

Distribution of caprellid amphipods (Crustacea) in the western North Pacific based on the CSK International Zooplankton Collection

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Abstract: The present study details the planktonic distribution of caprellid amphipods, which are usually regarded as eubenthic, in the western North Pacific based on the CSK International Zooplankton Samples. Only 70 specimens of 17 species were found among the total of 3302 plankton samples from the western North Pacific and its adjacent seas. Stations yielding caprellids were restricted to the marginal seas and not to the Pacific Ocean itself. In the temperate region, *Caprella equilibra* Say, Caprellidae, dominated in the west of the Sea of Japan to the north of the East China Sea. In the tropical region, *Protogeton* cf. *inflatus* Mayer, Phtisicidae, was the dominant species from the South China Sea to the Gulf of Thailand, while the Caprellidae (*Aciconula* sp. 1, etc.) was dominant in a station within the Malacca Strait.

Key words: Amphipoda, caprellids, north Pacific, planktonic distribution

Introduction

Of the more than 350 species of caprellid amphipods which have hitherto been recorded from the world, several species, i.e., *Caprella andreae* Mayer, 1890, *C. danilevskii* Czerniavski, 1868, *C. equilibra* Say, 1818, *C. penantis* Leach, 1814 and *Hemiaegina minuta* Mayer, 1890, have been recorded worldwide (e.g. McCain & Steinberg 1970; Takeuchi 1995a). The morphology of caprellids is well adapted to clinging to substrata such as algae and hydroids (e.g. Caine 1978; Takeuchi & Hirano 1995), with reduced appendages on the abdomen which are used for swimming in other amphipod crustaceans. This, as well as the lack of a planktonic larval stage, suggests the possibility that cosmopolitan species possess a greater ability to drift as plankton or to cling to drifting materials rather than be distributed by swimming. Although *C. andreae* has been reported to attach to floating objects and to the carapaces of sea turtles (e.g. McCain 1968; Aoki & Kikuchi 1995), the dispersal mechanism of the other cosmopolitan species is unclear at present. Thus, elucidating their distribution and abundances in the water column is the first step in understanding their dispersal mechanisms.

However, the scarcity of records for caprellids in plankton samples, with the exception of a few reports (e.g. Irie 1959; Utinomi 1968), leads to the necessity to study planktonic samples which have been collected in large scale surveys.

During the Cooperative Study of the Kuroshio and Adjacent Regions (CSK) of UNESCO, 1965–1974, a total of 3302 zooplankton samples were collected in the western North Pacific Ocean and its marginal seas (Motoda 1980; Kubota 1993). The present paper documents the distribution of the caprellid assemblage based on the CSK Zooplankton Collection.

Materials and Methods

CSK Standard Zooplankton Samples were collected from the western North Pacific Ocean and its marginal seas, mostly the Sea of Japan and the East and South China Seas. Usually, sampling was conducted as vertical hauls from 150-m depth using NORPAC nets (Motoda 1980; Kubota 1993). Primary sorting of these samples were completed at the National Science Museum, Tokyo and at the Regional Marine Biological Centre for Southeast Asia, Singapore. Sorted samples are now maintained at the Marine Biological Center, Tokai University. The authors temporarily acquired the vials containing caprellid amphipods and identified them to species level under a stereo- (Olympus SZH Series) and a compound microscope (Nikon Optiphot Series). CSK Zooplankton Data Reports Nos 1–8 (Tham 1972, 1973a, b; Chung 1974, 1977a, b, c, d) were referred to in order to obtain details on the sampling sites.

Results

From the 3302 CSK samples, 56 samples contained caprellid amphipods with a total of 70 individuals of 17 species. Most of the samples contained only one individual, with a maximum of 5 individuals. The stations where caprellids occurred were all located in marginal seas, i.e., the Sea of Japan and the East and South China Seas, the Gulf of Thailand, and the Malacca Strait. No caprellid amphipods were collected from the Pacific Ocean itself, although more than 1300 samples were collected from the area.

The stations yielding caprellid amphipods can be separated geographically into 2 groups (Fig. 1); one is situated around the western part of the Sea of Japan to the northern East China Sea in the temperate region, and the other is situated from the South China Sea to the Gulf of Thailand and the Malacca Strait in the tropical region. Surface seawater in the former area ranges from 10°C in February to 26°C in August, while that in the latter area is stable at around 26 to 28°C (Wadachi 1987).

Of the 27 individuals collected from the temperate region, the genus *Caprella* dominated the assemblage. In particular, *C. equilibra* Say composed 59.3% of the total number of the individuals (Table 1).

The caprellid assemblage of the tropical region did not include the genus *Caprella*. The genera belonging to the Phtisicidae dominate the assemblage in the South China Sea to the Gulf of Thailand with *Protogeton* cf. *inflatus* Mayer, 1903 (Fig. 2) comprising 68.2% of the total number of individuals. An ovigerous female of *P.* cf. *inflatus* of 4.07 mm in body length (0.68 mm in pereonite II length) carrying two late stage embryos was found. The size of the embryos was 0.23 mm along the long axis and 0.20 mm along the short axis, corresponding to ca. 2/3 the size of those of *Caprella* (Takeuchi & Hirano 1992).

On the contrary, a station called "Sister's Island" in the Malacca Strait where seasonal sampling was conducted, exhibited a completely different structural assemblage. Twenty-one indi-

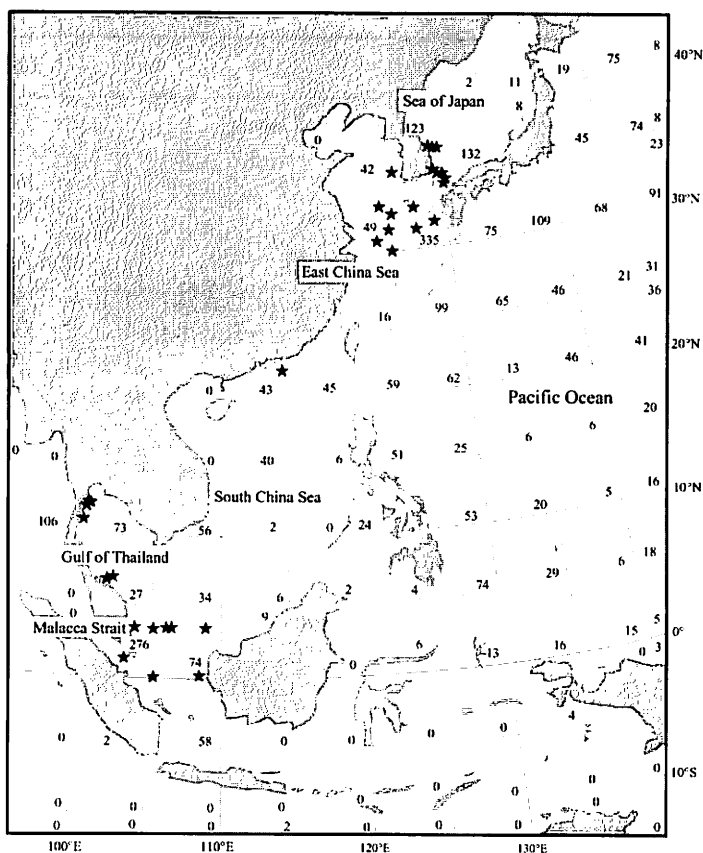


Fig. 1. Distribution of the CSK International Zooplankton Samples. Numbers on the map indicate the number of CSK International Zooplankton samples collected from each 5° latitude and longitude square based on Kubota (1993). In addition to the samples shown in the figure, 50 samples were collected from an area east of the map. Symbols “★” indicate stations where the caprellid amphipods were collected.

viduals were collected from 20 samples with dominance by genera belonging to the Caprellidae, i.e., *Aciconula* sp. 1. (Fig. 2) and *Paracaprella* cf. *alarta* Mayer, 1903, although no particular pattern of seasonal fluctuations was observed. According to the data sheets (Chung 1974, 1977a, b), the sampling method at this station was a horizontal surface tow of 30 min in duration. The influence of the collecting method on the perceived caprellid assemblage is unclear.

Most of the specimens from the tropical area have lost pereopods V to VII during the sampling and sorting procedure. These appendages are indispensable to the identification of them to the species level, and occasionally even to the genus level. This prevented us from being able to establish new taxa based on the present specimens. Lateral view of *Protogeton* cf. *inflatus* and *Aciconula* sp. 1. are shown in Fig. 2 in order to avoid future taxonomic confusion.

Discussion

The present study indicates that the type of planktonic caprellid assemblage in the Indo-Pacific region depends on the locality. The distribution of *Caprella*, the most dominant genus in the Caprellidea, is restricted to the temperate region. Irie (1959), based on a review of the planktonic gammarid and caprellid amphipods from waters adjacent to Japan, also reported that *Caprella* was dominant around 30–45°N and 125–135°E, overlapping with the occurrence of the genus reported in the present study. The dominance of *Caprella* in planktonic samples from the temperate region agrees well with a previous review on the biogeography of

Table 1. Species assemblage of the Caprellidea found in the CSK International Zooplankton Samples.

Species	Indiv.	Latitude/Longitude
East China Sea to the west of the Sea of Japan		
Family: Phtisicidae		
? <i>Paraproteo</i> sp. 1	7	30°00'–32°00'N/123°30'–125°00'E
? <i>Protomima</i> sp. 1	1	33°36'N/127°03'E
Family: Caprellidae		
<i>Caprella equilibra</i> Say, 1818	16	32°00'–37°54'N/125°36'–130°31'E
<i>Caprella</i> sp. 1	1	35°51'N/126°15'E
<i>Caprella</i> sp. 2	1	33°24'N/124°36'E
Damaged individual	1	34°09'N/130°40'E
Total	27	
South China Sea to the Gulf of Thailand		
Family: Phtisicidae		
<i>Protogeton</i> cf. <i>inflatus</i> Mayer, 1903	15	0°00'–11°30'N/99°50'–108°37'E
? <i>Metaproteo</i> sp.	2	3°13'–0°12'N/104°30'–108°37'E
? <i>Protomima</i> sp. 2	1	11°30'N/99°50'E
Family: Caprellidae		
<i>Propodalirius insolitus</i> Mayer, 1903	3	12°15'–12°25'N/100°00'–100°05'E
<i>Aciconula</i> sp. 2	1	22°10'N/115°50'E
Total	22	
Malacca Strait		
Family: Phtisicidae		
? <i>Protomima</i> sp. 3	2	1°13'N/103°50'E
Family: Caprellidae		
<i>Aciconula</i> sp. 1	8	1°13'N/103°50'E
<i>Paracaprella</i> cf. <i>alarta</i> Mayer, 1903	4	1°13'N/103°50'E
? <i>Monoliropus</i> sp. 2	3	1°13'N/103°50'E
<i>Metaprotella sandalensis</i> Mayer, 1898	1	1°13'N/103°50'E
? <i>Monoliropus</i> sp. 1	1	1°13'N/103°50'E
? <i>Protella</i> sp. 1	1	1°13'N/103°50'E
Damaged individual	1	1°13'N/103°50'E
Total	21	

caprellid amphipods on the global scale (McCain & Steinberg 1970).

Caprella equilibra, the dominant species in the temperate region (Table 1), is a cosmopolitan species, recorded from temperate regions throughout the world (e.g. McCain & Steinberg 1970; Arimoto 1976; Takeuchi 1995b). In the North Pacific, this species is usually associated with artificial constructions such as aquaculture nets, water duct pipes of power plants, and floating docks (e.g. Sakaguchi 1979; Hong 1988; Takeuchi 1995b), and is less dominant in *Sargassum* communities (e.g. Hirayama & Kikuchi 1980; Imada et al. 1981; Takeuchi 1992, 1995a) and *Zostera* communities (e.g. Kikuchi 1968; Takeuchi & Hino 1997). IT, the senior author, has observed that *Caprella* spp. inhabiting the *Sargassum* communities swim to the sea bed, if the *Sargassum* spp. become detached from the substratum and start to float towards the surface. The dominance of *C. equilibra* in the planktonic samples indicates the possibility that *C. equilibra* has a greater tolerance for longer periods of planktonic dispersal than other caprellid species.

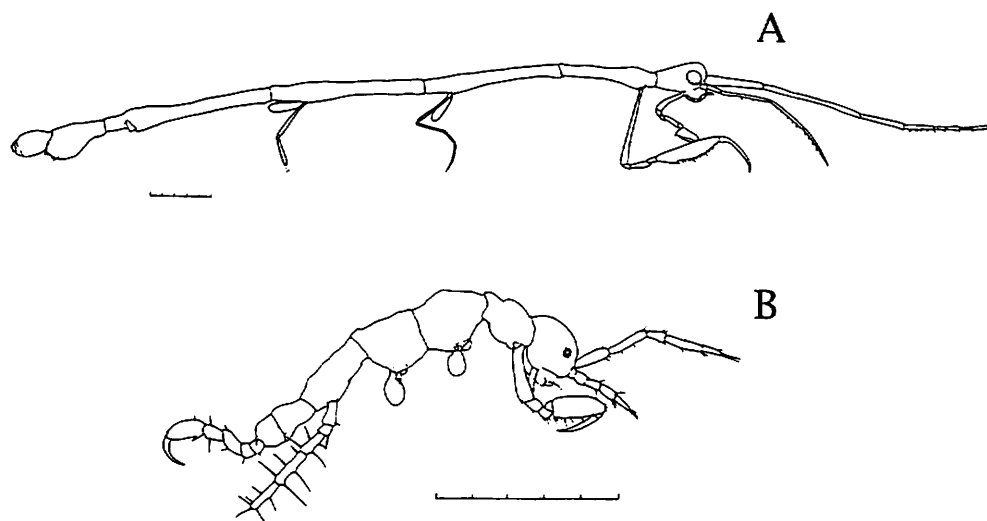


Fig. 2. Lateral view of two species of Caprellidea. **A.** *Protogeton* cf. *inflatus* Mayer, mature male from the Gulf of Thailand, 11°30.0'N, 99°50.0'E, on 9 March 1971. **B.** *Aciconula* sp. 1, immature female from Sister's Island, the Malacca Strait, 01°12.9'N, 103°49.8'E, on 2 May 1969. Bars indicate 0.5 mm.

Difficulties in identification of the present specimens from the tropical region may be partly because previous descriptions on the Caprellidea in this region have not been sufficient for complete positive identification. Laubitz (1991) recorded 17 species based on only 85 specimens collected during French Oceanographic Expeditions to the western Pacific: Philippines, Indonesia and New Caledonia. She also mentioned that knowledge of the caprellid species in these regions remained sparse because of the small number of specimens available for analysis. The present study, as with that of Laubitz (1991), illustrates the necessity for detailed surveys on the Caprellidea inhabiting the various substrata in this region.

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Literature Cited

- Aoki, M. & T. Kikuchi 1995. Notes on *Caprella andreae* Mayer, 1890 (Crustacea, Amphipoda) from the carapace of loggerhead sea turtles in the East China Sea and in Kyushu, Japan. *Proc. Jpn. Soc. Syst. Zool.* **53**: 54–61.
- Arimoto, I. 1976. Taxonomic studies of caprellids (Crustacea, Amphipoda, Caprellidae) found in the Japanese and adjacent waters. *Spec. Publ. Seto Mar. Biol. Lab.* Ser. III: i–v+1–229.
- Caine, E.A. 1978. Habitat adaptations of North American caprellid Amphipoda (Crustacea). *Biol. Bull.* **155**: 288–296.
- Chung, S.-H. 1974. *C.S.K. Zooplankton Data Report. No. 4.* Singapore University Press, Singapore, 361 pp.
- Chung, S.-H. 1977a. *C.S.K. Zooplankton Data Report. No. 5.* Singapore University Press, Singapore, 321 pp.

- Chung, S.-H. 1977b. *C.S.K. Zooplankton Data Report. No. 6*. Singapore University Press, Singapore, 253 pp.
- Chung, S.-H. 1977c. *C.S.K. Zooplankton Data Report. No. 7*. Singapore University Press, Singapore, 308 pp.
- Chung, S.-H. 1977d. *C.S.K. Zooplankton Data Report. No. 8*. Singapore University Press, Singapore, 332 pp.
- Hirayama, A. & T. Kikuchi 1980. Caprellid fauna associated with subtidal algal beds along the coast of the Oshika Peninsula, Tohoku District. *Publ. Amakusa Mar. Biol. Lab.* 5: 171–188.
- Hong, J.-S. 1988. Amphipod crustaceans as fouling organisms in Tungnyang Bay, Korea. *Mar. Fouling* 7: 1–7.
- Imada, K., A. Hirayama, S. Nojima & T. Kikuchi 1981. The microdistribution of phytal amphipods on *Sargassum* seaweeds. *Res. Crust.* (11): 124–137. (In Japanese with English abstract.)
- Irie, H. 1959. Studies on pelagic amphipods in the adjacent seas of Japan. *Bull. Fac. Fish., Nagasaki Univ.* (8): 20–42.
- Kikuchi, T. 1968. Faunal list of the *Zostera marina* belt in Tomioka Bay, Amakusa, Kyushu. *Publ. Amakusa Mar. Biol. Lab.* 1: 163–192.
- Kubota, T. 1993. CSK International Zooplankton Specimens available for study. *Bull. Plankton Soc. Jpn* 40: 76–79.
- Laubitz, D. R. 1991. Crustacea Amphipoda Caprellidea: Caprellids from the western Pacific (New Caledonia, Indonesia and the Philippines). In: Crosnier, A., (ed.) Résultats des Campagnes MUSORSTOM, Volume 9. *Mém. Mus natn. Hist. Nat., (A)* 152: 101–123.
- McCain, J. C. 1968. The Caprellidae (Crustacea: Amphipoda) of the western North Atlantic. *U.S. Nat. Mus. Bull.* 278: i–vi+1–147.
- McCain, J. C. & J. E. Steinberg 1970. Amphipoda I. Caprellidea I. Fam. Caprellidae. *Crustaceorum Catalogus* 2: 1–78.
- Motoda, S. 1980. CSK International Zooplankton Collection. *Bull. Plankton Soc. Jpn* 27: 41–45.
- Sakaguchi, M. 1979. Caprellids associated with buoys. *Hyogo Biol.* 7: 235–238. (In Japanese.)
- Takeuchi, I. 1992. Distribution of epifaunal caprellids (Crustacea: Amphipoda) in the *Sargassum* zone—Influence of wave exposure on the habitat segregation. *Kaiyo Monthly* 24: 470–475. (In Japanese.)
- Takeuchi, I. 1995a. Caprellid amphipods inhabiting *Sargassum* zone in Otsuchi Bay, northern Japan, with emphasis on species diversity and biomass (Abstract). *Otsuchi Mar. Res. Ctr Rep.*, (20): 90. (In Japanese.)
- Takeuchi, I. 1995b. Suborder Caprellidea, p. 193–205. In (ed. Nishimura, S.) *Guide to Seashore Animals of Japan with Color Picture and Keys. Vol. II*. Hoikusha, Osaka. (In Japanese.)
- Takeuchi, I. & A. Hino 1997. Community structure of caprellid Amphipoda (Crustacea) on seagrasses in Otsuchi Bay, northeastern Japan, with reference of the association of *Caprella japonica* (Schurin) and *Phyllospadix iwatensis* Makino. *Fish. Sci.* 63: 327–331.
- Takeuchi, I. & R. Hirano 1992. Duration and size of embryos in epifaunal amphipods *Caprella danilevskii* Czerniavski and *C. okadai* Arimoto (Crustacea: Amphipoda: Caprellidea). *J. Exp. Mar. Biol. Ecol.* 164: 161–169.
- Takeuchi, I. & R. Hirano 1995. Clinging behavior of the caprellid Amphipoda (Crustacea) in the *Sargassum* zone on the Pacific coast of Japan, with its evolutionary implications. *J. Crust. Biol.* 15: 481–492.
- Tham, A. K. 1972. *C.S.K. Zooplankton Data Report. No. 1*. Singapore University Press, Singapore, 315 pp.
- Tham, A. K. 1973a. *C.S.K. Zooplankton Data Report. No. 2*. Singapore University Press, Singapore, 190 pp.
- Tham, A.K. 1973b. *C.S.K. Zooplankton Data Report. No. 3*. Singapore University Press, Singapore, 274 pp.
- Utinomi, H. 1968. Epibenthic or planktonic caprellids from the environs of Tanabe Bay (Amphipoda: Caprellidae). *Publ. Seto Mar. Biol. Lab.* 26: 281–289.
- Wadachi, K. (ed.) 1987. *Encyclopedia of Oceanography*. Tokyo-do-shuppan, Tokyo, 589 pp. (In Japanese.)