1963
Gambier (Mangareva) de Tuamotu	*C. perlatus*	*Pandanus* fruit *Pemphis acidula* (dry twigs) bird feces	Seurat 1904
Caribbean Sea			
Curacao	*C. clypeatus*	fruits, berries, seeds germinating plants *Opuntia* discs *Cereus* trunks dead donkey horse and cow feces	De Wilde 1973
Indian Ocean			
Aldabra Atoll	*C. rugosus*	dead tortoises tortoise feces	Grubb 1971
	C. perlatus	stranded turtle marine crabs and fish (various species) tortoise feces	Alexander 1979
	C. rugosus	*Cathamathus roseus* terminal shoots	
Maldive Islands	*Coenobita* sp.	*Pandanus* fruit	Borradaile 1903
Red Sea			
Sar Uanle, Somalia	*C. rugosus*	dead fish, animals, fruit	Vannini 1976

lished at 1700 hr: (1) exposed carrion—two sides of the cage were removed, hermit crabs of all sizes were allowed access; (2) partially caged carrion—small openings (1.5 cm^2) in the cages excluded hermit crabs with a carapace length > 8 mm (C.L.) from the carrion; and (3) completely caged carrion—excluded all hermit crabs. The last treatment served as a control and provided estimates on the colonization rate of carrion by fly larvae. Day and night observations 2 to 4 hr apart were made over a 2-day period. The species and

TABLE 2

NUMBER OF HERMIT CRABS ON CARRION TREATMENTS*

	C. perlatus *C. rugosus* (< 8 mm)	*C. perlatus* (8–19 mm)	*C. perlatus* (⩾ 20 mm)	*C. brevimanus* (14–25 mm)	*Ocypode* sp.
Beach					
Caged fish (a)					
Caged fish (b)					
Partially caged fish	18 (35)				
Exposed fish†	5		24		2
Caged chicken					
Partially caged chicken	79 (217)				
Exposed chicken†	18		37		
Interior					
Caged chicken					
Exposed chicken†		3		5	

* Sum of eight observations on two consecutive nights. Sum of six daylight observations in parentheses. Individuals may have been counted more than once because crabs were not removed.

† Completely eaten by 0400 hr 3 October.

number of crabs feeding on the carrion were recorded over time. At 1250 hr on 4 October, the amount of chicken or fish remaining in each treatment was estimated and the fly maggots were counted.

In addition to the above experiment, a dead adult knoddy tern was secured to the ground just above the high water line on Ikuren Islet at 1750 hr on 15 October 1979. Observations were made through the night on the number and species of scavengers feeding on the bird.

RESULTS AND DISCUSSION

Coenobita (*C. perlatus* and *C. rugosus*) were observed eating *Scaevola* fruit, *Morinda* fruit, coconut meat, coconut husks, and the insides of a fallen coconut tree. Hermit crabs also fed on organic material that washed up on the beach. This included *Laurencia* sp. (a small tufted red alga), *Halimeda* sp. (corraline alga), a dead subtidal brachyuran crab, and a dead coconut crab, *Birgus latro*. Small *Coenobita* individuals were also observed feeding on bird feces.

Table 1 summarizes the observations of other authors on the food of terrestrial hermit crabs. The various species of *Coenobita* worldwide are consumers of dead animal material, feces, and vegetation, particularly fruit. Although experimental evidence is not available, heavy grazing by *Coenobita* on seedlings was thought to influence plant species diversity on Canton Island (Degener and Gillaspy 1955). Other authors have also observed *Coenobita* feeding on seedlings (De Wilde 1973, Alexander 1979). We did not observe hermit crabs feeding on living leaf vegetation.

The most numerous scavengers at the beach carrion stations were small *Coenobita perlatus* and *C. rugosus* (<8 mm C.L.) and large *C. perlatus* (≥20 mm C.L.) (Table 2). Ghost crabs (*Ocypode* sp.) were very abundant on the lower sand beach but were rarely observed at the carrion stations. The exposed carrion at the beach stations (chicken and fish) was completely eaten the first night (by 0400 hr) by large *C. perlatus*. The 18 small *Coenobita* feeding on the exposed chicken were counted in the early evening before the larger crabs became active (Table 2). When the larger hermit crabs were feeding, small individuals could be found in the area, but not on the carrion. Small hermit crabs were found on the partially caged carrion in greater numbers during the day than during the night (Table 2).

In contrast to the beach, *Coenobita brevimanus* and medium-sized *C. perlatus* (8–

TABLE 3

IMPACT OF HERMIT CRAB FEEDING ACTIVITY ON CARRION REMOVAL AND ON CARRION COLONIZATION BY FLY MAGGOTS

TREATMENTS	INITIAL WET WEIGHT (g)	PERCENT REMAINING AFTER 2 DAYS	NO. OF MAGGOTS AFTER 2 DAYS	NO. OF MAGGOTS/ INITIAL WET WEIGHT (g)
Beach				
Caged fish (a)	168	100	904	5.38
Caged fish (b)	157	100	1688	10.75
Partially caged fish	130	90	119	.92
Exposed fish	87	0	0	0
Caged chicken	150	100	156	1.04
Partially caged chicken	150	90	73	.49
Exposed chicken	117	0	0	0
Interior				
Caged chicken	173	100	692	4.00
Exposed chicken	206	0	0	0

19 mm C.L.) were the scavengers in the interior (Table 2). In addition, two coconut crabs, *Birgus latro*, were active in the vicinity of the carrion stations. Few small or large *C. perlatus* were observed at the interior station and none were feeding on the carrion. These results are consistent with the distribution patterns of *Coenobita* at Enewetak (Page and Willason 1982).

Hermit crab feeding activity on the knoddy tern on the beach resembled that at the chicken and fish stations. Throughout the night large *Coenobita perlatus* fed on the bird, and by the next morning only feathers and bone remained.

Fly maggots were observed in the carrion of the completely and partially caged treatments after 24 hr. When the experiment was terminated at the end of the second day, most maggots were large, approaching 1 cm in length; some were already moving into the sand to pupate. The maggots at all stations belonged to the family Sarcophagidae.

Although small hermit crabs were more abundant than the larger individuals (Page and Willason 1982; this study), their feeding activity had little effect on the removal of carrion (Table 3). The feeding activity of small crabs did, however, reduce the number of fly maggots in the partially caged carrion. The number of maggots in the completely caged treatments was from two to twelve times the number in the corresponding partially caged chicken and fish treatments (Table 3).

The scavenging behavior of *Coenobita* was postulated to be potentially important in controlling fly populations on inhabited islets (Fosberg, in Wiens, 1962). Fosberg noted that in areas where hermit crabs were numerous the fly problem seemed less severe than in areas where hermit crabs were absent. Because many fly species can develop from egg to adult in less than 10 days (Bohart and Gressitt 1951), the feeding activity of small crabs and the rapid removal rates of carrion by large crabs may indeed exert a negative impact on fly populations.

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