

# Association of *Caprella fimbrillata* Vassilenko, 1993 (Crustacea: Malacostraca: Amphipoda) with the deep-sea holothurian *Scotoplanes globosa* (Théel, 1879) in the bathyal zone off Tohoku District, northern Japan

ICHIRO TAKEUCHI<sup>1,2,\*</sup>, MOMOKO SHIRAISHI<sup>3</sup> & DHUGAL LINDSAY<sup>4</sup>

<sup>1</sup> Graduate School of Agriculture, Ehime University, 3–5–7 Tarumi, Matsuyama, Ehime 790–8566, Japan

<sup>2</sup> Center of Advanced Technology for the Environment, Graduate School of Agriculture, Ehime University, 3–5–7 Tarumi, Matsuyama, Ehime 790–8566, Japan

<sup>3</sup> Faculty of Agriculture, Ehime University, 3–5–7 Tarumi, Matsuyama, Ehime 790–8566, Japan

<sup>4</sup> Institute for Extra-cutting-edge Science and Technology Avant-garde Research (X-STAR), Japan Agency for Marine-Earth Science and Technology (JAMSTEC), 2–15 Natsushima-cho, Yokosuka, Kanagawa 237–0061, Japan

Received 3 February 2023; Accepted 4 August 2023 Responsible Editor: Fumio Takeshita

doi: 10.3800/pbr.18.190

**Abstract:** During an ROV *Hyper-Dolphin* dive to bathyal depths in the Kamaishi Marine Canyon, off Tohoku District, the north Pacific, the association of a large specimen of *Caprella* (Crustacea: Malacostraca: Amphipoda) was observed, surrounded by juveniles, clinging to the dorsal tube feet of the deep-sea holothurian *Scotoplanes globosa* (Théel, 1879) at 1142 m depth. *Scotoplanes globosa* “walks” on the seafloor using long tube-like limbs extending from its body. The present observation indicated that “walking” deep-sea holothurians are an underrated substrate for *Caprella* spp. in the bathyal depths. Approximately 25 juveniles were collected with the mature female specimen from the same holothurian. These individuals were identified as *Caprella fimbrillata* Vassilenko, 1993 which has previously been reported from the eastern seaboard of Etorofu/Iturup Island, Chishima/Kuril Islands, in 605 to 1200 m water depth; these sites are located approximately 600 km northeast from the present site off Tohoku in the northwest Pacific. The mature female was closely surrounded by juveniles on the same deep-sea holothurian, suggesting maternal care by the mother caprellid in the bathyal depth environment.

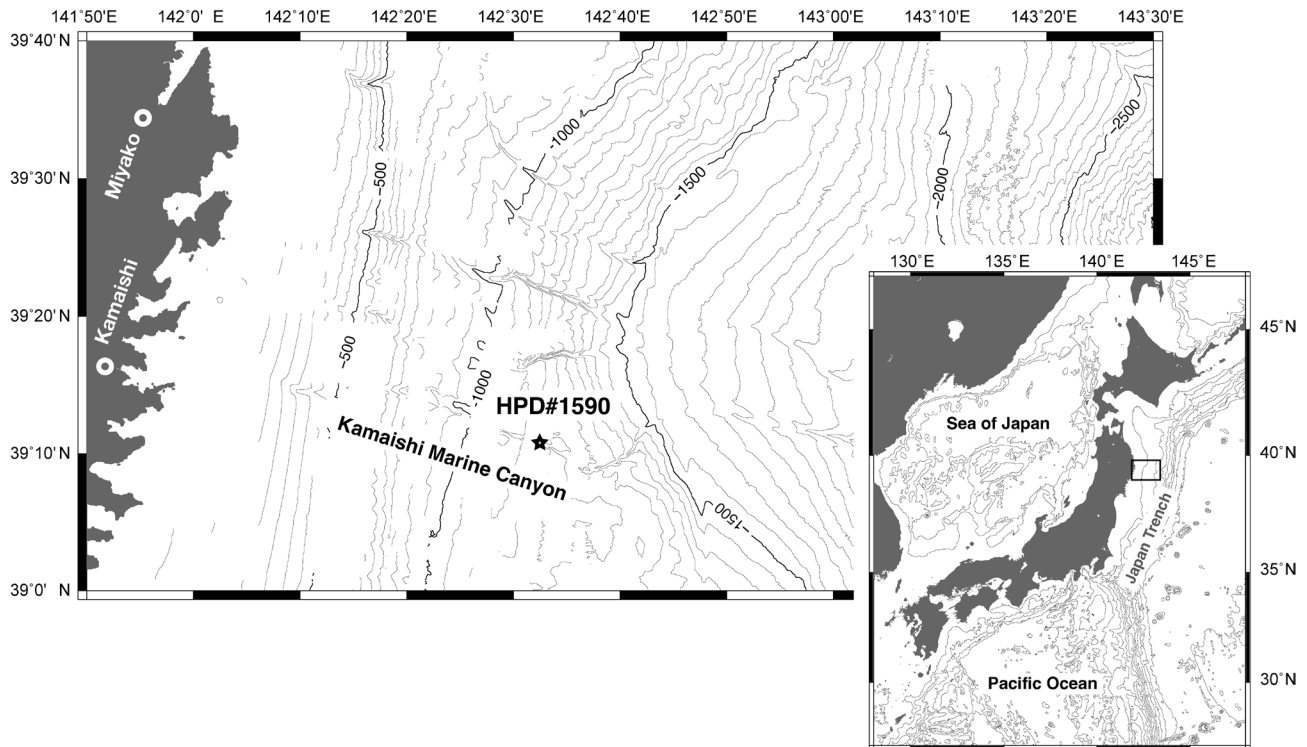
**Key words:** Amphipoda, bathyal depth, *Caprella*, deep-sea holothurian, maternal care

## Introduction

While 9389 species had so far been registered in the Amphipoda (Crustacea) by 2022 in WoRMS (World Register of Marine Species) (WoRMS 2023b), 2004 species were described after 2001 (WoRMS 2023b). Of these, the genus *Caprella* is listed as one of the five most species-rich genera in the Amphipoda (Arfianti et al. 2018). One hundred and eighty six species were listed for *Caprella* in WoRMS at the end of January 2023 (Horton et al. 2023). *Caprella* spp. mostly inhabit the algal communities, on buoys, ropes and related artificial materials in ports or aquacul-

ture facilities in brackish to marine shallow water ecosystems (see Arimoto 1976, Takeuchi et al. 2001, 2003, Woods 2009, Guerra-García et al. 2013, Yamauchi & Mori 2013). The generic morphological feature of *Caprella* is that they have evolved reduced pereopods 3 and 4, abdominal segments and appendages on the abdomen (Takeuchi 1993). While more than 70 species of *Caprella* have been recorded from Japan and adjacent waters (McCain & Steinberg 1970, Arimoto 1976, Takeuchi 1999, Guerra-García & García-Gomez 2003, Aoki & Ito 2012, Takeuchi & Oyamada 2013, Takeuchi et al. 2019, 2021), fewer than 10 species have been recorded from deep waters, at depths greater than 300 m, off central Japan and adjacent areas in the north-western Pacific (Arimoto 1934, 1976, Takeuchi et al. 1989, 2019, 2021, Guerra-García & García-Gomez

\*Corresponding author: Ichiro Takeuchi; E-mail, takeuchi@agr.ehime-u.ac.jp



**Fig. 1.** Map showing the collection site of *Caprella fimbrillata* Vassilenko, 1993 off the Tohoku District, northern Japan in the North-west Pacific. The asterisk denotes the sampling site for ROV dive HPD#1590 in the Kamaishi Marine Canyon.

2003, Lindsay & Takeuchi 2008).

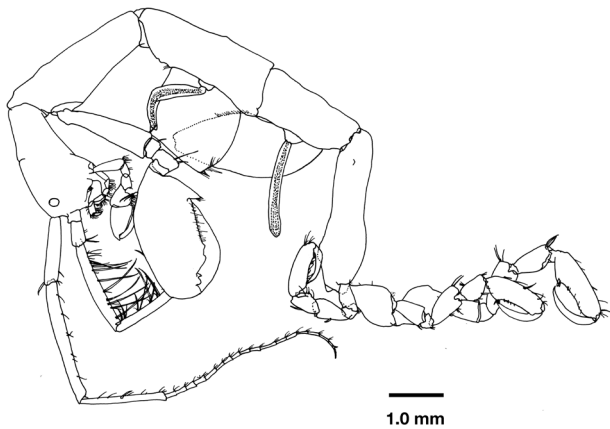
During the 2011 Tohoku earthquake and tsunami, large amounts of debris were washed into the ocean and several research cruises were subsequently carried out to assess the state of the deep-sea ecosystem off the Tohoku District, northern Japan in the northwest Pacific. During Leg 1 of cruise NT13-21 of the R/V *Natsushima* (October 6 to 19, 2013), twenty-one Remotely-Operated Vehicle (ROV) *Hyper-Dolphin* dives were conducted to understand the influence of the 2011 Tohoku earthquake on the deep-sea ecosystem off Kesenuma, Miyagi Prefecture to Miyako, Iwate Prefecture located north of the seismic center of the 2011 Tohoku earthquake (JAMSTEC 2013). On one of these dives in the Kamaishi Marine Canyon, the attachment of caprellid amphipods to a deep-sea holothurian was observed and the corresponding individuals were collected. The specimens collected during that cruise are identified as *Caprella fimbrillata* Vassilenko, 1993 known from bathyal depths east of Etorofu/Iturup Island in the Chishima/Kuril Islands. A detailed description with figures is presented in the present paper. The behaviour and aggregation of juveniles near the mother caprellid on the deep-sea holothurian of the present species was also noted in this paper.

### Materials and Methods

During leg 1 of Cruise NT13-21 of the R/V *Natsushima*, a series of ROV *Hyper-Dolphin* dives (dive #1579–1590)

were conducted off the Tohoku District between October 6 to 19, 2013 (JAMSTEC 2013). The attachment of *Caprella* individuals to the deep-sea holothurian *Scotoplanes globosa* (Théel, 1879) was discovered at 1142 m depth during the last dive in the Kamaishi Marine Canyon (#1590). The deep-sea holothurian with caprellids was first sighted at 15:29 and observed using an ultrahigh-sensitivity high-definition television (HDTV) camera recording onto HDCAM videotapes (Sony Corporation, Minato-ku, Tokyo, Japan) located in the ROV control van. The camera zoomed in on the holothurian at 15:31, making the attached caprellids easily visible, and after approximately one minute of zoomed-in in-situ recording, the deep-sea holothurian with caprellids was successfully collected at 15:44 by gently suctioning it into the tube of a suction sampler (slurp gun) and then transferring it into a lidded sample box using one of the manipulator arms of the ROV *Hyper-Dolphin* before closing the lid for retrieval. The caprellid specimens on the host holothurian were photographed by Dr. Yoshihiro Fujiwara in the darkroom space of the R/V *Natsushima* using a digital SLR camera (Olympus OM-D E-M1 with LUMIX G VARIO 12–35/F2.8 lens; Olympus Imaging Corp., Shinjuku-ku, Tokyo, Japan) at 4608 × 3456 pixel resolution and fixed in a 5% formalin-seawater solution for taxonomic study.

In the land laboratory, the attachment of caprellids to the deep-sea holothurian was again photographed using a digital SLR camera (Canon EOS Mark III with EF100 mm f/2.8 L Macro IS USM lens; Canon Inc., Ohta-ku, Tokyo,



**Fig. 2.** *Caprella fimbrillata* Vassilenko, 1993 mature female, 14.79 mm body length, collected from the Kamaishi Submarine Canyon (1142 m depth) off the Tohoku District, northern Japan.

Japan) at  $5760 \times 3840$  pixel resolution. After that, all caprellid specimens were carefully sorted out from the deep-sea holothurian and the formalin-seawater solution in the plastic bag for further study. Sexes of the specimens were determined under a binocular microscope (Olympus SZH, Olympus Corporation, Shinjuku-ku, Tokyo, Japan) according to Takeuchi & Hirano (1991). The body length (BL) of all collected individuals was measured under a microscope (Olympus BX60, Olympus Corporation) equipped with a *camera lucida*. The mouthpart and pereopods 5 to 7 of the largest individual were dissected under the same binocular microscope. The lateral body, antenna 1 and 2, dissected mouth parts, gnathopod 2, and dissected pereopods 5 to 7 of the largest individual were drawn under the same microscope. According to the method described by Takeuchi (2015), figure plates were compiled following the methodology of combining hand-inked sketches with digital inking using Adobe Photoshop CS6 and 2023 (Adobe Systems Incorporated, San Jose, CA, USA). The lateral body views of three smaller specimens were also drawn.

### Taxonomy

Order **AMPHIPODA** Latreille, 1816

Family **Caprellidae** Leach, 1814

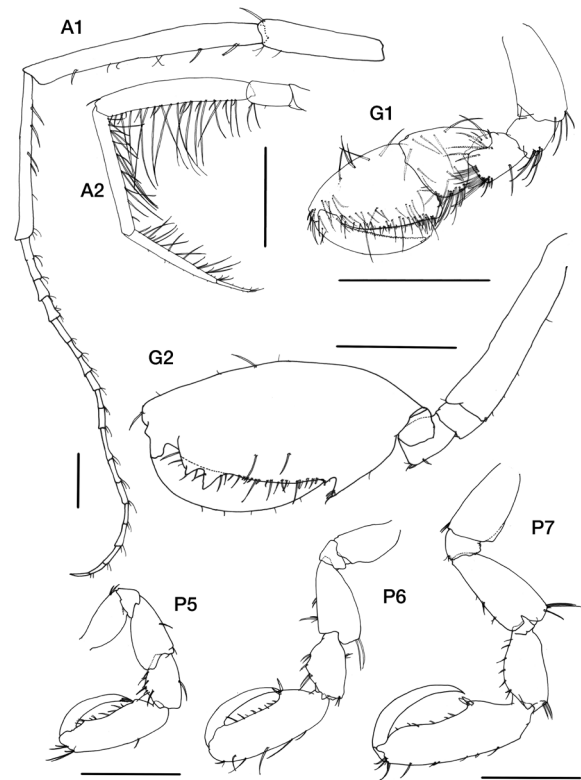
Genus **Caprella** Lamarck, 1801

### *Caprella fimbrillata* Vassilenko, 1993 (Figs 2–4)

*Caprella fimbrillata* Vassilenko, 1993, 140–145, figs. 4–6.

Material studied. 1 mature female,  $39^{\circ}10.367'N$   $142^{\circ}33.270'E$ , 1142 m depth, 18 Oct 2013, R/V *Natsushima*, NT-13-21, HPD #1590, on the deep-sea holothurian *Scotoplanes globosa* (Théel, 1879), coll. Yoshihiro Fujiwara.

*Mature female*, body length, 14.79 mm, Head, 1.28 mm; pereonite 1, 0.79 mm; pereonite 2, 2.73 mm; pereonite 3, 2.85 mm; pereonite 4, 2.16 mm; pereonite 5, 3.06 mm; pe-



**Fig. 3.** *Caprella fimbrillata* Vassilenko, 1993 mature female, 14.79 mm body length, collected from the Kamaishi Submarine Canyon (1142 m depth) off the Tohoku District, northern Japan. A, antenna; G, gnathopod; P, pereopod. Scale bar: 1.0 mm.

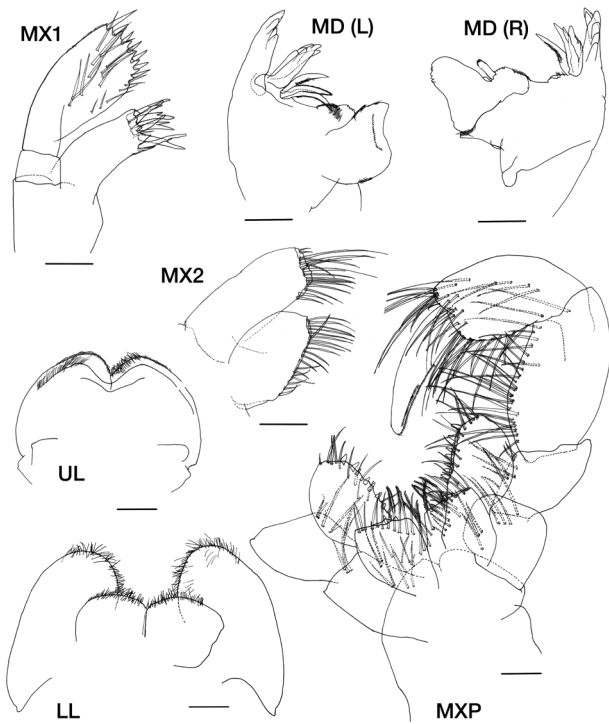
reonite 6, 0.96 mm; pereonite 7, 0.96 mm. Pereonite 5 longest followed by pereonite 3.

Head without distinct projection; eye distinctive. Pereonite 3 with shallow mid-dorsal projection. Pereonite 5 with shallow antero-lateral projection.

*Antenna 1* slender,  $0.65 \times$  body length; peduncle article 2 longest; peduncle article 3 straight,  $0.70 \times$  peduncle article 2 length; flagellum  $0.80 \times$  peduncular length, with 17 articles, proximal article composed of 2 articles. *Antenna 2* slender;  $0.75 \times$  antenna 1 length; peduncle article 2 to flagellum article 1 with plumose setae (swimming setae).

Mouthparts. *Upper lip* width  $2.0 \times$  depth, setose on upper face. *Lower lip*, inner lobe, setose on upper face. *Mandible* right incisor with 5 teeth, lacinia mobilis with 2 teeth followed by 2 bundle of setae (1 missed during dissection), molar large and distinct with molar flake. Mandible left incisor with 5 teeth, lacinia mobilis with 5 teeth followed by 3 bundle setae, molar large and distinct. *Maxilla 1* outer plate with 7 stout apical setal-teeth; palp 2-articulate; article 2  $2.5 \times$  article 1 with 7 apical to lateral, setose on lateral part. *Maxilla 2* inner plate, oval, with approximately 25 setae; outer plate with approximately 20 apical setae. *Maxilliped* densely setose, outer plate (ischial endite)  $1.5 \times$  inner plate (basal endite); palp 4-articulate, article 2 longest, setose; dactylus falcate.

*Gnathopod 1*, setose. *Gnathopod 2* positions 0.10 from



**Fig. 4.** *Caprella fimbriata* Vassilenko, 1993, mature female, 14.79 mm body length, collected from the Kamaishi Submarine Canyon (1142 m depth) off the Tohoku District, northern Japan. LL, lower lip; MD, mandible, MX, maxilla; MXD, maxilliped; UL, upper lip; L, left; R, right. Scale bars: 0.10 mm.

along anterior margin of corresponding pereonite; coxa vestigial; basis  $0.70 \times$  length of pereonite 2, basis projection near distal margin; propodus ovate, large, length  $2.0 \times$  width; palm proximal projection with 1 robust (grasping) seta, palm margin convex, smooth, with midpalmar projection, with narrow sinus, with narrow distal shelf. *Gill 3* elongate,  $0.75 \times$  corresponding pereonite. *Gill 4* elongate,  $0.95 \times$  corresponding pereonite.

*Pereopod 5*, basis shorter than propodus; propodus with 1 pair of robust setae from approximately 0.2 palm length from articulation with carpus, with approximately 10 setae along palm; dactylus curved. *Pereopods 6–7* progressively longer than pereopod 5.

#### Distribution

Type locality: East of Etorofu/Iturup Island in the Chishima/Kuril Islands, Northwest Pacific,  $44^{\circ}48.5'N$   $149^{\circ}31'E$ , 1100–1200 m depth;  $44^{\circ}52'N$ ,  $149^{\circ}27.7'E$ , 910–920 m depth;  $44^{\circ}58'N$   $149^{\circ}21.8'E$  680 m depth;  $44^{\circ}58.2'N$ ,  $149^{\circ}19'E$ , 605–620 m depth.

Other locality: East of Kamaishi, Iwate Prefecture, Honshu Island, Northwest Pacific,  $39^{\circ}10.367'N$   $142^{\circ}33.270'E$ , 1142 m depth.

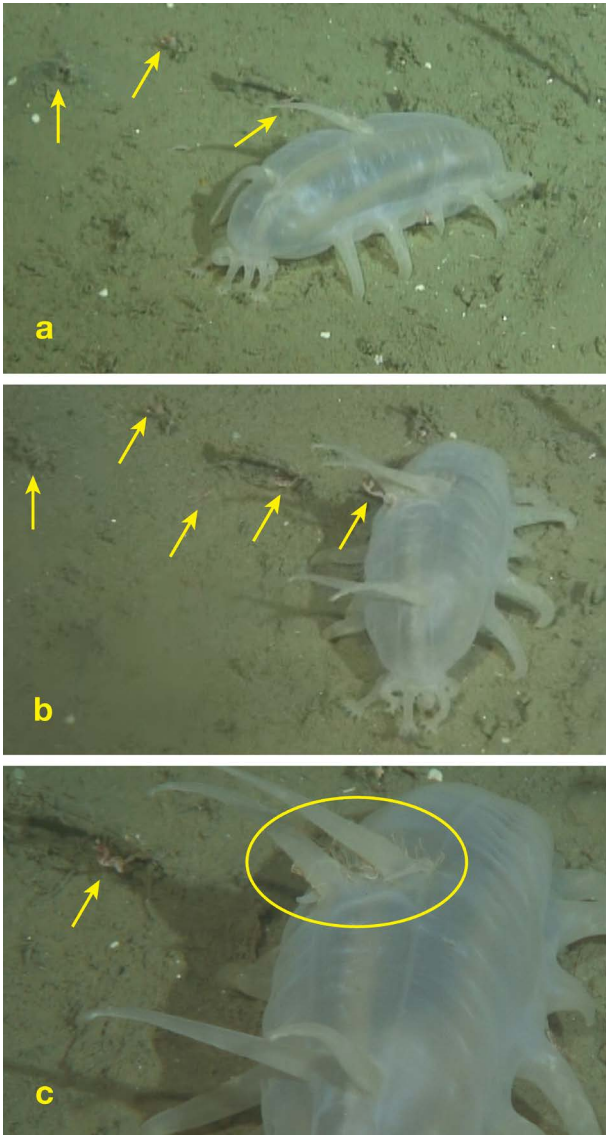
**Remarks.** Vassilenko (1993) reported 14 species of *Caprella* and related genera from the continental slope off the

east coast of the Chishima/Kuril Islands in the northwest Pacific. *Caprella fimbriata* was established based on specimens collected from a sandy to muddy bottom east of Etorofu/Iturup Island in the Chishima/Kuril Islands in 605–1200 m water depth (Vassilenko 1993). These collecting sites are located approximately 600 km northeast from the collection site of the present study. Vassilenko (1993) presented the description with figures of the holotype male of 40 mm in BL and a mature female of 20 mm in BL. Vassilenko (1993) mentioned several diagnostic characters including, 1) body segment smooth or with one pair of small dorsal spines on pereonites 2–5, 2) pereonites 2–5 are long and slender, 3) pereonite 5 longer than pereonite 4. While the presence of small dorsal spines on pereonites 2–5 were not clearly figured on the mature male, a small antero-lateral projection on pereonite 5 was figured on both male and female (Vassilenko 1993; Fig. 4 on 141 p.). The present specimens collected off Iwate Prefecture agree well with the figure of the mature female in Vassilenko (1993) by 1) antenna 1 longer than half of BL, 2) gnathopod 2 positioned along the anterior margin of pereonite 2, 3) smooth or with one pair of small dorsal projections on pereonites 2–5, 4) pereonite 5 longer than pereonite 4, and 5) presence of a small antero-lateral projection on pereonite 5.

**Ecology.** The use of remotely operated vehicles (ROVs), operated from research vessels, has helped unveil the unique ecology of deep-sea amphipods, including those associated with gelatinous microzooplankton (e.g., Lindsay & Pagès 2010, Lindsay et al. 2017, Hughes & Lindsay 2017) as well as benthic caprellid and phitiscid amphipods in the deep-sea benthopelagic zone (Lindsay & Takeuchi 2008, Takeuchi et al. 2016, 2021). For example, Lindsay & Takeuchi (2008) reported that *Caprella subtilis* Mayer, 1903 attached to the surface of the elpidiid holothurian *Ellipinion kumai* (Mitsukuri, 1912), which swam in an upright position above a muddy bottom at 309 m depth in Sagami Bay, central Japan. They suggested that pelagic/benthopelagic holothurians may be a previously underrated substrate for smaller benthic crustaceans.

The deep-sea holothurian *Scotoplanes globosa* is known to be distributed worldwide at bathyal and abyssal depths of the ocean, except for the North Atlantic (Thandar 1999, JAMSTEC 2023, WoRMS 2023a). Off Tohoku District, northern Japan in the northwest Pacific, *S. globosa* has been recorded from 754 to 6467 m depth (JAMSTEC 2023).

*Scotoplanes globosa* has a unique morphology with five-to-seven pairs of long, tube-like limbs extending from its body and the oversized tube feet helping it “walk” on the abyssal seafloor (Hansen 1972). Congregations of this species have been observed, usually in groups of 10–30 individuals but sometimes numbering in the hundreds (Smith & Hamilton 1983). During ROV *Hyper-Dolphin* dive #1590 during leg 1 of cruise NT13–21, the large specimen of *Caprella fimbriata* was observed, surrounded



**Fig. 5.** Photograph of the deep-sea holothurian *Scotoplanes globosa* (Théel, 1879) with *Caprella fimbriata* Vassilenko, 1993 attached to it, at the Kamaishi Submarine Canyon (1142 m depth) off the Tohoku District, northern Japan. Arrows indicate the individual of *C. fimbriata*. The circle in (c) indicates the aggregation of juveniles of *C. fimbriata*.

by juveniles, and clinging to the dorsal tube feet of the deep-sea holothurian (9.5 cm in BL and 5.5 cm in width by measurement after preservation) on the muddy bottom at 1134 m depth (Fig. 5). The temperature and salinity at the collecting site were 2.6°C and 34.22, respectively. Careful observations of the video recording during the dive confirmed juveniles clustered around the mother on the surface of the holothurian and at least four other adult individuals of probably the same species of *Caprella* occurring mainly on the muddy bottom near the deep-sea holothurian (Fig. 5). Our observation indicated that, the same as with the pelagic/benthopelagic elpidiid holothurian (Lindsay & Takeuchi 2008), “walking” deep-sea holothurians are also a



**Fig. 6.** Photograph of *Caprella fimbriata* Vassilenko, 1993 attached to the deep-sea holothurian *Scotoplanes globosa* (Théel, 1879), taken on the live material after collection.

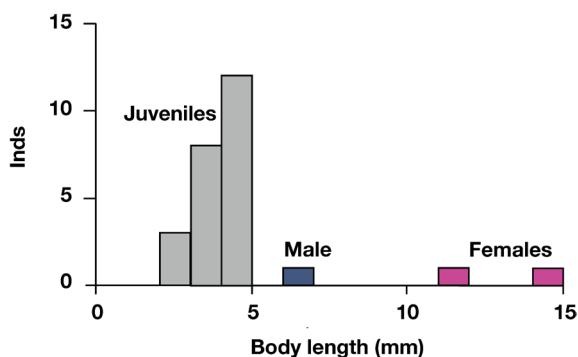


**Fig. 7.** Photograph of *Caprella fimbriata* Vassilenko, 1993 attached to the deep-sea holothurian *Scotoplanes globosa* (Théel, 1879), taken in the laboratory after preservation.

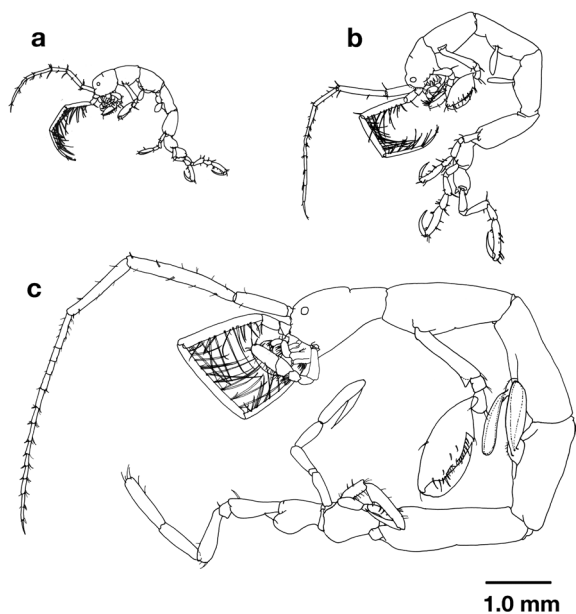
previously underrated substrate for *Caprella* spp. at bathyal depths.

Images taken after the collection on live animals show that the natural colour of *C. fimbriata* was pale orange except for vivid orange in the mouth parts and surrounding parts (Fig. 6). Images taken after preservation show that the large specimen clung to the mid-dorsal tube feet of the deep-sea holothurian by pereopods 6 to 7 in an “upright” behaviour (Takeuchi & Hirano 1995) (Fig. 7). The dense feather-like plumose setae on antenna 2 and “upright” behaviour suggest that *Caprella fimbriata* filters suspended materials from the surrounding water (Caine 1977, Takeuchi & Hirano 1995). Suspended materials are probably generated by the movement of the deep-sea holothurian along the muddy bottom, through genital products and/or through faeces being excreted.

In total, 26 specimens were collected from the surface of the deep-sea holothurian and the plastic bag in which the deep-sea holothurian was stored (Figs. 8, 9). Of these,



**Fig. 8.** Size distribution of *Caprella fimbrillata* Vassilenko, 1993 attached to the deep-sea holothurian *Scotoplanes globosa* (Théel, 1879) at the Kamaishi Submarine Canyon (1142 m depth) off the Tohoku District, northern Japan.



**Fig. 9.** *Caprella fimbrillata* Vassilenko, 1993, a, juvenile, 2.82 mm body length; b, male, 6.04 mm body length; c, immature female, 11.88 mm body length, collected in the Kamaishi Submarine Canyon (1142 m depth) off the Tohoku District, northern Japan.

larger specimens were only three of the individuals, a mature female of 14.79 mm in BL, an immature female (11.88 mm in BL) and a small male (6.04 mm in BL). The other 23 specimens were juveniles of less than 5.00 mm in BL with four to six being the number of flagella of antenna 1. The mean fecundity of *Caprella* spp. during one spawning event has been reported as less than approximately 100 (Takeuchi & Hirano 1992b, Aoki 1997, Hosono 2009, Nuñez Valazques et al. 2017). The number of embryos per female of *C. mutica* Shurin, 1935 in a 9.96 (maximum–minimum: 7.02–12.56) mm BL has been reported as 35.6 (maximum–minimum: 3–140) (Hosono 2009). The number of juveniles attached to maternal females of *C. monoceros* Mayer, 1890 of 12.1 to 15.3 mm BL has been recorded as

53 to 103 (Aoki 1997). The number of flagella of antenna 1 increases during growth in *Caprella* spp. (Takeuchi & Hirano 1991, 1992a). The number increases from two in newborn juveniles to four in instar 3 in *C. danilevskii* Czerniawski, 1868 (Takeuchi & Hirano 1991). Thus, these small individuals were considered to belong to a single clutch of juveniles born from the same mother caprellid—probably the described mature female.

Approximately 35 species of Amphipoda have been reported to show extended parental care for fully developed juvenile offspring (Thiel 2003). While in the genus *Caprella*, the juveniles immediately disperse to the substratum of seaweed thalli or hydroid branches after their emergence from the brood pouch of the mother (Takeuchi & Hirano 1991, 1992a), maternal care for juveniles has been reported for several species inhabiting shallow water ecosystems (Lim & Alexander 1986, Aoki & Kikuchi 1991, Aoki 1997, Thiel 2003). Juveniles of *C. monoceros* attached to the surface of their mother and molted at least four times there before dispersal (Aoki & Kikuchi 1991). While the newly born juveniles of *C. scaura* Templeton, 1836 have been reported to often detach from the surface of their mother and move onto nearby red alga substrata, the juveniles always stayed on or around the mother caprellid and never dispersed over a one week-observation period (Aoki 1997). Juveniles of *C. decipiens* Mayer, 1890 immediately moved to the substratum after hatching, but stayed around the mother for around 30 days (Aoki & Kikuchi 1991). Thus, the co-occurrence of a mature female with a large number of juveniles on the same deep-sea holothurian suggests that *C. fimbrillata* possesses some kind of maternal care behavior, like in *C. scaura* or *C. decipiens*, in this bathyal depth environment.

### Acknowledgements

The authors would like to express their appreciation to the science crew of Leg 1 of Cruise NT13–21, the operations team of the ROV “*Hyper-Dolphin*”, and to the captain and crew of the Research Vessel “*Natsushima*” for enabling the videotaping and capture of the organisms recorded in the present paper. The authors also wish to thank Dr. Yoshihiro Fujiwara for providing photographs of the fresh material and Dr. Kazumasa Oguri for his assistance in preparing Figure 1. This study is a contribution to the Deep Ocean Stewardship Initiative (DOSI) and Challenger150 program.

### References

- Aoki M (1997) Comparative study of mother-young association in caprellid amphipods: is maternal care effective? *J Crust Biol* 17: 447–458.
- Aoki M, Ito T (2012) *Caprella takedai*, a new species of caprellid amphipod from off Ito, the east coast of Izu Peninsula, Shizuoka, Japan. In: *Studies on Eumalacostraca: a homage*

- to Masatsune Takeda (eds Komatsu H, Okuno J, Fukuoka K). *Crustaceana Monographs* 17: 63–69.
- Aoki M, Kikuchi T (1991) Two types of maternal care for juveniles observed in *Caprella monoceros* Mayer, 1890 and *Caprella decipiens* Mayer, 1890 (Amphipoda: Caprellidae). *Hydrobiologia* 223: 229–237.
- Arfianti T, Wilson S, Costello MJ (2018) Progress in the discovery of amphipod crustaceans. *PeerJ* 6: e5187 <https://doi.org/10.7717/peerj.5187>
- Arimoto I (1934) Caprellidae (Crustacea) collected by T/S “Soyomaru”, Fisheries Training Institute, Ministry of Agriculture and Forestry. *Dobutsugaku-zasshi* (Zoological Magazine, Tokyo) 46 (553): 494–509.
- Arimoto I (1976) Taxonomic studies of caprellids (Crustacea, Amphipoda, Caprellidae) found in the Japanese and adjacent waters. *Spec Publ Seto Mar Biol Lab Kyoto Univ* 3: i-v + 1–229.
- Caine EA (1977) Feeding mechanisms and possible resource partitioning of the Caprellidae (Crustacea: Amphipoda) from Puget Sound, U.S.A. *Mar Biol* 42: 331–336.
- Guerra-García JM, García-Gómez JC (2003) A new species of *Caprella* (Amphipoda, Caprellidae) from deep waters. *Crustaceana* 76: 581–590.
- Guerra-García JM, Navarro-Barranco C, Corzo J, Cobos-Muñoz V, García-Adiego EM, Giménez FS, García-Gómez C (2013) An illustrated key to the soft-bottom caprellids (Crustacea: Amphipoda) of the Iberian Peninsula and remarks to their ecological distribution along the Andalusian coast. *Helgol Mar Res* 67: 321–336.
- Hansen B (1972) Photographic evidence of a unique type of walking in deep-sea holothurians. *Deep Sea Res Oceanogr Abstr* 19: 461–462, IN3.
- Horton T, Lowry J, De Broyer C, Bellan-Santini D, Coleman CO, Corbari L, Costello MJ, Daneliya M, Dauvin J-C, Fišer C, Gasca R, Grabowski M, Guerra-García JM, Hendrycks E, Hughes L, Jaume D, Jazdzewski K, Kim Y-H, King R, Krapp-Schickel T, LeCroy S, Lörz A-N, Mamos T, Senna AR, Serejo C, Sket B, Souza-Filho JF, Tandberg AH, Thomas JD, Thurston M, Vader W, Väinölä R, Vonk R, White K, Zeidler W (2023) World Amphipoda Database. *Caprella* Lamarck, 1801. Accessed through: World Register of Marine Species. Available at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=101430> (accessed on 31 Jan 2023)
- Hosono T (2009) Effect of temperature on the duration of reproductive cycles of female *Caprella mutica* (Crustacea: Amphipoda) in the laboratory. *Mar Biodiv Rec* 2: e140.
- Hughes L, Lindsay DJ (2017) *Pseudocallisoma coecum* (Holmes, 1908) (Amphipoda, Scopelocheiridae) and *Lanceola clausi clausi* Bovallius, 1885 (Amphipoda, Lanceolidae) associated with *Poralia rufescens* Vanhöffen, 1902 (Scyphozoa, Ulmariidae). *Crustaceana* 90: 1303–1318.
- JAMSTEC (2013) Onboard Report of the ROV *Hyper-Dolphin 3000* Cruise off Tohoku (NT13-21LEG1). October 6–19, 2013. 41 pp.
- JAMSTEC (2023) BiSMaL. Biological Information System for Marine Life. *Scotoplanes globosa* Théel, 1879 Senjyu-Namako. Available at: <https://www.godac.jamstec.go.jp/bismal/jview/9000270> (accessed on 31 Jan 2023)
- Lim STA, Alexander CG (1986) Reproductive behaviour of the caprellid amphipod *Caprella scaura typica* Mayer, 1890. *Mar Behav Physiol* 12: 217–230.
- Lindsay DJ, Grossmann MM, Bentlage B, Collins AG, Minemizu R, Hopcroft RR, Miyake H, Hidaka-Umetsu M, Nishikawa J (2017) The perils of online biogeographic databases: A case study with the “monospecific” genus *Aegina* (Cnidaria, Hydrozoa, Narcomedusae). *Mar Biol Res* 13: 494–512.
- Lindsay DJ, Pagès F (2010) *Voragonema tatsunoko* (Trachymedusae: Rhopalonematidae), a new species of benthopelagic medusa, host to the hyperiid amphipod *Mimonectes spandli* (Physosomata: Mimonectidae). *Zootaxa* 2671: 31–39.
- Lindsay DJ, Takeuchi I (2008) Associations in the deep-sea benthopelagic zone: the caprellid crustacean *Caprella subtilis* (Amphipoda: Caprellidae) and the holothurian *Ellipinion kumai* (Elasipodida: Elpidiidae). *Sci Mar* 72: 519–526.
- McCain JC, Steinberg JE (1970) Amphipoda-1, Caprellidea-1. *Crustaceorum Catalogus* (eds Gruner HE, Holthuis LE) 2: 1–78.
- Núñez Velázquez S, Rumbold CE, Obenat SM (2017) Population dynamics of *Caprella dilatata* and *Caprella equilibra* (Peracarida: Amphipoda) in a Southwestern Atlantic harbour. *Mar Biol Res* 13: 888–898.
- Smith CR, Hamilton SC (1983) Epibenthic megafauna of a bathyal basin off southern California: patterns of abundance, biomass, and dispersion. *Deep Sea Res Part A Oceanogr Res Pap* 30: 907–928.
- Takeuchi I (1993) Is the Caprellidea a monophyletic group? *J Nat Hist* 27: 947–964.
- Takeuchi I (1999) Checklist and bibliography of the Caprellidea (Crustacea: Amphipoda) from Japanese waters. *Otsuchi Mar Sci* 24: 5–17.
- Takeuchi I (2015) A new species of *Paraproto* (Crustacea: Amphipoda: Phtisicidae) from South Shetland Islands, Antarctica. *Polar Sci* 9: 368–373.
- Takeuchi I, Hirano R (1991) Growth and reproduction of *Caprella danilevskii* (Crustacea: Amphipoda) reared in the laboratory. *Mar Biol* 110: 391–397.
- Takeuchi I, Hirano R (1992a) Growth and reproduction of the epifaunal amphipod *Caprella okadai* Arimoto (Crustacea: Amphipoda: Caprellidea). *J Exp Mar Biol Ecol* 161: 201–212.
- Takeuchi I, Hirano R (1992b) 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, Hirano R (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.
- Takeuchi I, Kihara M, Matsumoto AK (2019) A new species of *Caprella* (Crustacea: Amphipoda: Caprellidae) from the landward slope of the Japan Trench, North Pacific. *Plankton Benthos Res* 14: 124–130.
- Takeuchi I, Shiraishi M, Mimori R (2021) A new species of *Caprella* (Crustacea: Amphipoda: Caprellidae) collected from the gorgonian at 1497 m depth off Boso Peninsula, central Japan. *Species Diversity* 26: 225–233.
- Takeuchi I, Takeda M, Takeshida K (1989) Redescription of the

- bathyal caprellid, *Caprella unguolina* Mayer, 1903 (Crustacea, Amphipoda) from the North Pacific. Bull Nat Sci Mus Tokyo, Ser A (Zool) 15: 19–28.
- Takeuchi I, Tomikawa K, Lindsay D (2016) A new genus and species of Phtisicidae (Crustacea: Amphipoda) from abyssal depths in the Japan Trench, with special reference to similarities with Southern Ocean genera. J Crust Biol 36: 495–506.
- Takeuchi I, Matsumasa M, Kikuchi S (2003) Gill ultrastructure and salinity tolerance of *Caprella* spp. (Crustacea: Amphipoda: Caprellidea) inhabiting the *Sargassum* community. Fish Sci 69: 966–973.
- Takeuchi I, Oyamada A (2013) Description of two species of *Caprella* (Crustacea: Amphipoda: Caprellidae) from the North Pacific; *C. californica* Stimpson, 1857 and *C. scauroides* Mayer, 1903, with a new appraisal of species ranking for *C. scauroides*. Helgoland Mar Res 67: 371–381.
- Takeuchi I, Takahashi S, Tanabe S, Miyazaki N (2001) *Caprella* watch; a new approach for monitoring butyltin residues in the ocean. Mar Environ Res 52: 97–113.
- Thandar AS (1999) Deep-sea holothuroids taken by the R.V. *Africanana II* in 1959, from off the West Coast of the Cape Peninsula, South Africa. Ann S Afr Mus 105: 363–409.
- Thiel M (2003) Extended parental care in crustaceans—an update. Rev Chil de Hist Nat 76: 205–218.
- Vassilenko SV (1993) [Caprogammarids and caprellids (Amphipoda, Caprellidea) of the continental slope of the Kurile Islands]. Issledovaniya Fauny Morei 46: 130–155. (in Russian with English summary)
- Woods CMC (2009) Caprellid amphipods: an overlooked marine finfish aquaculture re- source? Aquaculture 289: 199–211.
- WoRMS (2023a) *Scotoplanes globosa* (Théel, 1879). Available at: <https://www.marinespecies.org/aphia.php?p=taxdetails&id=148773> (accessed on 31 Jan 2023)
- WoRMS (2023b) Statistics. Available at: <https://www.marinespecies.org/aphia.php?p=stats> (accessed on 5 May 2023)
- Yamauchi T, Mori A (2013) Record of the little-known skeleton shrimp *Caprella algaceus* (Amphipoda: Caprellidae) from a brackish lake, Nakaumi, western Honshu, Japan. Biogeography 15: 111–115.