

Feeding habits of caprellids (Crustacea: Amphipoda) from the west coast of Mexico. Do they feed on their hosting substrates?

Alimentación de los caprélidos (Crustacea: Amphipoda) de la costa oeste de Méjico. ¿Se alimentan de los sustratos en los que viven?

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ABSTRACT

We studied the gut contents of the dominant species of the West coast of Mexico to explore if caprellids can use their host substrates (mainly hydroids and gorgonians) as food resource or just as a place to cling on. Two hundred and forty two specimens of four species of caprellids were examined: *Aciconula acanthosoma* Chess, 1989, *Caprella equilibra* Say, 1818, *Caprella* aff. *penantis* Leach, 1814 and *Paracaprella* sp. Detritus was the dominant component in all the species, although hydroids were also abundant in *C. equilibra* and *Paracaprella* sp. Crustaceans were present in the digestive tracts of the four species, being an important component in *Aciconula acanthosoma* and *Paracaprella* sp. *Caprella* aff. *penantis* and *C. equilibra* collected from gorgonians did not show any trace of gorgonian sclerites in their guts. Therefore, the present study reveals that caprellids from the Pacific coast of Mexico are able to feed on hydroids but not on gorgonians. Furthermore, *Paracaprella* sp. associated to hydroids also showed a significant amount of harpacticoid copepods in the digestive tract, supporting the idea of cleptocomensalism. Further experimental studies are needed to explore the complex relationships between hydroids and caprellids.

RESUMEN

Se estudió el contenido del digestivo de las especies dominantes de la costa oeste de Méjico para explorar si los caprelidos pueden usar los sustratos en los que viven (principalmente hidrozoos y gorgonias) como fuente de alimento o solamente como sustrato al que anclarse. Se examinaron doscientos cuarenta y dos ejemplares de cuatro especies de caprelidos: *Aciconula acanthosoma* Chess, 1989, *Caprella equilibra* Say, 1818, *Caprella* aff. *penantis* Leach, 1814 y *Paracaprella* sp. El componente dominante en todas las especies fue el detritus, aunque los hidrozoos también fueron abundantes en *C. equilibra* y *Paracaprella* sp. Se encontraron restos de crustáceos en los tractos digestivos de las cuatro especies, siendo un componente importante en *Aciconula acanthosoma* y *Paracaprella* sp. *Caprella* aff. *penantis* y *C. equilibra* recolectadas en gorgonias no mostraron ningún resto de escleritos en sus digestivos. Por tanto, el presente estudio revela que los caprelidos de la costa pacífica de Méjico son capaces de alimentarse de hidrozoos pero no de gorgonias. Además, *Paracaprella* sp. asociada a hidrozoos también mostró una cantidad importante de copépodos harpacticoides en el tracto digestivo, lo que apoya la idea de cleptocomensalismo. Para el futuro, sería interesante desarrollar estudios experimentales para explorar las complejas relaciones entre hidrozoos y caprelidos.

INTRODUCTION

Caprellids are small crustaceans which constitute an important trophic link between primary producers and higher trophic levels in marine ecosystems (Woods, 2009). They have been proposed as useful marine bioindicators (Guerra-García & García-Gomez, 2001; Ohji *et al.*, 2002; Guerra-García *et al.*, 2009) and as potential marine finfish aquaculture resource (Woods, 2009). A recent study based on 62 species in 31 genera has shown that caprellids feed mainly on detritus (Guerra-García & Tierno de Figueroa, 2009) and, secondarily, on microalgae, dinoflagellates, hydroids, sponges, polychaetes and crustaceans (copepods and amphipods). Although this study reveals the main components of the general diet of a wide variety of species, little is known yet about the trophic relationships among caprellids and their substrates.

Caprellids usually live as epibionts on a variety of substrates from the littoral zone to a depth of 4790 m (Laubitz & Mills, 1972). The majority of species occur on a variety of organisms, clinging to algae, hydroids, bryozoans, sponges, seagrasses (McCain, 1968; Laubitz, 1972; Caine, 1989; Guerra-García, 2001). Several caprellid species, however, live in more specific associations with invertebrates such as gorgonians, sea anemones, mollusks, medusae, large crustaceans and echinoderms (see references in Guerra-García, 2001). Species with specific habitats have morphological adaptations to their substrate, and even those species occurring on different

substrates may exhibit some substrate-specific morphological adaptations (Caine, 1978, McCain, 1968).

Caprellids use their substrates mainly as a place to cling on, but it is not still clear if they can also feed on their own substrates. It is evident that caprellids can receive food from the substrates in the form of attached diatoms and entrapped detritus (Caine, 1998), and that the substrates can also provide refuge from predators (Guerra-García, 2006) but little has been explored about the possibility of caprellids feeding directly on the substrates where they are clinging on. In this sense, Mayer (1882) suggested that caprellids might feed on polyps of hydroids and bryozoans. Guerra-García & Tierno de Figueroa (2009) did not find trace of bryozoans in the gut contents of the 62 studied species, but they found abundant hydroid cnidocysts in three caprellid species. However, other authors (Bavestrello *et al.*, 1996; Di Camillo *et al.*, 2008) point out that caprellids do not feed directly on hydroid polyps but the food collected by these polyps (e.g. copepods) can be exploited by caprellids in a cleptocommensalistic relationship. Caine (1998) reported the first case of caprellid-hydroid mutualism: *Paracaprella tenuis* Mayer, 1903 aggressively displaces *Tenellia pallida* (Alder & Hancock, 1845), a nudibranch predator of the hydroid. The caprellid receives a substrate of suitable diameter to be grasped by the pereopods and access to food items (detritus, diatoms, nematodes and harpacticoid copepods) from the epibiotic community, but it does not feed directly on hydroid polyps. This caprellid aggressively defends its location on the hydroid, causing the nudibranch to move away. A similar relationship has also been proposed for *Paracaprella pusilla* and the hydroid *Eudendrium racemosum* in Southern Spain (Ros & Guerra-García, 2012). Regarding with corals, Scinto *et al.* (2008) pointed out the importance of cnidarians as a trophic source for caprellids and suggested that these predator/prey interactions are very fragile and that disequilibrium towards predators can occur, dramatically affecting prey survivorship and gorgonian population stability. These authors reported a gorgonian mortality related to a massive attack by the caprellid *Metaprorella sandalensis* in North Sulawesi, Indonesia; finding numerous sclerites in the digestive tract. Lewbel (1978) also reported that *Caprella gorgonia* feed on gorgonian tissue and polyp mucus secretions. However, Guerra-García & Tierno de Figueroa (2009) did not find any trace of gorgonian sclerites in the gut contents of any of the 62 species studied. Therefore, it remains unclear if caprellids effectively feed on polyps of hydroids and gorgonians or if the consumption is only accidental.

Although in temperate ecosystems the highest densities of caprellids can be found in algae (Guerra-García, 2001), in the tropical region caprellids are mainly associated to hydroids and secondarily to gorgonians and other

corals (Guerra-García, 2006; Scinto *et al.*, 2008). In fact, in the Pacific coast of Mexico, hydroids and gorgonians are clearly the substrates containing highest abundances of caprellids (Sánchez-Moyano, in prep.). Consequently, the main objective of the present study was to explore if caprellids feed on polyps of hydroids and gorgonians, based on the study of digestive contents of material collected from the West Coast of Mexico.

MATERIAL AND METHODS

We studied 242 specimens of 4 species of caprellids: *Aciconula acanthosoma* Chess, 1989, *Caprella equilibra* Say, 1818, *Caprella* aff. *penantis* Leach, 1814 and an undescribed species of *Paracaprella* (Table 1). These are the most common species inhabiting shallow waters of the West coast of Mexico. Caprellids were collected from June 2011 to February 2012 at 3 to 25 m deep. To explore if substrates could influence the feeding habitats of each species, caprellids were collected, whenever possible, from different substrates. *Aciconula acanthosoma* were collected from algae (I. Pájaros) and hydroids (C. Pelón), *Caprella equilibra* from gorgonians (I. Pájaros) and hydroids (B. Tiburón and B. Viudas), *Caprella* aff. *penantis* from gorgonians of different stations (I. Pájaros, C. Pelón and Las Monas) and *Paracaprella* sp from hydroids (I. Pájaros) and coral rubble (I. Marietas) (Fig. 1, Table 1). The substrates were collected by snorkelling or SCUBA and samples were fixed in 70% ethanol. In the laboratory, the caprellids were sorted and identified. For the diet study, individuals were analyzed following the methodology of Bello & Cabrera (1999) used previously for caprellids by Guerra-García & Tierno de Figueroa (2009). Each individual was introduced in a vial with Hertwig's liquid (consisting on 270 g of chloral hydrate, 19 ml of chloridric acid 1 N, 150 ml of distilled water and 60 ml of glycerine) and heated in an oven at 65° for 3 to 10 hours depending on the size of specimens. After this, they were mounted on slides for its study under the microscope. The percentage of the absolute gut content (100x), as the total area occupied by the content in the whole digestive tract, and the relative gut content (400 and 1,000x), as the area occupied for each component within the total gut content, were estimated using a microscope equipped with an ocular micrometer. Mean and standard error of the mean were calculated.

RESULTS AND DISCUSSION

Two hundred and forty two specimens were examined (Table 2). The percentage of empty guts were very high (63% in *Paracaprella* sp., 61% in

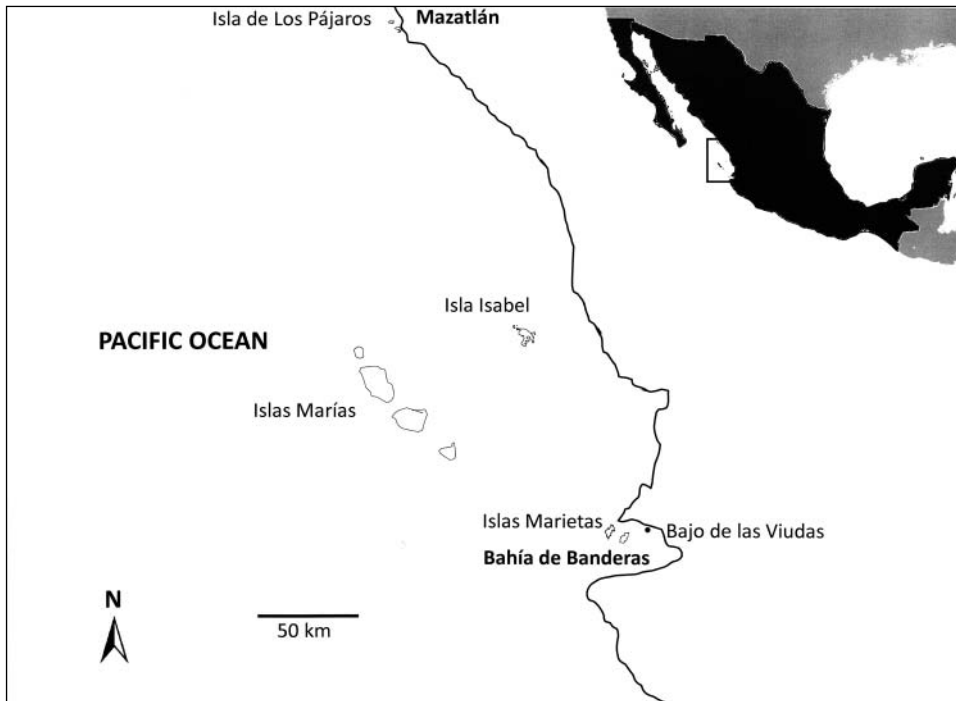


Fig. 1.—Map of the study area where caprellids were collected.

Fig. 1.—Mapa del area de estudio donde se recolectaron los caprélidos.

A. acanthosoma, 55% in *C. equilibra*, 44% in *Caprella* aff. *penantis*). The mean value of the total area occupied by the content in the whole digestive tract ranged from 21% (*A. acanthosoma*) and 37% in *C. aff. penantis*). Gut contents of the studied caprellid species included detritus, crustaceans (mainly harpacticoid copepods), hydroids, microalgae (mainly diatoms) and dinoflagellates. Detritus was the dominant component in all the species, although hydroids were also abundant in *C. equilibra* and *Paracaprella* sp. Crustaceans were present in the digestive tracts of the four species, although they represented an important component in *Aciconula acanthosoma* and *Paracaprella* sp.

When the gut contents were graphically compared among substrates (Fig. 2), a clear pattern was observed. The three species which were collected from hydroids (*A. acanthosoma*, *C. equilibra* and *Paracaprella* sp.) showed a significant amount of polyp tissue in the stomachs. This indicates that hydroid can constitute effectively an important part of the diet. However, *Caprella* aff. *penantis* collected from gorgonians of different localities, and

Table 1.—List of stations where caprellids were collected. See also Fig. 1.
 Tabla 1.—Lista de las estaciones donde se recolectaron los caprellidos. Véase también la Fig. 1.

Stations	Coordinates	Depth	Caprellids	Substrates
Isla de los Pájaros	23°15'08.02"N, 106°28'24.81"W	3-6 m	<i>Aciconula acanthosoma</i> <i>Caprella equilibra</i>	Algae Gorgonians
			<i>Caprella aff. penantis</i> <i>Paracaprella</i> sp	Gorgonians Epiphytic hydroids
Isla Isabel, Cerro Pelón	21°51'12.08"N, 105°53'25.90"W	25 m	<i>Aciconula acanthosoma</i> <i>Caprella aff. penantis</i>	Hydroids Gorgonians
Isla Isabel, Las Monas	21°50'59.36"N, 105°52'46.25"W	6 m	<i>Caprella aff. penantis</i>	Gorgonians
Isla Isabel, Bahía Tiburón	21°50'36.51"N, 105°53'03.92"W	3 m	<i>Caprella equilibra</i>	Hydroids
Islas Marietas	20°42'2.52"N, 105°33'52.68"W	4 m	<i>Paracaprella</i> sp	Coral rubble
Bajo de las Viudas	20°43'58.38"N, 105°23'32.64"W	5-8 m	<i>Caprella equilibra</i>	Hydroids

Table 2.—Gut contents of the studied caprellid species. N: number of specimens of each species examined, n: number of specimens with detected digestive contents. %Abs: total area occupied by the content in the whole digestive tract. Det: detritus, Cru: crustaceans, Hyd: hydroids, Mic: microalgae, Din: dinoflagellates.

Tabla 2.—Contenidos digestivos de las especies de caprellidos estudiadas. N: número de ejemplares examinados de cada especie, n: número de ejemplares con presencia de contenido digestivo. %Abs: área total ocupada por el contenido en el tracto digestivo completo. Det: detritus, Cru: crustáceos, Hyd: hidrozoos, Mic: microalgas, Din: dinoflagelados.

	N/n	Components (100%)					
		%Det	%Abs	%Cru	%Hyd	%Mic	%Din
<i>Aciconula acanthosoma</i> Chess, 1989	31/12	75.0(10.5)	21.0(6.8)	17.5(9.8)	6.7(5.9)	0.8(0.7)	0.7(0.3)
<i>Caprella equilibra</i> Say, 1818	72/32	73.6(4.9)	29.1(4.7)	0.7(0.4)	17.1(5.1)	7.8(2.3)	0.8(0.4)
<i>Caprella aff. penantis</i> Leach, 1814	87/49	84.2(2.9)	37.4(3.9)	8.9(2.5)	—	4.6(1.5)	1.3(0.3)
<i>Paracaprella</i> sp	52/19	63.4(7.7)	32.3(6.7)	18.2(8.2)	10.2(5.6)	8.2(3.1)	—

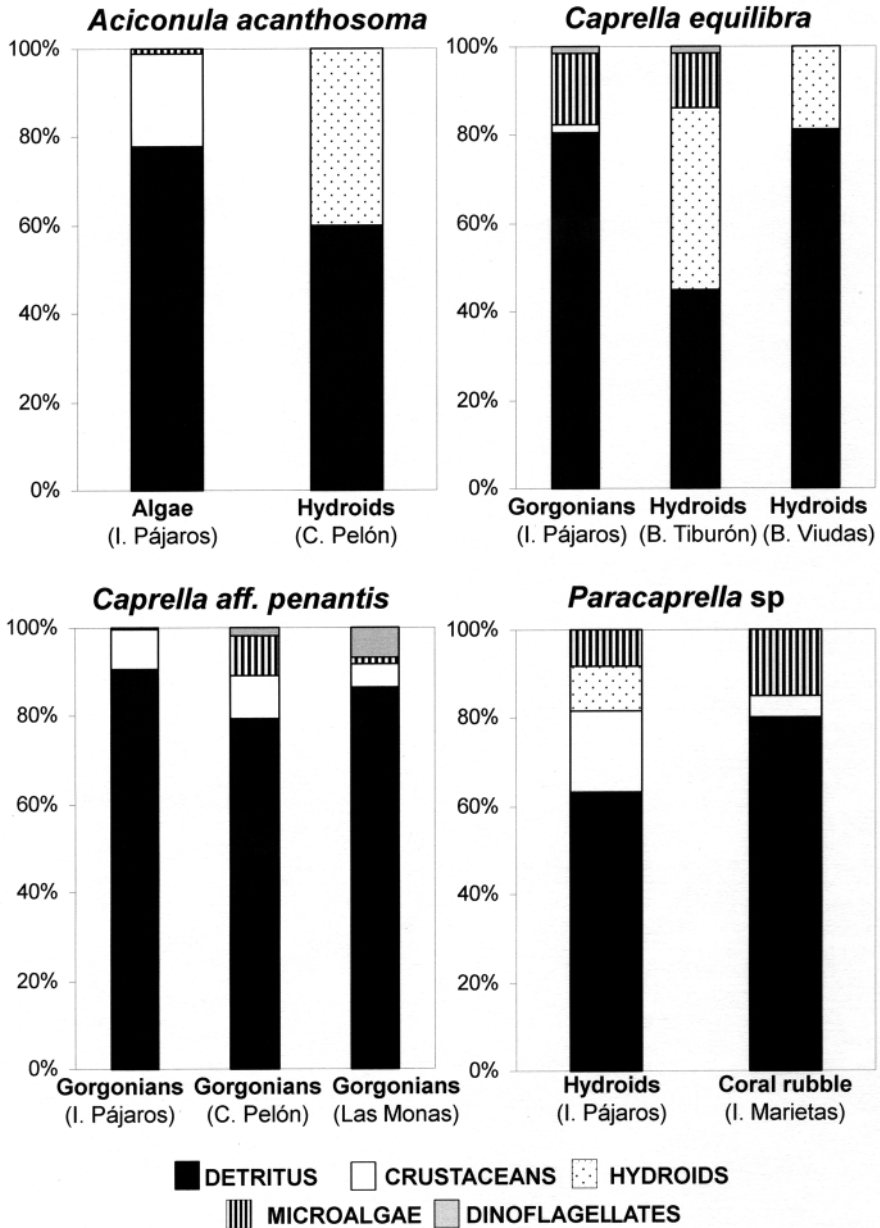


Fig. 2.—Percentage of the components found in the digestive tract of the four caprellid species studied in different localities and substrates.

Fig. 2.—Porcentaje de los distintos componentes encontrados en el tracto digestivo de las cuatro especies de caprellidos estudiadas en diferentes localidades y sustratos.

C. equilibra collected from gorgonians of I. Pajaros, did not show any trace of gorgonian sclerites in their guts.

The dominant component of the guts was detritus for the four species. These results agree with the general pattern obtained for caprellids by Guerra-García & Tierno de Figueroa (2009). These authors found a clear relationship between the presence/absence of molar in the mandibles and the feeding habits. Species lacking molar are mainly predators and species with molar are characterised by a diet mainly based on detritus. The four species of this study have molar process in the mandible and, consequently, a diet with detritus as the main component. On the other hand, the present study also reveals that caprellids are rather opportunistic since they can change feeding habits depending on the substrates where they are clinging to.

The present study also reveals that caprellids from the West coast of Mexico, mainly clinging to hydroids and gorgonians, are able to feed on hydroids but not on gorgonians. Therefore, besides the cleptocomensalism suggested by Bavestrello *et al.* (1996) and Di Camillo *et al.* (2008), and the mutualistic relationship reported by Caine (1998), it seems that hydroids are not only used as habitat substrate, but can also be as source of food. Furthermore, in the case of *Paracaprella* sp., it seems that when the species inhabit hydroids, the number of crustaceans (harpacticoid copepods) in the gut is higher than in coral rubble. This could be due to the fact that the caprellid exploits the preys captured by the polyps. Bavestrello *et al.* (1996) observed that *Pseudoprotella phasma* and *Caprella* sp. showed a peculiar trophic strategy involving the *Eudendrium* polyps. If laboratory reared colonies of *Eudendrium* are fed with *Artemia* nauplii, caprellids, using their antennae, detect polyps which have just caught their prey. Immediately, caprellids snatch the *Artemia* with their gnathopods and swallow them. Such prey was never captured directly by the caprellids they observed. Although the hydranths lose some prey, they rarely suffer damage (Bavestrello *et al.*, 1996). On the other hand, Guerra-García (2006) pointed out that, taking into account that many of the tropical hydroids are stinging species, it would be possible that the caprellids use hydroid habitats as a protection instead of using algae where they are potentially less protected from fish predators.

In connection with gorgonians, although they do not provide direct food for caprellids, probably the detritus trapped in the colonies is of great value as food resource. In fact, more than 80% of the digestive tract is occupied by detritus in *C. aff. penantis* associated to gorgonians. In any case, further experimental studies under laboratory conditions are needed to understand the interesting relationships among caprellids and their substrates.

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