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PALATABILITY OF FIVE CARIBBEAN OPHIUROIDS

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ABSTRACT

The feeding preferences of fishes for five Caribbean ophiuroid species were tested in a shallow back reef in St. Croix, United States Virgin Islands. Wrasses, *Halichoeres bivittatus*, and juvenile *Sparisoma* parrotfish were the principal predators of tethered ophiuroids, selecting their prey visually. The ophiuroids were ranked, from most to least susceptible: *Ophiocoma pumila* > *Ophiocoma echinata* > *Ophiolepis impressa* > *Ophioderma appressum* = *Ophiothrix oerstedi*. These differences are at least partially explicable in terms of the mechanical properties of the ophiuroid species. Although it was least preferred, *O. oerstedi* was readily eaten in the absence of other prey at several sites, suggesting that *H. bivittatus* and *Sparisoma* spp. are opportunistic feeders.

The effects of feeding by coral reef fish on sessile benthos are well documented (Bakus, 1964; Randall, 1974; Kaufman, 1977; Ogden and Lobel, 1978; Hay, 1981; Hay and Goertemiller, 1983; Wellington, 1982; Lewis, 1986). However, comparatively little is known about their influence on the ecology of cryptic mobile invertebrates (Lobel, 1980; Wolf et al., 1983; Reaka, 1985). Ophiuroids are numerically important constituents of mobile cryptofaunas in Caribbean and Indo-Pacific reef ecosystems (Clark, 1976; Kissling and Taylor, 1977; Sloan, 1982; Chartock, 1983; Lewis and Bray, 1983; Hendler and Littman, 1986). Several recent studies have suggested that predatory fishes are at least partially responsible for their cryptic behavior (Hendler, 1984a; 1984b; Aronson and Harms, 1985; Sides, 1987). In Sweetings Pond, a Bahamian saltwater lake lacking predatory fishes, ophiuroid density is elevated, and the animals live out in the open, carpeting the bottom (Aronson and Harms, 1985).

Information on prey susceptibility is crucial to understanding their ecology. I determined the palatability of five common, rubble-dwelling ophiuroid species to the predator assemblage with which they occur. The results of this field study are compared with previous palatability studies on ophiuroids (Sides, 1981; Hendler, 1984a). Direct observations of fishes preying on brittlestars suggest both the mechanism of prey detection and the reasons that some species are preferred as food while others are clearly avoided.

STUDY AREA AND METHODS

Observations and experiments were carried out in Rod Bay, a shallow (0.5 m depth) bay on the south coast of St. Croix, United States Virgin Islands (17°44'N, 64°35'W). The sand bottom on the east side of Rod Bay is littered with boulders and cobbles of volcanic origin and with coral rubble. Large individuals of large-bodied ophiuroid species are common under the rocks and stones, as Hendler and Littman (1986) found in Belize.

Five ophiuroid species were used in a feeding preference experiment: *Ophiocoma echinata*, *Ophiocoma pumila*, *Ophioderma appressum*, *Ophiolepis impressa* and *Ophiothrix oerstedi*. All five species are common in rubble habitats throughout the Caribbean. Ophiuroids 9–11 mm in disk diameter were collected in Rod Bay for immediate use. This size range is at the high end for the smallest species, *O. oerstedi*, and at the low end for *O. echinata*. One individual of each of the five species was tethered to a small lead fishing weight (approximately 60 g) at shore. The five ophiuroid-weight assemblies were placed 20 cm apart in a line on a flat, open surface in Rod Bay. In each of 12 trials the positions of the species were randomized with respect to each other. Each trial was conducted at a different, haphazardly selected location in the eastern part of the bay. I observed the ophiuroid arrays for 45 min from a distance of 3 m using mask and snorkel.

The ophiuroids were affixed to the fishing weights with heavy thread. A threaded needle was passed through the mouth and out the aboral disk, and the ophiuroid was tied to the weight. This sewing method prevents escapes but does not release predator-attracting body fluids (Aronson, 1987). Witman (1985) and Aronson (1987) describe different methods for tethering ophiuroids and discuss the advantages of the sewing method.

In each trial the ophiuroids were assigned palatability ranks. Species that were consumed entirely were ranked by how quickly they were eaten. Species that were partially consumed, attacked occasionally, or not attacked in 45 min were ranked accordingly.

RESULTS

The most abundant daytime predators of ophiuroids in Rod Bay were the slippery dick wrasse, *Halichoeres bivittatus* (Labridae) and juvenile parrotfish, *Sparisoma* spp. (Scaridae) (mostly *S. chrysopterum*). These fishes appeared as soon as the tethered ophiuroids were placed on the substrate in Rod Bay. They attacked the experimental ophiuroids from the arm tips inward, eating the disk last. Beaugregories, *Stegastes leucostictus* (Pomacentridae), sometimes participated in these attacks, and twice a puddingwife, *H. radiatus,* took several bites in passing.

The great preponderance of attacks in the feeding trials were by *H. bivittatus.* These wrasses identified their prey visually. Slippery dicks swam along the lines of tethered ophiuroids, dipping down briefly and turning their heads to the side to examine each ophiuroid-fishing weight assembly. They also inspected weights from which the brittlestars had already been eaten. In Barbados, *H. bivittatus* attacked tethered ophiuroids that were sealed in clear plastic bags (R. B. Aronson, pers. obs.). Juvenile *Sparisoma* also appeared to examine the prey visually.

Several predatory fish species inspected but did not attack the brittlestars. These included juvenile *Lutjanus apodus* (Lutjanidae), juvenile *Haemulon flavolineatum* (Haemulidae), *Pseudupeneus maculatus* (Mullidae), *Gerres cinereus* and *Eucinostomus* sp. (Gerreidae), and *Thalassoma bifasciatum* (Labridae). Juvenile *Scarus* spp. (Scaridae) did not attack the tethered ophiuroids either.

Ophiocoma pumila was always the first species attacked and consumed by *H. bivittatus* and *Sparisoma,* generally within the first few minutes of the trial (Table 1). In one trial, a *S. leucostictus* defended the area around a tethered *O. pumila,* preventing other fishes from consuming the ophiuroid for 14 min. In all but one trial (trial 5), *Ophiocoma echinata* was ranked second. This species was completely consumed in 10 trials; in trials 5 and 9 the *O. echinata* were partially and completely dismembered, respectively. *Ophiolepis impressa* was usually ranked third or fourth. In two trials this species was consumed, but in the rest it was completely or partially dismembered, or attacked only occasionally. I frequently observed *H. bivittatus* or *Sparisoma* spp. tugging vigorously at the distal end of an *O. impressa* arm, unable to tear off a segment. The fishes often gave up and swam away. This also happened with *Ophioderma appressum* in trial 8. *Ophioderma appressum* and *Ophiothrix oerstedi* were consistently ranked fourth or fifth, although there were some reversals with *O. impressa.* Two *O. oerstedi* were completely consumed (trials 2 and 10). Otherwise, *O. appressum* and *O. oerstedi* were partially dismembered, attacked several times during a trial, or not attacked at all.

Palatabilities of the five ophiuroid species were compared pairwise by performing sign tests on the ranks from the twelve trials (Table 2; Siegel, 1956). The species ordered as follows, from most to least palatable prey: *O. pumila* > *O. echinata* > *O. impressa* > *O. appressum* = *O. oerstedi.* This ordering is consistent with casual observations in Rod Bay and in a back reef rubble habitat at Carrie Bow Cay, Belize. When rocks were turned over, exposing ophiuroids and other

Table 1. Palatability ranks of the five ophiuroid species in the feeding preference experiment (Ties are denoted by decimal ranks)

Species	Trial 1	2	3	4	5	6	7	8	9	10	11	12	Mean rank
pumila	1	1	1	1	1	1	1	1	1	1	1	1	1.0
echinata	2	2	2	2	3	2	2	2	2	2	2	2	2.1
impressa	3	4	3	3	2	3	3.5	4	3	4	3	3	3.2
appressum	4.5	5	5	4.5	4	4	3.5	3	4	5	5	4.5	4.3
oerstedi	4.5	3	4	4.5	5	5	5	5	5	3	4	4.5	4.4

cryptofauna, wrasses and juvenile *Sparisoma* appeared immediately. *Ophiocoma pumila* were most frequently attacked, *O. echinata* and *O. impressa* less often, and *O. appressum* and *O. oerstedi* not at all.

DISCUSSION

Hendler (1984a) investigated the palatability of four *Ophiocoma* species in Belize. The palatability ranking obtained in the present field study agrees with his results: *O. pumila* was more readily eaten than *O. echinata*. However, my ranking is somewhat at variance with an aquarium study by Sides (1981). She found that the crab *Portunis sebae* readily attacked *Ophioderma appressum*, but *Halichoeres bivittatus* did not. *Ophiocoma pumila* and *Ophiolepis impressa* were preferred by both predators in her study, and *O. echinata* was less preferred. *Ophiothrix oerstedi* was not tested. Although Sides (1981) concluded that susceptibility to predation was not size-related for most species, small *O. echinata* were as susceptible as her preferred species.

By restricting ophiuroid size to 9–11 mm disk diameter to accommodate *O. oerstedi*, this study used small *O. echinata*, which were preferred as in Sides's (1981) study. Her mixed results with *O. appressum* highlight the importance of conducting feeding trials in the field. In more than 200 hours of day and night snorkeling in Caribbean back reef rubble habitats (St. Croix, St. John, Belize, Bahamas and Barbados), I have not observed any *P. sebae*. Visually-hunting fishes appear to be responsible for virtually all daytime predation on rubble-dwelling ophiuroids (this study; R. B. Aronson, unpubl. census data). At night, fishes again comprise the vast majority of predators of ophiuroids (R. B. Aronson, unpubl. census data).

Table 2. Results of two-tailed sign tests on palatability ranks, pairwise by species. Ratios are the number of trials in which the species in the row was preferred over the species in the column, to the number of trials in which the reverse situation occurred. Ties are not included. ns = not significant

	echinata	*impressa*	*appressum*	*oerstedi*
pumila	12:0 $P = 0.0005$	12:0 $P = 0.0005$	12:0 $P = 0.0005$	12:0 $P = 0.0005$
echinata		11:1 $P = 0.006$	12:0 $P = 0.0005$	12:0 $P = 0.0005$
impressa			10:1 $P = 0.01$	10:2 $P = 0.04$
appressum				6.3 $P = 0.51$ns

The preferred status of *O. pumila* may result from its relatively fragile construction and ready arm autotomy (Hendler, 1984a). Observations during the feeding trials suggest a partial explanation for the less-preferred status of *O. impressa* and *O. appressum*. These species have more robust arms and do not autotomize as readily as *Ophiocoma* spp. (see also Sides, 1987). *Ophiothrix oerstedi* autotomizes readily but may have been avoided because of its long, sharp, glassy arm spines. The possibility of chemical defenses in ophiuroids, specifically acid mucus (Fontaine, 1964; disputed by Gorzula, 1976; Sides, 1987), demands further attention.

Ophiothrix oerstedi, the least palatable species, dominates the low-predation Sweetings Pond community (Aronson and Harms, 1985). Hence there is no immediately apparent tradeoff between defense against predation and competitive ability in a predator-free environment for the five species examined. On the other hand, even this least-preferred species is subject to considerable predation pressure in coastal communities. Populations of *O. oerstedi* display high natural frequencies of sublethal arm damage (Aronson, 1987), and tethered individuals are readily eaten in the absence of other ophiuroid prey.

Of 15 tethered *O. oerstedi* placed in Rod Bay, 14 were consumed over the course of 8 daylight hours (R. B. Aronson, unpubl. data). Predation rates in St. John and Belize were even higher: all 15 tethered ophiuroids were eaten within 2 h (Aronson, 1987). Such rapid consumption of relatively avoided prey suggests that *H. bivittatus,* like other small wrasses (Aronson and Sanderson, 1987), are opportunistic feeders in Caribbean back reef habitats. Animal material may be an important supplement to the diets of Caribbean *Sparisoma* spp. (Hendler, 1984a; 1984b; Aronson and Harms, 1985), which are generally considered herbivores (Randall, 1967).

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