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Utilization of algae and sponges by tropical decorating crabs (Majidae) in the Southeastern Gulf of California

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Resumen: Dieciseis especies tropicales de cangrejos Majidae fueron colectadas en la ensenada de Puerto Viejo, en la Bahía de Mazatlán, Sinaloa, México. De éstos, 12 especies presentaron hábito decorador. El material fue analizado, observándose una neta preferencia para algas y esponjas. Cinco especies utilizan algas y esponjas o esponjas solamente. Se discute el hábito decorador de las especies colectadas así como la tendencia a asociarse con praderas de algas. Diez especies se encontraron comúnmente entre *Padina durvillaei*, una de las cuáles se encontró también asociada con otras algas. Tres especies aparecieron en algas verdes y tres no fueron observadas asociadas con algas. Los cangrejos tienden a utilizar las algas más accesibles en su habitat.

Many species of Majidae utilize pieces of decorating material, either living or dead, to camouflage themselves from predators. As suggested by Wicksten (1980), this might be the result of a long evolutionary process which found its origin in feeding behaviour and food storing.

Material used by decorating crabs is quite varied; however, for many species, algae are among the favourite items as they are usually plentiful in the environment and sometimes are characteristic of their habitat (Garth 1958; Crane 1947; Wicksten 1980). Little is known, however, of the specific relationship that exists between tropical majid crabs and the algae they use for decorating.

Field work with living crabs and observations on freshly collected specimens allowed us to obtain information related to the use (or no use) of six species of algae by sixteen species of tropical Majidae occurring in a small embayment in the Bay of Mazatlán, Sinaloa, Mexico, a small embayment located in the Southeastern part of the Gulf of California (23°12' N 106°25' W). It is a well-protected shallow system which opens into the Bay of Mazatlán and includes a surrounding rocky shore and a gently sloping sandy bottom covered by rocks.

Specimens of Majidae were collected in the intertical rocky shore and in the shallow subtidal from August 1982 to August 1983, by hand (intertidal) and by means of a small dredge (shallow subtidal from 1 to 5 m deep) and observed for attached material. Algae growing in the study area were sampled simultaneously and identified separately to prepare a list of species of algae available to the animals.

Contrary to what is found in the Northern Gulf of California (Brusca 1980) the intertidal and shallow subtidal of the Southeastern part does not present great extension of *Sargassum*. The most abundant species to be found in the Bay of Mazatlán is without any doubt *Padina durvillaei* Bory, 1827, a species which also occurs abundantly in the Bay of Topolobampo and several localities along the mainland coast. In the Bay of Mazatlán, *P. durvillael* is most abundant from April to July and represents the typical subtidal habitat for many species of mollusks and crustaceans from Puerto Viejo.

Other species of algae present in the lower intertidal include the green algae *Caulerpa sertularoides* (Gmelin), *Codium conjunctum* Setchell and Gardner and *Ulva lactuca* Linnaeus; the brown algae *Colpomenia ramosa* Taylor and *C. sinuosa* Derbés and Solier; and the red algae *Hypnea pannosa* Agardh, *Ceramium ho-*

TABLE 1

Decorating material observed on 16 species of majidae collected in ensenada de Puerto Viejo, bay of Mazatlán

Species	Material ♂	Material ♀	Habitat: Intertidal	Habitat: Shallow Subtidal	Decorating Material
Eucinetops lucasi (1) (2)	5	6	+		*Hypnea pannosa; Caulerpa sertularoides;*
Eucinetops rubellula	3	–	+		*Hypnea pannosa; Padina durvillaei; Haliclona* sp.
Inachoides laevis (2)	3	1	+	+	*Hypnea pannosa; Padina durvillaei.*
Podochela latimamus (1) (2)	6	4	+	+	*Hypnea pannosa; Padina durvillaei; Caulerpa sertularoides.*
Pitho picteti (1) (2)	2	–	+	+	*Hypnea pannosa; Padina durvillaei; Ulva lactuca; Bossiella californica.*
Pitho sexdentata (1)	2	–	+		*Haliclona* sp.
Acanthonyx petiveri (1) (2)	4	2	+		No decoration
Epialtus minimus (1) (2)	18	10	+	+	No decoration
Epialtus sulcirostris (2)	24	4	+	+	No decoration
Pelia pacifica (1)	7	8	+	+	*Hypnea pannosa; Padina durvillaei; Caulerpa sertularoides; Micale* sp.
Ala cornuta (1)	3	2	+		*Micale* sp.
Hemus finneganae	1	1		+	*Caulerpa sertularoides; Ceramium horridum; Haliclona* sp.
Microphrys platysoma (1)	58	29	+	+	*Hypnea pannosa; Padina durvillaei; Caulerpa sertularoides; Bossiella californica; Haliclona* sp; *Micale* sp.
Mithrax (Mithraculus) denticulatus	18	17	+		No decoration
Mithrax (Mithrax) armatus	7	2	+	+	Unidentified pieces of algae.
Thoe sulcata sulcata (1)	2	0	+		*Haliclona* sp.; *Micale* sp.

Previously reported: (1) as decorating species; (2) associated with *Sargassum.*

rridum Setchell and Gardner and *Bossiella californica* Silva. The species of *Colpomenia* were also found in the lower midlitoral zone, while *Ulva lactuca, Hypnea pannosa, Padina durvillaei* and *Bossiella californica* are also members of the shallow subtidal flora.

A total of 249 specimens of Majidae were collected and observed, 152 presented decorating habits, including 12 of the 16 species that were found. Of these 12 species, three [*Pitho sexdentata* Bell, *Ala cornuta* (Stimpson) and *Thoe sulcata sulcata* Stimpson] were devoid of algae and partly covered by sponges. A list of the decorating material found on all species is given in Table 1.

Decorating habits for 10 out of the 16 species of Majidae collected during this study had been reported previously (Table 1). No information was available, however, on the specific relationships between algae and tropical spider crabs from the Eastern Pacific Region, except for a few species that extend their distribution range to the Northern part of the Gulf of California, where they occur in *Sargassum* beds and may carry bits of this alga (Garth, 1958; Brusca 1980) (see Table 1).

Of the three species of the genus *Eucinetops* from this region, *E. rubellula* Rathbun had not been observed with attached algae. *Eucinetops panamensis* Rathbun, a species not found in the study area, reportedly uses bits of weed and filamentous algae to camouflage itself (Crane, 1937; Garth 1958). In addition to the three species of algae observed during this study, *E. lucasi* Stimpson also uses *Cladophora hesperia* Setchell Gardner to decorate (Garth 1958; specimens from Baja California); Crane (1937) reported this species as fairly well covered with algae.

No decorating habits had formerly been presented for *Inachoides laevis* Stimpson, a small majid commonly found is *Sargassum* in the Northern Gulf (Brusca 1980). In the Southeastern Gulf, it uses bits of one or two species of algae in camouflaging.

The genus *Podochela,* which includes 9 Paci-

fic species has 7 which are exclusively tropical in distribution. Five species are represented in the Gulf of California (including *P. lobifrons* Rathbun, a species that ranges along the West coast [Garth, 1958, 1960]). Of these, only *P. hemphilli* (Lockington) has so far been reported as carrying algae on its carapace and legs, although all 5 species have been occasionally collected among weed (Crane 1937; Garth 1958; Brusca 1980; Wicksten 1980).

Pitho picteti (de Saussure) and *P. sexdentata* are both known to decorate by using bits of algae (Crane 1937; Garth 1958). In this study, only the former species was heavily decorated, using up to 4 species of algae to do so (Table 1). There is no report of decoration for the third Eastern Pacific species of the genus *(Pitho quinquedentata* Bell).

A rarely decorated species which, according to Crane (1947), sometimes attaches long flags of weed to the rostrum, is *Acanthonyx petiveri* Milne Edwards. The species is a mimic of the color of *Padina durvillaei* and was never observed carrying algae. Another species that was found with the carapace free of decorating items is *Epialtus minimus* Lockington, a species which also occurs at Cabo San Lucas, Baja California, where Crane (1937) reported it to be covered with bryozoans and bits of sponge. Both species, related to *Pugettia producta* (Randall), may be "secondary decorators", spider crabs that have lost the habit of decorating (Wicksten 1980).

Pelia pacifica A. Milne Edwards, once of the most abundant Majidae in the area, is ussually a well-decorated species, using algae, sponges and hydroids to camouflage (Crane 1947). A second East Pacific species [*P. tumida* (Lockington)] seems to be a sponge-user (Garth 1958; Wicksten 1980), while a third one (*P. pulchella* Bell) has not yet been reported as decorated.

Decorating behaviour of *Ala cornuta* has been described by Peterson (1967), who reported *Sargassum, Laurencia,* bryozoans and corals on collected specimens, and by Behrstoch (1967) and Brusca (1980). Specimens collected during this study, however, were devoid of algae and only used sponges of the genus *Micale* to decorate. In Puerto Viejo, *A. cornuta* is abundant among *Codium conjunctum,* but the crab apparently has no tendency to use this alga to decorate.

Microphrys platysoma (Stimpson) uses a wide variety of algae and sponges to decorate (Table 1); specimens from the West coast of the Gulf of California use bits of weed held by their curved hairs (Crane, 1937). No other species of *Microphrys* from the Eastern Pacific has been reported to use algae for decorating; but spongecovered specimens of *M. aculeatus* (Bell) from Peru have been observed by Garth (1958).

The genus *Mithrax,* which includes 9 Eastern Pacific species and subspecies, tend to remain free of decoration (Wicksten, 1980) and at the most will use few bits of algae (likes, *M. armatus* de Saussure, in this study) or encrusting organisms like bryozoans and worm tubes (*M. tuberculatus;* Crane, 1937).

Thoe sulcata sulcata Stimpson and *T. s. panamensis* Nobili (the more southerly subspecies) both share identical decorations items (polychaetes, bryozoans and other encrusting species; Crane 1947); only sponges were observed on the specimens collected from the study area.

Only a few relationship between Majidae of the East Pacific and the algae they use to decorale have been examined at the species level (Wicksten 1980; Mastro 1981). Mastro (*op. cit.*) noted that a population of the majid *Pugettia producta* (Randall) can use up to 10 different species of algae to camouflage.

Association of Majidae with algal beds in the Gulf of California is scarcely documented. Brusca (1980) reported only 8 species commonly encountered in *Sargassum* in the Northern Gulf, including *Epialtoides paradigmus* Garth and *Stenorynchus debilis* (Smith), two species not found during this study, and Garth (1958) reported *Epialtus sulcirostris* in *Sargassum liebmanni.*

Comparatively, in Puerto Viejo, 10 out of the 16 collected species were commonly observed among *Padina durvillaei;* three species (*Eucinetops rubellula, Hemus finneganae* and *Mithrax armatus*) were never collected among *Padina* or any other algae growing in the area, and four species were found associate to other species of algae (*Pitho sexdentata* with *Codium conjunctum; Ala cornuta* with *C. conjunctum* and *Caulerpa sertularoides; Mithrax denticulatus* with *C. conjunctum; Epilatus sulcirostris* with *Hypnea pannosa* in addition to *P. durvillaei*). The algae used in decorating tend to reflect easily available species in the habitat.

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