

CAPRELLA BATHYTATOS NEW SPECIES (CRUSTACEA, AMPHIPODA, CAPRELLIDAE), FROM THE MOUTHPARTS OF THE CRAB *MACROREGONIA MACROCHIRA* SAKAI (BRACHYURA, MAJIDAE) IN THE VICINITY OF DEEP-SEA HYDROTHERMAL VENTS OFF BRITISH COLUMBIA

Joel W. Martin and Gary Pettit

ABSTRACT

Caprella bathytatos new species, is described from the mouthparts of spider crabs in the vicinity of deep-sea hydrothermal vents off British Columbia. The species was found attached to the setae of the third maxillipeds of the majid crab species *Macroregonia macrochira*, a vagrant associate of hydrothermal vents in this region. The new caprellid is morphologically very similar to *Caprella unguлина* Mayer, a species known from the mouthparts of lithodid (anomuran) crabs, but is characterized by a first gnathopod that lacks grasping spines and by pereopods having a notched propodus that facilitates attachment to the host setae. This report extends the depth record for the genus *Caprella* to over 2200 m, is the first report of caprellids associated with brachyuran crab mouthparts as the primary (or only) substratum, and is the first record of any member of the family Caprellidae in the vicinity of marine hydrothermal vents.

Amphipods of the family Caprellidae typically inhabit shallow marine waters where they are found most often in association with hydroids, bryozoans, or marine algae. Although records exist for caprellids associated with echinoderms and cnidarians (Jones, 1970; Vader, 1972; Caine, 1983, Takeuchi and Hirano, 1995), there has been only one species of caprellid, *Caprella unguлина* Mayer, previously reported from the mouthparts of a decapod crustacean (reviewed by Takeuchi et al., 1989). There have been no reports of caprellids associated with true (brachyuran) crabs, or with marine hydrothermal vents or the animals that frequent them.

In the summer of 1988, several specimens of a new species of caprellid amphipod were observed adhering to the setae of mouthparts of the majid crab *Macroregonia macrochira* Sakai, 1978 collected in the vicinity of a marine hydrothermal vent on the Juan de Fuca Ridge. The species is described herein.

MATERIALS AND METHODS

All of the specimens upon which this report is based were taken from the mouthparts of a single crab of the species *Macroregonia macrochira* Sakai collected by the DSRV ALVIN, Dive 2065, 16 July 1988, 47°56.9'N, 129°06.1'W, at a depth of 2201 m from the Endeavor site of the Juan de Fuca Ridge (Tunnicliffe, 1988; Tunnicliffe et al., 1986). We have not been able to ascertain the whereabouts of the crab; it is likely, because this species is rather common near the Juan de Fuca hydrothermal sites (Tunnicliffe and Jensen, 1987), that the crab was discarded after some of the caprellids were removed from the mouthparts and stored separately (C. L. Van Dover, pers. comm.). The caprellid specimens were sent to us by one of the dive scientists, C. L. Van Dover. Some of the caprellids were still attached to parts of the crab mouthparts (Fig. 1A), by which we were able to determine that at least the third maxillipeds are used by the caprellids as a substrate.

All illustrations were made with either a Wild M5APO dissecting stereoscope or a Nikon Labophot, both equipped with drawing tube. Specimens subjected to scanning electron microscopy were cleaned by brief sonication in a commercial surfactant and then dehydrated to 100% ethyl alcohol before immersing in HMDS (hexamethyldisilazane; Nation, 1983) and air drying. After sputter coating, amphipods were mounted on stubs and examined at 10–20 kv in a Cambridge Stereoscan 360 SEM.

All specimens have been deposited in the Crustacea collections of the Natural History Museum of Los Angeles County, as follows: holotype male, LACM 88-399.1; allotype female, LACM 88-399.2; paratypes (including figured male in 1A and its associated crab mouthpart), LACM 88-399.3.

SYSTEMATICS

Caprella bathytatos new species

(Figs. 1–5)

Material Examined.—Male holotype, LACM 88-399.1, 10.4 mm total length (when flattened out, and excluding antennae); female allotype, LACM 88-399.2, and 28 paratypes, LACM 88-399.3, including 1 female, 8 males, and 19 juveniles (those individuals less than or equal to 6.5 mm total length), all from DSRV ALVIN, Dive 2065, 16 July 1988, 47°56.9'N, 129°06.1'W, 2201 m, hydrothermal vents along Juan de Fuca Ridge, Endeavor site. One male sacrificed for SEM work.

Description.—**SIZE**: Smallest juvenile 2.2 mm total length (excluding antennae); largest (male sacrificed for SEM work) 14.9 mm (excluding antennae).

HEAD AND ANTENNAE: Head rounded, lacking spines or projections. Eyes obscure, pigment greatly reduced. Head and pereon lacking any spines or projections. Antenna 1 length equal to approximately half or slightly more than half the body length, peduncle article lengths greatest in the order 2, 3, 1. Flagellum composed of 18 segments. Antenna 2 approximately half length of Antenna 1, distal 3 articles approximately equal in length.

MOUTHPARTS: Mandibles (Fig. 3) lacking palp; right and left mandible with incisor process and lacinia mobilis each divided into 5 teeth, and with 3 setae (Fig. 3B) in setal row behind lacinia mobilis. Other mouthparts (not illustrated) as for genus.

GNATHOPOD 1: Dactylus approximately equal in length to propodus, which is triangular and does not bear any grasping spines. Article 1 longer than combined length of articles 2 and 3; article 4 approximately equal in length to combined articles 2 and 3.

GNATHOPOD 2: Dactylus approximately 2/3 length of propodus. Propodus bears one blunt, rectangular tooth, separated by a U-shaped notch from a slightly more acute tooth just proximal to it. An acute proximal lobe, located just proximal to the point where the dactylus meets the propodus when closed, and approximately 1/3 of length of propodus from the proximal end, bears a single stout spine and seta. Gnathopod attached to body at midlength of pereionite 2. Basis equal to 3/4 length of pereionite 2; claw (dactylus and propodus) approximately equal in length to pereionite 2.

PEREIONITES: Pereionite 2 essentially equal in length to pereionite 3, and slightly longer than pereionites 4 and 5.

GILLS: Oval, oblong, sausage-shaped. Some individuals with unusual secondary gill at base of first, reminiscent of the two types of gills seen in some cyamids.

PEREOPODS: Approximately equal in length to one another. Each with grasping spines along cutting edge of anterior face of claw (Fig. 4C), and with notch in propodus opposing scale-like elaborations on base of dactylus, together forming a mechanism for attaching to host setae. Propodal margin nearly straight.

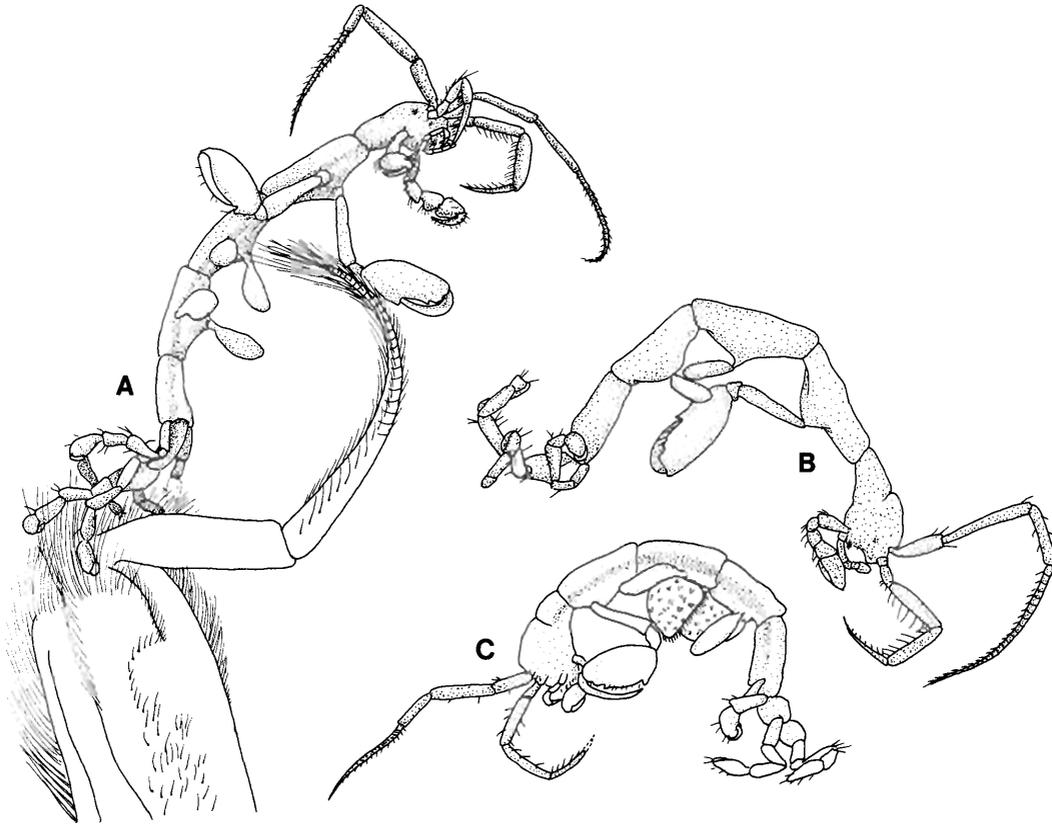


Figure 1. *Caprella bathytatos*, new species. A, male paratype, still attached to third maxilliped of the deep-sea majid crab *Macroregonia macrochira* Sakai. B, male holotype, lateral view. C, female allotype, lateral view.

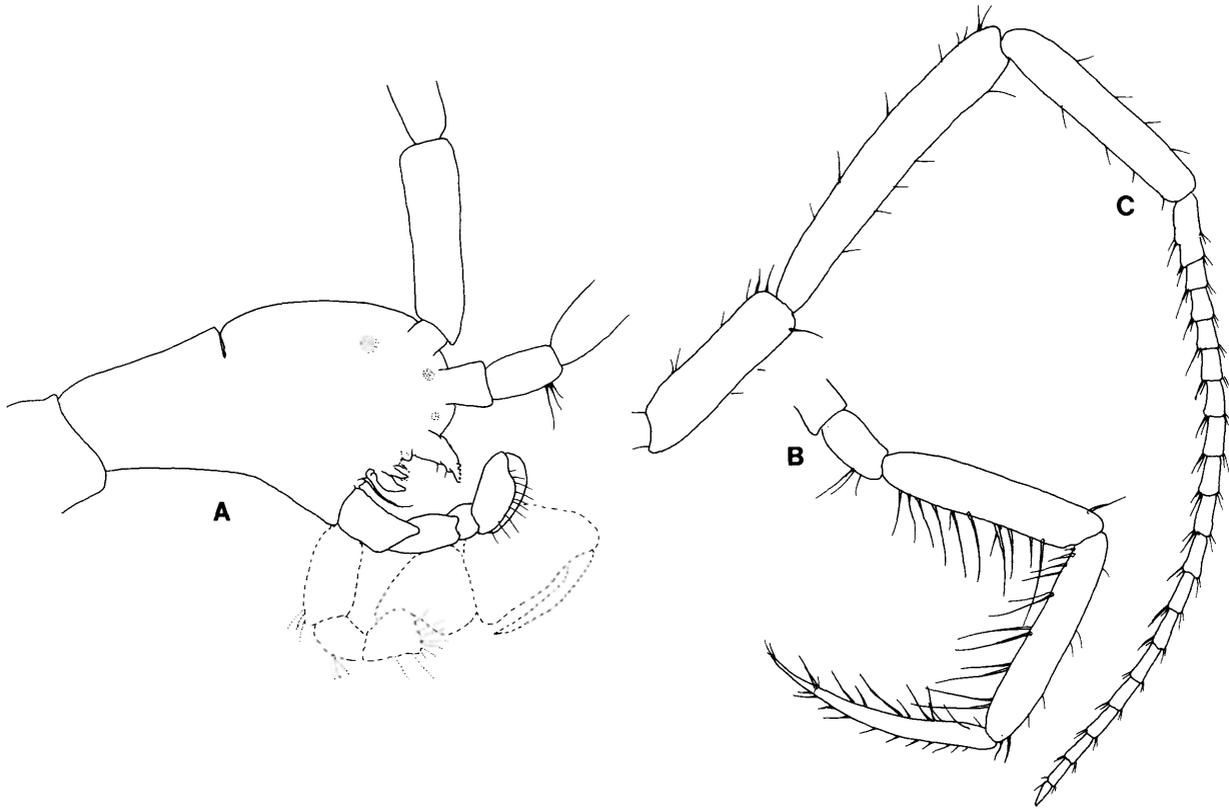


Figure 2. *Caprella bathytatos* new species, head and antennae of male holotype. A, head with gnathopod 1 of right side removed (and with left side gnathopod 1 indicated by dotted line). B, first antenna. C, second antenna.

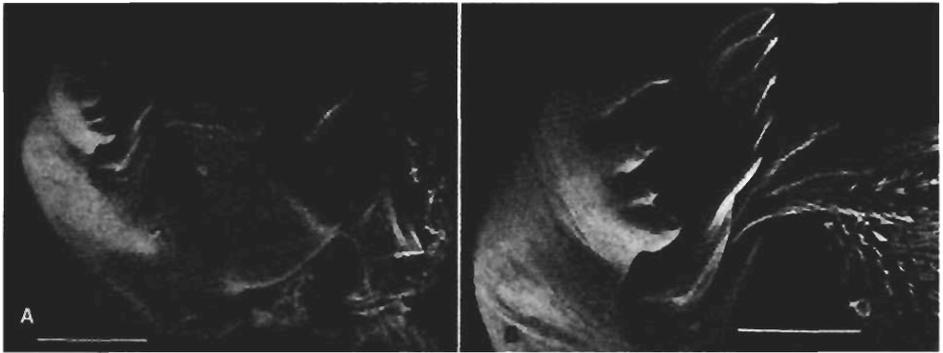


Figure 3. *Caprella bathytatos* new species, mandible. A, Entire mandible. Scale = 100 μm . B, higher magnification of incisor, lacinia mobilis, and setal row of three serrate setae. Scale = 50 μm .

MALE ABDOMEN (Figs. 6,7): Consisting of three components: penes, appendages, and lobes. The penes are short, paired, and uniramous, and extend posteriorly between the bases of the "abdominal appendages" (see McCain 1968: 5 for description and discussion of the various parts of the male abdomen). The abdominal appendages are approximately twice the length of the penes, are uniramous, and are two-segmented, with 6–8 setae on the distal end of the proximal segment and 3 setae on the distoventral surface of the distal segment. The distal segment bears a dense patch of fringe-like cuticular projections directed posteriorly (Fig. 7D). The abdominal lobes or flaps arise from the bases of the appendages and extend directly posteriorly; they are oval or nearly discoidal in shape (Fig. 7A).

SEXUAL DIMORPHISM: Females and males essentially identical with the exception of the male abdomen and the plates of the female brood pouch (Fig. 1C).

Etymology.—The specific name is from the Greek *bathytatos*, meaning "deepest," referring to the fact that this report marks a significant depth record (to 2201 m) for the genus *Caprella* (see also Remarks).

Remarks.—*Caprella bathytatos* most closely resembles *Caprella unguina* Mayer, a species known from the mouthparts of the following anomuran crabs, all in the family Lithodidae: *Neolithodes asperrimus* Barnard (endemic to South Africa), *Paralomis multispina* (Benedict), and *Lithodes aequispina* Benedict. *Caprella unguina* is very widely distributed, having been reported from the North Pacific (off British Columbia, Canada, and San Diego, California), the Galapagos Islands, off Tierra del Fuego and the Falkland Islands, off South Africa, in the Sea of Okhotsk, and off central Japan, at depths of from 300 m to 1200 m (Takeuchi et al., 1989). Thus, *C. unguina* has a geographic range that exceeds that of any of the lithodids on which it is found. Because of the wide bathymetric and geographic range of *C. unguina*, and because of their similar morphology, it seems likely that *C. bathytatos* is an offshoot of that species. Indeed, the two species are extremely close morphologically. The new species can be distinguished from *C. unguina* (abbreviated below as *C. u.*) by its possession of the following combination of features:

- Male antenna 1 approximately equal to half body length (longer than half body length in *C. u.*)
- Male antenna 1 flagellum composed of 18 segments (15 segments in *C. u.*)
- Male antenna 1 flagellum longer than distal peduncle article and approximately 2/3 length of combined articles of peduncle (antenna 1 flagellum shorter than distal peduncle article and equal in length to only approximately 1/3 peduncular length in *C. u.*)

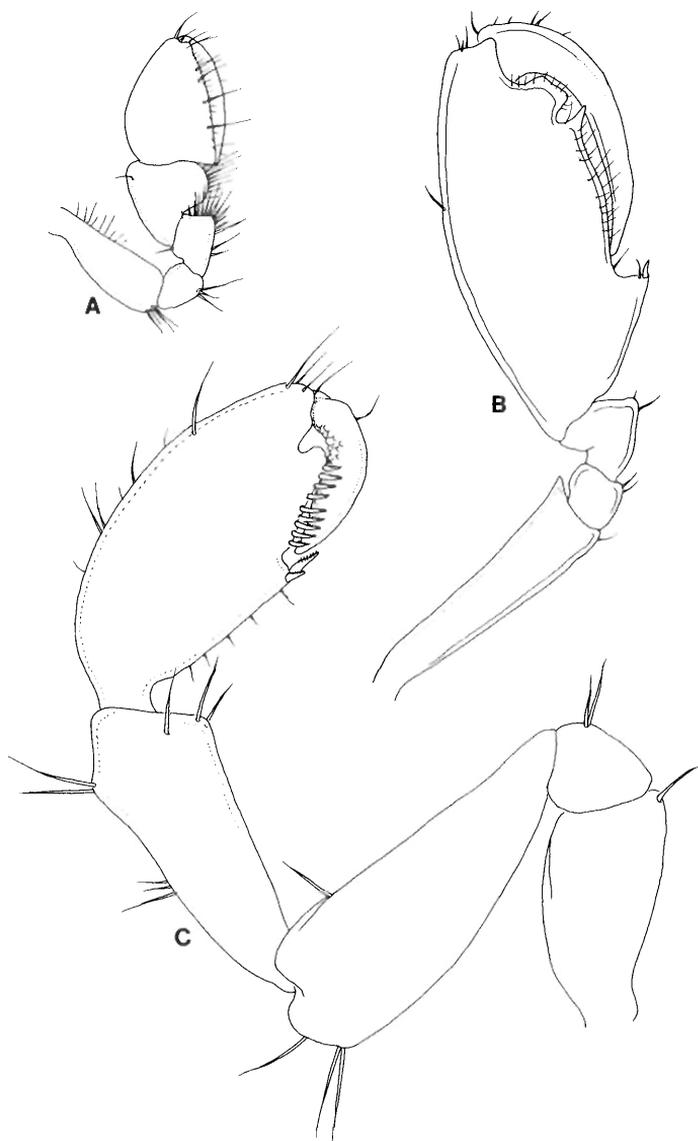


Figure 4. *Caprella bathytatos*, new species, gnathopods and pereopod 7 of holotype. A, right gnathopod 1. B, right gnathopod 2. C, right pereopod 7, anterior surface. Note heavy spination/setation and rugose surface of base of dactylus.

–Pereonites I, II, and III approximately equal in length (Pereonites I and II clearly longer than III in *C. u.*)

–Pereopods V, VI, and VII with notch at base of dactylus and corresponding flattened teeth on opposing area of propodus (no such notch in pereopods of *C. u.*)

–Mandibles with 3 setae in setal row behind lacinia mobilis (only 2 such setae in *C. u.*).

The above differences may not be as significant as their number indicates. In their redescription of *C. unguina*, Takeuchi et al. (1989) noted considerable variability in sev-

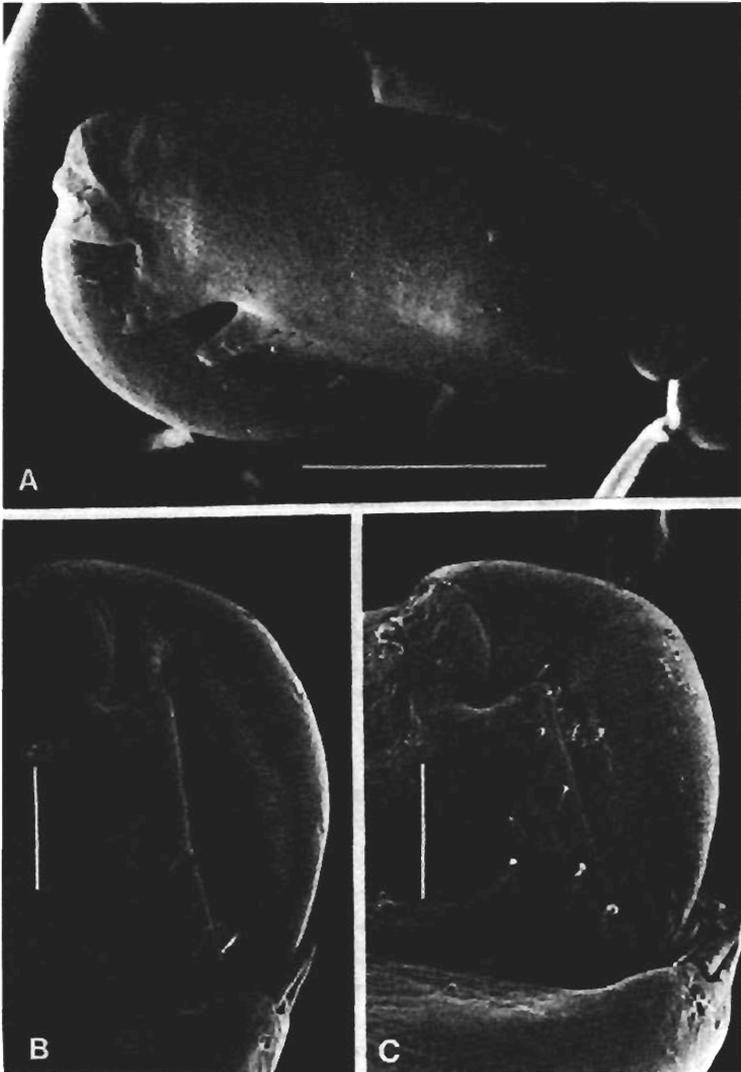


Figure 5. *Caprella bathytatos*, new species, gnathopod 2 and pereiopods. A, male gnathopod 2. B, male pereiopod 6, left side, posterior surface, with dactylus open showing grasping spines just visible on far side of claw (shown in Fig. 4C). C, male pereiopod 7, left side, posterior surface, with dactylus closed to show how notch in dactylus opposes groove in propodus to grasp setal shafts of the host's mouthparts. Scale bar = 1.0 mm.

eral characters, and differences in even such characters as the presence or absence of an eye exist in earlier descriptions (see Takeuchi et al. 1989). Size may also account for some of the differences between the two caprellid species. Our largest individual, at 14.9 mm total body length, is slightly more than half the size of the largest specimen of *C. unguina* (23.3 mm) known to Takeuchi et al. (1989). There is, therefore, some possibility that as we learn more about variability in bathyal caprellids, especially as concerns ontogenetic differences in development when living on different hosts, the current species may be shown to be synonymous with *C. unguina*. At present, given the number of small but

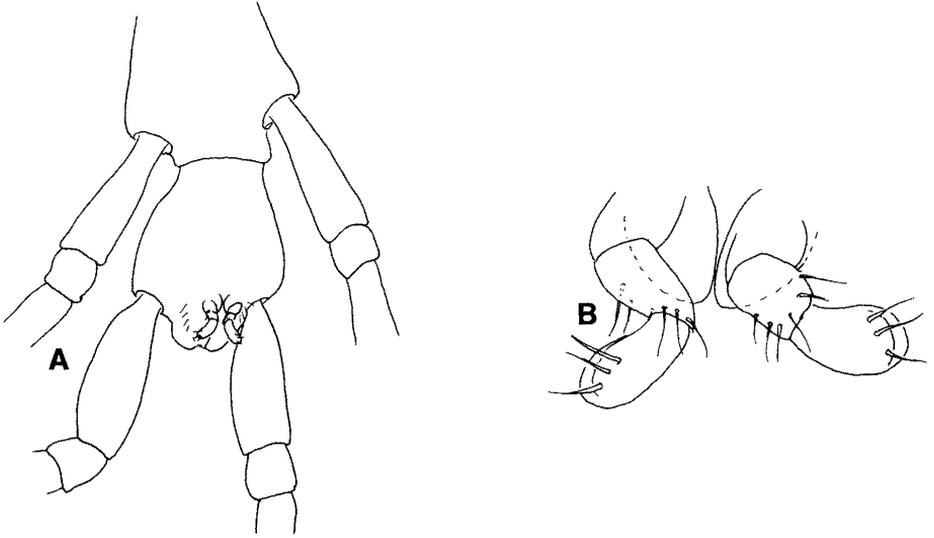


Figure 6. *Caprella bathytatos*, new species, abdomen of holotype male. A, last 2 body somites and their pereopods in ventral view. B, abdominal appendages in ventral view, with lobes visible as oval dashed line beneath them.

consistent morphological character differences, greater depth, and different decapod infraorder as its host, we felt the conservative approach was to erect a new species to accommodate these specimens. Additional features described herein as unique to *C. bathytatos*, such as the dense cuticular fringe on the distal segment of the penes, may prove to be shared with other members of the genus once SEM becomes more widely employed in comparisons and descriptions of species of the Caprellidae.

At the time of McCain's (1966) description of the genus *Abyssicaprella* from 3501–4004 m in the eastern Pacific (the depth record for the family Caprellidae), only 18 caprellid species were known from depths greater than 400 m. McCain's list included 6 species belonging to the genus *Caprella*, but none of these was known from a depth greater than 1600 m, with the exception of *C. equilibra* Say. However, Schellenberg's (1926) record of *C. equilibra* Say from 3000 m was from a vertical tow from 0 to 3000 m depth, and the specimen could have come from any intermediate depth; for this reason McCain listed it as questionably occurring below 400 m (McCain, 1966).

This is the first time that any caprellids have been found in association with *Macroregonia* or in the vicinity of marine hydrothermal vents. There are no obvious morphological adaptations that would indicate that the species inhabits areas adjacent to hydrothermal vents, and indeed this is not surprising as the host crabs are not vent-restricted but are considered merely vagrants that occasionally take advantage of vent habitats (Tunnicliffe and Jensen, 1987). There are no "swimming setae" on the antennae or filtering setae on the mouthparts of the caprellid that might indicate at least partial reliance on filtration as a mode of feeding (Caine, 1977, 1979). The characters (1) absence of swimming setae, (2) absence of a mandibular palp, and (3) presence of a molar process place *C. bathytatos* in the "Group III" classification of caprellids by McCain (1970), and the "Category 5" of Caine (1977). This group includes species that are "without feeding preferences" (Caine, 1977). This more generalized feeding mode (as opposed to being specialized for filtering,

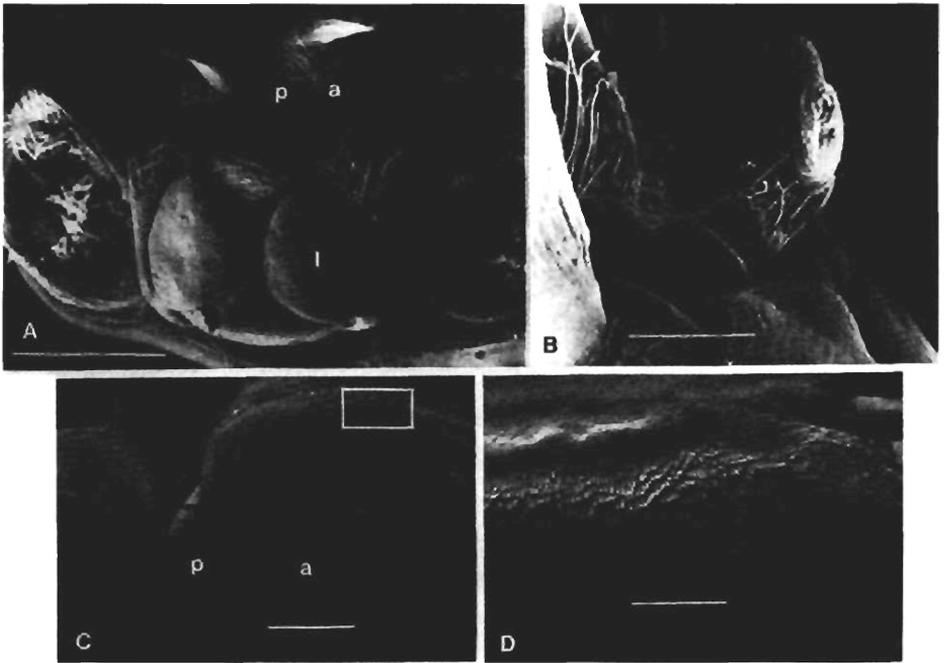


Figure 7. *Caprella bathytatos*, new species, SEM of the abdomen of an adult male. A, posterior view of abdomen with pereopod 7 of both sides removed, showing penes (p), appendages (a), and lobes (l). Scale bar = 200 μm . B, lateral view of right side appendage. Scale bar = 100 μm . C, posterior view of left side appendage showing setation of both segments. D, higher magnification of area indicated by white box in C, showing cuticular fringe on outer posterior surface of appendage.

scraping, predation, etc.) would make sense in light of the unpredictable nature of the quality and quantity of food in the deep sea.

Caine (1978), unaware at the time that some caprellids live on the mouthparts of brachyuran crabs, or that a few have been found associated with medusae and anemones (Vader, 1972), noted that caprellids could be divided into "four habitat categories: cosmopolitan substrata, starfish epibionts, gorgonian and bryozoan epibionts, and free on the bottom" (Caine 1978: 288). In the "cosmopolitan" group he included those species living on or with hydroids and algae, which includes the majority of the species of *Caprella*. With the exception of the starfish group, attachment of caprellids to the substrate is by "encirclement," with the propodus and dactylus of each pereopod more or less encircling a branch of the substrate (hydroid, brozoan, alga, etc.) The new species shows the same adaptation, with pereopods modified for grasping, in this case for grasping the long setae on the mouthparts of the crab. The rather heavy spines and setae of the pereopodal propodus, as well as the bumpy undersurface of the base of the dactylus that opposes this notch (Fig. 4C), would facilitate grasping branches of relatively small diameter, such as the setae of the host's mouthparts (Aoki and Kikuchi, 1990; their "first mode" of substrate holding).

ACKNOWLEDGEMENTS

We are grateful to C. L. Van Dover for bringing these specimens to our attention, and to I. Takeuchi for help locating literature and for useful discussion. The SEM work was facilitated by the help of

A. Thompson at the Center for Electron Microscopy and Microanalysis at the University of Southern California, and by the National Science Foundation via grant DEB 90-20088 to J. W. Martin.

LITERATURE CITED

- Aoki, M. and T. Kikuchi. 1990. Habitat adaptations of caprellid amphipods and the importance of epiphytic secondary habitats in a *Sargassum patens* bed in Amakusa, southern Japan. *Publications from the Amakusa Marine Biological Laboratory, Kyushu Univ.* 10: 123–133.
- Caine, E. A. 1977. Feeding mechanisms and possible resource partitioning of the Caprellidae (Crustacea: Amphipoda) from Puget Sound, USA. *Mar. Biol.* 42: 331–336.
- _____. 1978. Habitat adaptations of North American caprellid Amphipoda (Crustacea). *Biol. Bull.* 155: 288–296.
- _____. 1979. Functions of swimming setae within caprellid amphipods (Crustacea). *Biol. Bull.* 156: 169–178.
- _____. 1983. Community interactions of *Caprella penantis* Leach (Crustacea: Amphipoda) on sea whips. *J. Crust. Biol.* 3: 497–504.
- Jones, M. B. 1970. The distribution of *Pariambus typicus* var. *inermis* Mayer (Amphipoda, Caprellidae) on the common starfish *Asterias rubens* L. *Crustaceana* 19: 89–93.
- McCain, J. C. 1966. *Abyssicaprella galathea*, a new genus and species of abyssal caprellid (Amphipoda: Caprellidae). *Galathea Report* 8: 91–95.
- _____. 1968. The Caprellidae (Crustacea: Amphipoda) of the western North Atlantic. *U.S. Nat'l. Mus. Bull.* 278: 1–147.
- _____. 1970. Familial taxa within the Caprellidae (Crustacea: Amphipoda). *Proc. Biol. Soci. Wash.* 82: 837–842.
- Nation, J. L. 1983. A new method using hexamethyldisilazane for preparation of soft insect tissues for scanning electron microscopy. *Stain Technol.* 38: 347–351.
- Sakai, T. 1978. Decapod Crustacea from the Emperor Seamount Chain. *Researches on Crustacea* 8 (suppl.): 1–39, pls. I–IV.
- Schellenberg, A. 1926. Die Caprelliden und *Neoxenodice caprellinoides* n. g., n. sp. der Deutschen Sudpolar-Expedition, 1901–1903. *Deutsch. Sudpol.-Exped.* 18 (Zool. 10): 465–473.
- Takeuchi, I., and R. Hirano. 1995. Clinging behavior of the epifaunal caprellids (Amphipoda) inhabiting the *Sargassum* zone on the Pacific coast of Japan, with its evolutionary implications. *J. Crust. Biol.* 15: 481–492.
- _____, M. Takeda, and K. Takeshita. 1989. Redescription of the bathyal caprellid, *Caprella unguina* Mayer, 1903 (Crustacea, Amphipoda) from the North Pacific. *Bull. Nat'l. Sci. Mus., Tokyo, ser. A* 15: 19–28.
- Tunnicliffe, V. 1988. Biogeography and evolution of hydrothermal-vent fauna in the eastern Pacific Ocean. *Proc. Royal Soc. Lond. B* 233: 347–366.
- _____, M. Botros, M. E. de Burgh, A. Dinet, H. P. Johnson, S. K. Juniper, and R. E. McDuff. 1986. Hydrothermal vents of Explorer Ridge, northeast Pacific. *Deep Sea Res.* 33: 401–412.
- _____, and R. G. Jensen. 1987. Distribution and behavior of the spider crab *Macroregonia macrochira* Sakai (Brachyura) around the hydrothermal vents of the northeast Pacific. *Can. J. Zool.* 65: 2442–2449.
- Vader, V. 1972. Associations between gammarid and caprellid amphipods and medusae. *Sarsia* 50: 51–56.

DATE SUBMITTED: March 28, 1997.

DATE ACCEPTED: May 23, 1997.

ADDRESSES: (J.W.M.) *Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007*; (G.P.) *1208 Royal Palm Drive, Naples, Florida 33940*.