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First record of the genus *Caprella* and species *Caprella danilevskii* Czerniavski, 1868 (Amphipoda: Corophiida: Caprellidae) from Arabian Sea, North Indian Ocean

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The genus *Caprella* (Amphipoda: Caprellidae) has been recorded from all over the world oceans, whereas the species *C. danilevskii* Czerniavski, 1868 was only limited to southern parts of the Indian Ocean. Here, the occurrence of the genus *Caprella* and species *C. danilevskii* is described from the coastal waters of India for the first time, thus extending the distribution of this species to the northern Indian Ocean. The specimens of *C. danilevskii* were collected from macroalgae located at the rocky intertidal coast at Veraval, Gujarat, India. A detailed description of the specimen from the Indian region was provided, including explicit morphometric relations among the male and female sexes. Some abnormalities and special characters were observed in the population, which have not been discussed prior to this study. The species *C. danilevskii* could represent an introduction in the coastal waters of India; however it cannot be ignored that the species was present earlier or could have been overlooked.

[**Keywords**: Abnormal growth, Algae, *Caprella*, Morphometric, West coast of India]

Introduction

The family Caprellidae belongs to the infraorder Corophiida in the order Amphipoda. These amphipods are remarkably different than the rest. Caprellids have effectively colonized most coastal habitats such as algae, hydroids, ascidians, anthozoans, bryozoans, sponges, seagrasses and sediments[1]. The trophic status of caprellids has been efficiently studied by Guerra-García & de Figueroa[2], and Awal *et al.*[3]. The caprellids are vital prey for many fish species in coastal areas around the world[4,5] and are used as a bioindicator for pollution stress[6,7]. Recently, many studies have focused on family Caprellidae from the Indo-Pacific regions other than the Indian coast. Those studies were mainly from the regions such as Oman[8], Island of Zanzibar[9], Thailand[10], Indonesia[10], Philippines[11], Hong Kong[12], Papua New Guinea[13], Western and Northern territory Australia[14], Tanzania[15], Mauritius[16], Egyptian Red Sea coast[17] and Malaysia[18,19].

Amphipods other than caprellids were majorly reported in benthic macrofaunal ecological studies from the Indian waters[20,21]. Whereas the studies on caprellids are limited in the Indian waters[22–24]. Guerra-García *et al.*[23] reported 11 caprellid species from the Indian coast (east and west) till date, namely *Hemiaegina minuta* Mayer 1890, *Heterocaprella krishnaensis* Swarupa & Radhakrishna 1983, *Metaprotella excentrica* Mayer 1890, *M. haswelliana* Mayer 1882, *M. problematica* Mayer 1890, *Monoliropus falcimanus* Mayer 1904, *Paracaprella alata* Mayer 1903, *P. pusilla* Mayer 1890, *Paradeutella bidentata* Mayer 1890, *Pseudocaprellina pambanensis* Sundara Raj 1927 and *Jigurru longimanus* Guerra-García, Ganesh, Jaikumar & Raman 2010 and majorly *P. pusilla* was recorded from the west coast of India. The genus *Caprella* has been described as a cosmopolitan species, but there are no records of this genus from the Indian waters as well as from the northern Indian Ocean. Here, the genus *Caprella* Lamarck, 1801 was reported for the first time from the Indian coast and described *C. danilevskii* Czerniavski 1868 with morphometric relations between sexes and some abnormalities in the species.

Materials and Methods

The samples were collected from Veraval rocky intertidal zone (20°55'1.48" N; 70°20'29.61" E)

covering a wide diversity of algae situated in north-west Indian coasts (Fig. 1). Algae samples were collected by scraping the rocks in the mid and low littoral zone. All the algae samples were washed, and the water was sieved with 500 μm mesh and preserved with 5 % buffered formalin. The specimens were dissected under a stereo zoom microscope. Body parts of selected specimens were mounted in glycerol, examined and photographed. The drawings were made using a Corel draw X7 by superimposing detailed higher magnified images on each other. The specimens were observed under Scanning Electron Microscopy (SEM) for minute details.

A total of 69 adult specimens of caprellids were selected for morphometric analysis, out of which 25 were females, and 44 were males. Adult males were chosen, such that they had a larger body length than the average body length of the female specimens. The male specimens were characterized as normal male and a variant male based on length of antenna 1, pereonites 1 and 2, basis and propodus of the gnathopod 2[refs. 25,26]. In the present study, investigation of variations in other body parts contributing to morphological differences between the male (including normal and variant) and female was also performed. Therefore, the body parts (n = 28) were selected of each individual (Appendix 1), and length was measured. These measured lengths were analyzed to see the variation of body parts among the individuals of male (including normal and variant) and female. The analysis was carried out using PRIMER v6 software package[27]. The lengths were transformed to square root, and the matrix was made by following the Bray-Curtis similarity index before proceeding to non-metric Multidimensional scaling (n-MDS plot).

Furthermore, groups were formed based on the n-MDS plot and then SIMPER was used to evaluate the body part, which caused differentiation in the groups (Table S1). Similarly, variations in the body parts of *Caprella danilevskii* were presented in the Box-whisker plot. The specimens are deposited in the museum of CSIR-National Institute of Oceanography, Regional Centre, Mumbai (MLBETA/AMP/CAP/001/2015).

Results

Systematics

Phylum: Arthropoda von Siebold, 1848

Order: Amphipoda Latreille, 1816

Family: Caprellidae Leach, 1814

Genus: *Caprella* Lamarck, 1801

Caprella danilevskii Czerniavski, 1868 (Figs. 2 – 6)

Caprella danilevskii Czerniavski, 1868, 92, pl. 6, figs 21–34.

Caprella inermis Haswell, 1879, pp. 246, pl. XXIII, fig. 3.

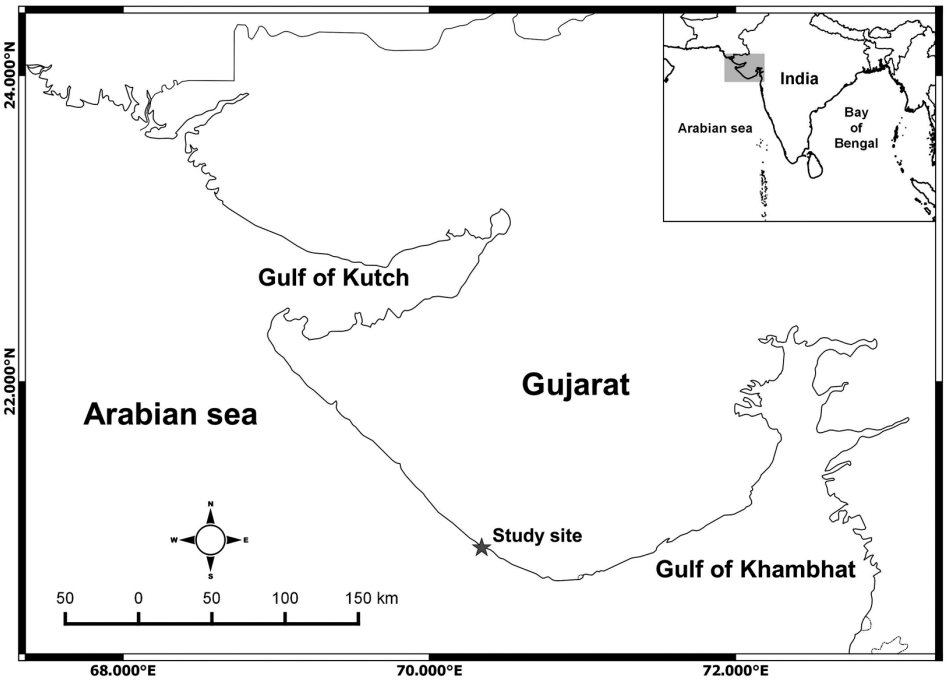

Fig. 1 — Map showing study region of reported *Caprella danilevskii* Czerniavski, 1868

Description of male

Body (Fig. 2A), medium sized, 5.16±0.49 mm long, smooth dorsally and ventrally, microscopic setae present in irregular arrangements. Head, small rostrum, un-constricted, eyes rounded. Antenna 1 (Fig. 2C), peduncular article 1 stout, about 0.8 times as long as article 2; peduncular article 2 longest of all peduncular articles; peduncular article 3 slender, about 0.8 times as long as article 1; flagellum 10-articulate, about 2.3 times as long as peduncular article 1; Antenna 1 about 0.5 times as long as the body. Antenna 2 (Fig. 2D) peduncular article 4 shortest of all; antenna 2 about 0.7 times as long as antenna 1, almost similar in length to peduncle of antenna 1. Gnathopod 1 (Fig. 2E) propodus longer and broader than other articles of gnathopod 1, with two proximal grasping spines and long setae; dactylus falcate, reaching inner side of posterodistal spines of propodus; grasping margin of dactylus and propodus serrated. Gnathopod 2 (Fig. 2F) basis (0.49±0.16 mm),

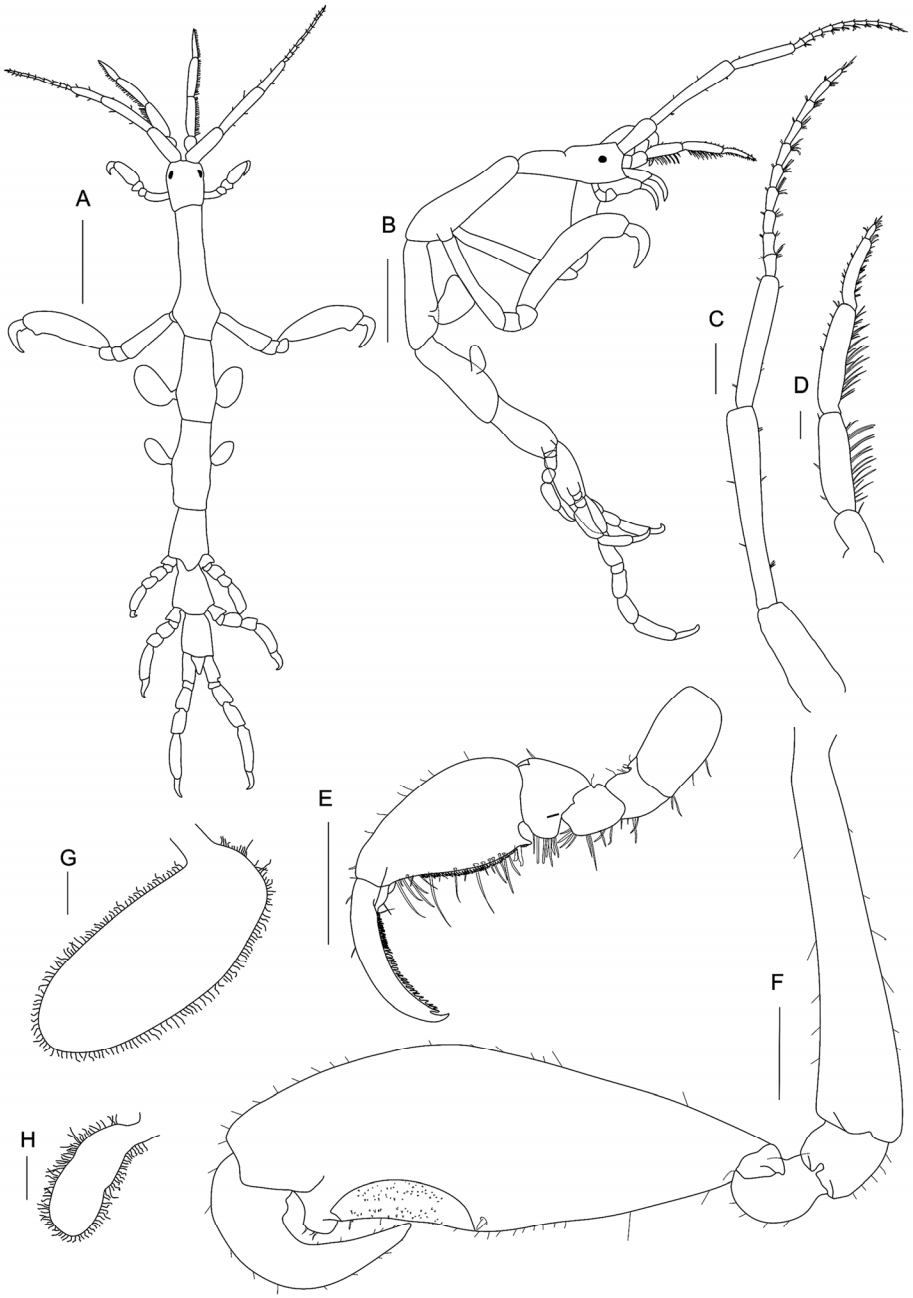

Fig. 2 — Male *Caprella danilevskii* Czerniavski, 1868: A. Male (dorsal view), B. Variant male (lateral view), C. Antenna 1, D. Antenna 2, E. Gnathopod 1, F. Gnathopod 2, G. Gill 3, and H. Gill 4. Scale bars: A – B = 1 mm, C – F = 0.25 mm, and G – H = 0.1 mm

4.8 × ischium, 4.2 × merus, 8.3 × carpus, 0.6 × propodus, 1.2 × dacytlus, 0.5 × perionite 2, insertions posterodistally positioned on pereonite 2; propodus, inner margin smooth, shows intraspecific variations based on the stage of development: smaller males present straight flattened inner margin of some setae while bigger males (hyper adults) show a gradual transformation of the anterodistal concavity; dactylus, curved and serrated, reaching shorter than half of propodus. Gills (Fig. 2G – H) elliptical, gill 3 larger than gill 4. Pereopods (Fig. 3A – C) 3 and 4 absent; pereopod 5, well developed, basis with dorsal carina, propodus without grasping spines but with some setae and longer than carpus, dactylus curved hook, inner margin serrated with several fine setae; pereopods 6 slightly longer than pereopod 5 but analogous, propodus without robust seta; pereopod 7, longer than pereopod 6, basis with dorsal carina, propodus

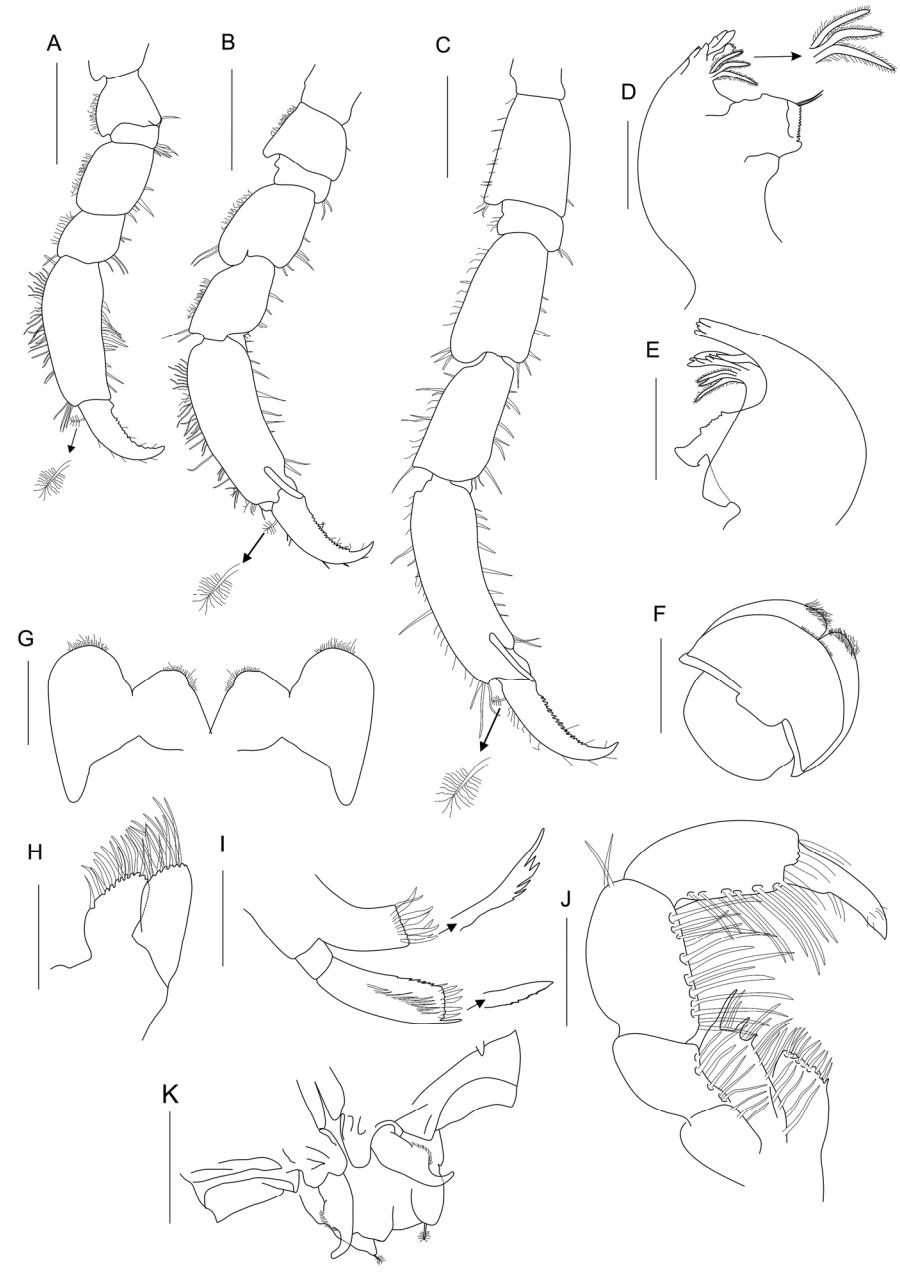

Fig. 3 — Male *Caprella danilevskii* Czerniavski, 1868: A. Pereopod 5, B. Pereopod 6, C. Pereopod 7, D. Left mandible, E. Right mandible, F. Upper lip, G. Lower lip, H. Maxilla 2, I. Maxilla 1, J. Maxilliped, and K. Abdomen (ventral view). Scale bars: A – C = 0.25 mm, and D – K = 0.1 mm

without grasping spines. Left mandible (Fig. 3D), incisor with 5 humps; lacinia mobilis with teeth; 3 setae in a row; molar process small and minutely serrated. Right mandible (Fig. 3E), incisor with 4 teeth; lacinia mobilis with 5 teeth; molar process small and minutely serrated. Mandibular palp absent. Upper lip (Fig. 3F), broad, semi-rounded in shape, hairy anteriorly. Lower lip (Fig. 3G), outer and inner lobes provided with setulae, apically rounded. Maxilla 2 (Fig. 3H), inner plate much shorter and broader than outer, with 13 apical setae, serrated apical margin; outer plate with 10 apical setae, serrated apical margin. Maxilla 1 (Fig. 3I), outer lobe with robustly serrated 7 spines with minutely serrated apical margin; inner lobe broad, 2 biarticulated, article 1 without seta, bearing 7 serrated robust apical setae, inner margin serrated. Maxilliped (Fig. 3J), inner plate with 11 apical setae without any stout tooth; outer plate having 2 stout teeth and 4 setae on apical margin. Maxillipedal palp, 4 articulate; article 1 with some setae; articles 2, inner margin with 15 long setae, outer margin with 2 setae; articles 3, inner margin with 6 long setae, outer margin with 1 seta; nail of article 4 long, stout with few setae. Abdomen (Fig. 3K), a pair of 1-articulate appendages provided with fine setulae distally, pair of lateral lobes and single dorsal lobe bearing pair of plumose setae.

Description of female

Body (Fig. 4A), small sized, 4.65±0.66 mm long, smooth dorsally and ventrally, microscopic setae present in irregular arrangements. Head, very small rostrum, un-constricted, eyes rounded. Antenna 1 (Fig. 5A), peduncular article 1 stout, about 0.7 times as long as article 2; peduncular article 2 longest of all

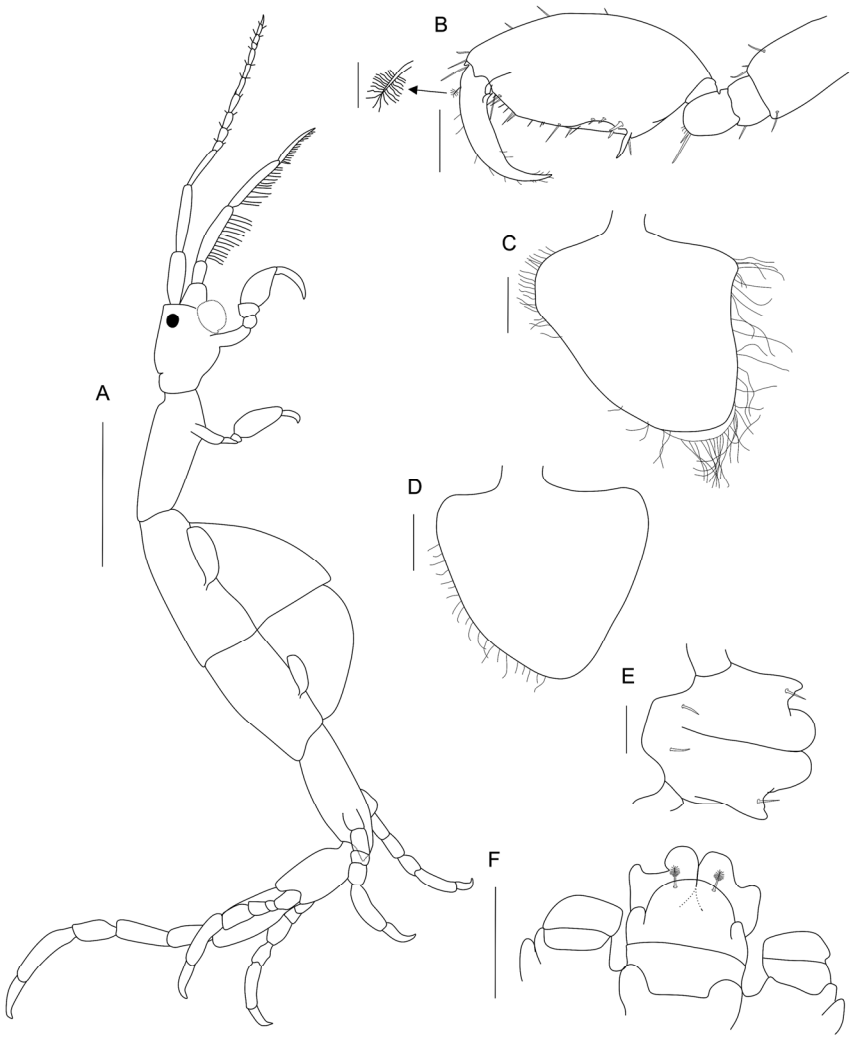

Fig. 4 — Female *Caprella danilevskii* Czerniavski, 1868: A. Female body (lateral view), B. Gnathopod 2, C. Oostegite 3, D. Oostegite 4, E. Abdomen (ventral view), and F. Abdomen (dorsal view). Scale bars: A = 1 mm; C – D = 0.25 mm, B & F = 0.1 mm, and E = 0.04 mm

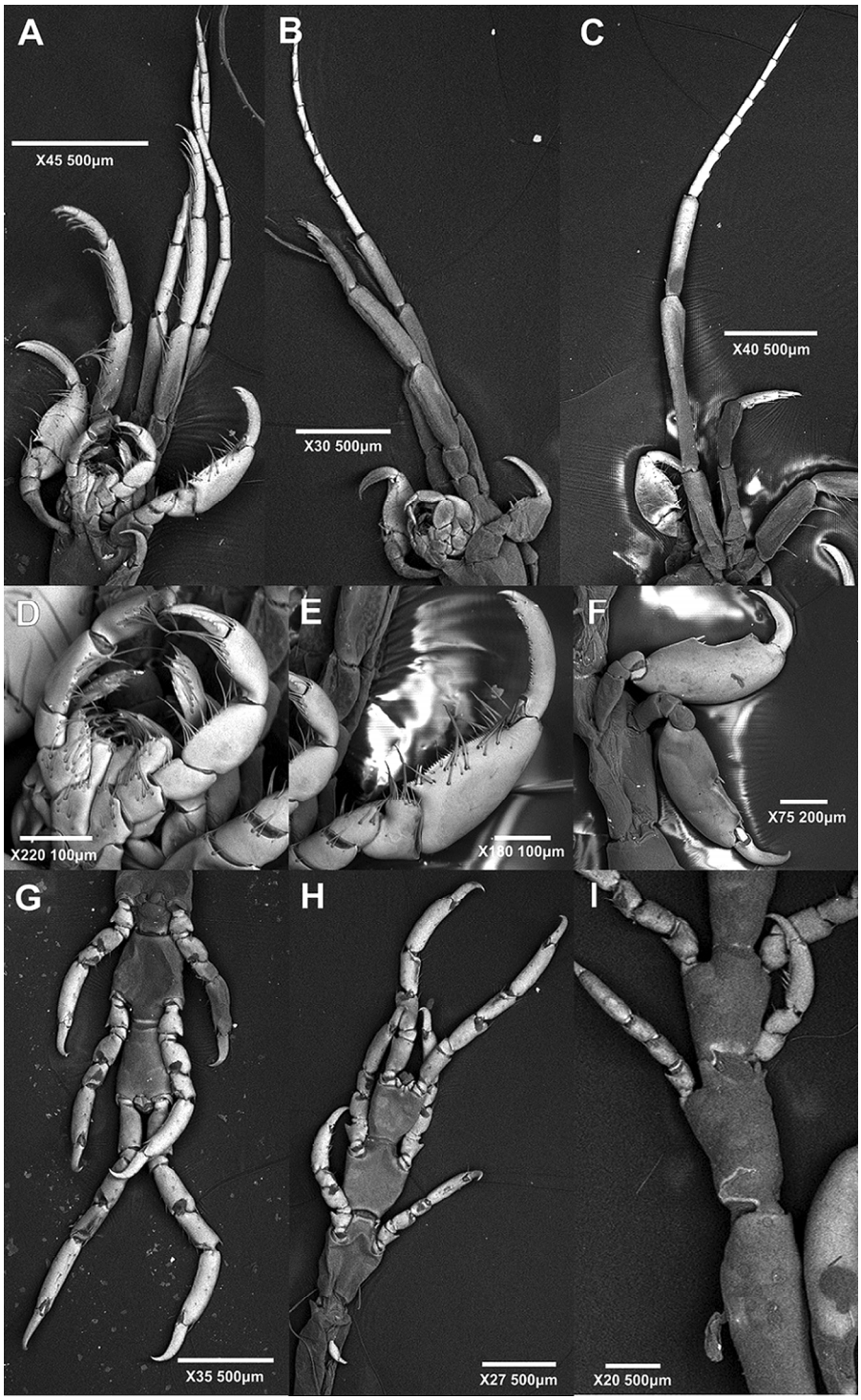

Fig. 5 — SEM images of *Caprella danilevskii* Czerniavski, 1868: A. Anterior view of female, B. Anterior view of male, C. Anterior view of variant male, D. Female mouth parts, E. Female gnathopod 1, F. Male gnathopod 2, G. Posteroventral view of female, H. Posteroventral view of male, and I. Lateral view of Variant male showing smooth body surface without minute rows of setae

peduncular articles; peduncular article 3 slender, about 0.9 times as long as article 1; flagellum 11-articulate, about 2.7 times as long as peduncular article 1; antenna 1 about 0.4 times as long as body. Antenna 2, peduncular article 4 shortest of all peduncular articles; antenna 2 about 0.7 times as long as antenna 1, longer than peduncle of antenna 1. Mouth parts (Fig. 5D), similar to male. Gills,

elliptical, similar to male. Gnathopod 1, similar to male (Fig. 5E). Gnathopod 2 (Fig. 4B), basis (0.23±0.08 mm), 5.0 × ischium, 4.6 × merus, 8.0 × carpus, 0.6 × propodus, 1.0 × dacytlus, 0.3 × perionite 2, basis of gnathopod 2 insertions posterodistally positioned on pereonite 2, propodus, inner margin smooth; dactylus, curved and serrated, reaching shorter than half of propodus. Pereopods analogues to male. Oostegites (Fig. 4C – D), on pereonite 3 and 4 with inner margin setose. Abdomen (Fig. 4E – F) lacking appendages, with pair of lateral lobes with four spines (2 anteroventral + 2 dorsoventral) and single dorsal lobe with two plumose setae. The scanning electron micrographs were provided for detailed structural understanding (Fig. 5).

Description of variant male

The morphology of the present material was compared to published accounts, and it complied with the description by McCain[1]. The appendages of the male abdomen, lack of grasping spines of pereopods 5 – 7 and the short dactylus of male gnathopod 2 suggest that these specimens belong to *C. danilevskii*. Some differences were observed in the present specimen of males with other original descriptions such as very long antenna 1 (Fig. 5A – C), pereonites 1 and 2, basis and propodus of the gnathopod 2. The body was -large-sized and exceeded normal male length (6.49±0.45 mm) and was smooth dorsally. Some variant males were found with ventral tubercles on the pereonites 2 and 3 (Fig. 6A), but some were smooth bordered. The normal male and females did not show any projection ventrally. The microscopic setae were present in irregular arrangements, but the lateral surface was smooth without rows of minute setae in variant males (Fig. 5I). The head was with a very small rostrum, and Eyes were rounded. The antenna 1, peduncular article 1 stout, about 0.6 times as long as article 2; peduncular article 2 longest of all peduncular articles; peduncular article 3 slender, about 1.1 times as long as article 1; flagellum 10-articulate, about 1.6 times as long as peduncular article 1; antenna 1 about 0.6 times as long as body; antenna 2 peduncular article 4 shortest of all peduncular articles; antenna 2 about 0.5 times as long as antenna 1, shorter than peduncle of antenna 1. Gills were elliptical, larger than normal male; gnathopod 2, basis (1.35±0.24 mm), 7.3 × ischium, 7.4 × merus, 12.4 × carpus, 0.9 × propodus, 2.5 × dacytlus, 1.0 × perionite 2, basis of gnathopod 2 insertions posterodistally positioned on pereonite 2, propodus, inner margin smooth with anterodistal concave; dactylus, curved and non-serrated, reaching shorter than half of propodus; pereopods analogues to normal male but larger in size.

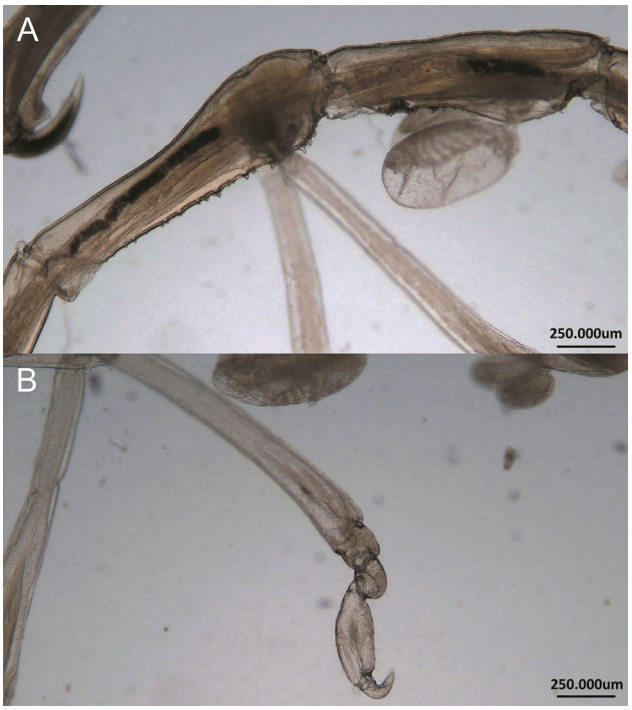

Fig. 6 — Variant male of *Caprella danilevskii* Czerniavski, 1868 with special characters: A. Ventral body margin with presence of spines, and B. Abnormal growth of gnathopod 2. Scale bar: A – B = 0.25 mm

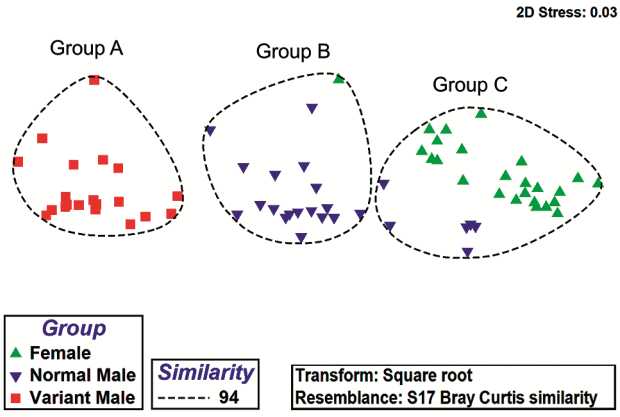

Fig. 7 — n-MDS plot of morphometric measurements of *Caprella danilevskii* Czerniavski, 1868

Morphometric multivariate analysis

The non-metric Multidimensional Scaling (n-MDS) results showed three distinct groups at 94 % similarity, labeled as Group A, Group B, and Group C (Fig. 7). Group A was entirely composed of variant male dimensions, Group B with normal males and

Group C with primarily females and few males (dimensionally analogous). SIMPER results showed 96.80 %, 96.56 % and 96.26 % similarity in individuals within groups A, B and C, respectively. The total body length contributed more than 9 % (Table S1). The dissimilarity between the Groups B and A, Groups C and B and Groups C and A were 8.26 %, 8.13 % and 15.34 %, respectively. The body parts such as G2T, G2B, A1PT, A1T, G2P and A1PA2 contributed cumulatively more than 50 % to the dissimilarity between the groups B and A. Similarly, G2T, G2P, G2B, T, A1T, A1PT and G2D between groups C and B and G2T, G2B, G2P, A1PT, A1T and T between groups C and A contributed for dissimilarity.

Morphometric measurements showed wide variation in some body parts among *C. danilevskii* population, *i.e.* A1PA2, PR2, G2B, G2P, G2T, T (Fig. 8A). The length of most of the body parts was found to be highest in Group A (variant males) than Group B (normal males) and then followed by Group C (females). In females, A1F and T showed variation compared to other parts, whereas PR2, PR3 and PR4 contributed largely to the variation in T (Fig. 8B). In males, A1F, PR2, G2B and T showed a disparity in each individual (Fig. 8C). A1PA2 and G2B were deviated largely in the variant males compared to other parts (Fig. 8D).

Discussion

The specimens from Tasmania and Colombia was found with similar morphological variations compared to the present study[25,26]. These differences of *C. danilevskii* were suspected as intraspecific variation during development[25]. Similarly, the genus *Caprella* is known for its intraspecies variation, as in the case of *Caprella scaura* Templeton, 1836. Gillon *et al.*[28] described the differences in two

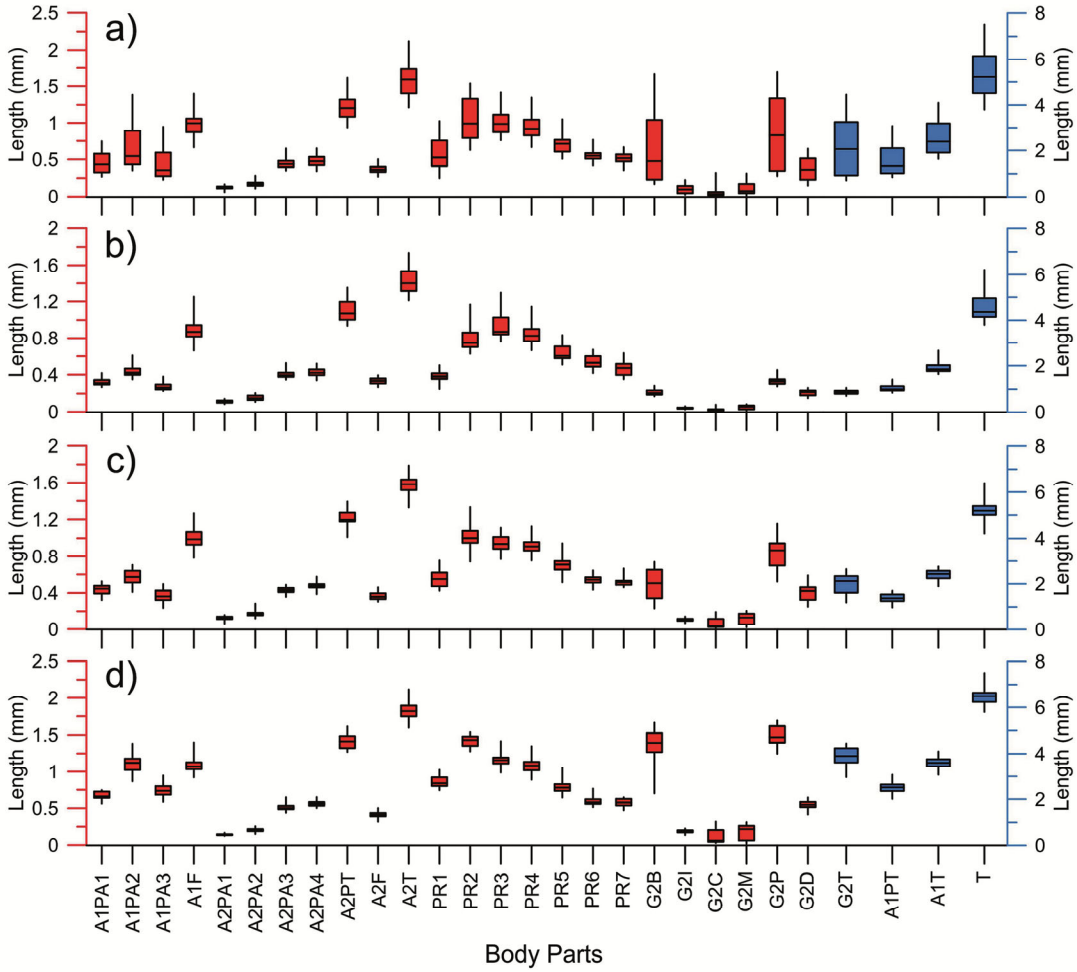

Fig. 8 — Box-whisker plot of morphometric measurements of *Caprella danilevskii* Czerniavski, 1868: a) All groups together (n = 69), b) Female (n = 25), c) Normal male (n = 24), and d) Variant male (n = 20)

subspecies of *C. scaura* recorded from different geographical ranges. However, the *C. scaura* complex among similar species may represent distinct species with a restricted distribution[29]. The presence of two pairs of processes on pereonite 5 of males of *C. s. typica* Templeton, 1836, was lacking in *C. s. scaura* Mayer, 1890 and so on. The four specimens of male *C. danilevskii* were found with abnormal growth of single gnathopod 2. This abnormality is characterized by partial growth of propodus and dactyl, unlike adjacent gnathopod 2. It can be easily recognized by the reduced total length of the gnathopod 2 (Fig. 6B).

The occurrence of *C. danilevskii* in the Indian region could be a result of introduction from other geographical area through the natural or anthropogenic mode like floating objects and vessels. Several species of the genus *Caprella* have been reported as invasive worldwide[28,30,31]. The biogeographic range of littoral caprellids is expanding, which may be related to the association and transportation of fouling communities on floating objects and vessels[32]. The association of *C. scaura* with fouling communities was described by Gillon *et al.*[28]. An extensive study on caprellids has been carried out by Guerra-García *et al.*[23] in the Indian coast, but *C. danilevskii* was not found from any of the sites during the study. The caprellids have limited swimming ability and benthic developmental stage[1,33].

Furthermore, the present study site is located on Veraval coast, Gujrat, which is near the busy shipping route in the sea areas. Therefore, it could be assumed that possible introduction pathways for *C. danilevskii* to the Indian coast happened through the direct movement of uinternational vessels or any other boats infested with biofouling communities, transporting goods from major ports such as Mumbai to Veraval port. In order to develop mitigation plans for controlling the invasive species *C. danilevskii*, detail research dealing with its impacts on regional biodiversity is needed in the Indian coastal region.

Habitat

Algae species: *Sargassum* sp., *Acantophora* sp., *Gracilaria* sp., *Ulva lactuca* and *Hypnea musciformis*[34]. *Sargassum* sp. in the present study.

Distribution

Type locality: Black sea; cosmopolitan; a new record for Indian coast and other records in the world oceans (Fig. 9).

Key to species of Indian caprellids (modified from Guerra-García *et al.*[23])

1. Large ventral projection on pereonite ….……...… *Heterocaprella krishnaensis*
- Pereonite 4 without projection ….....……..….. 2
2. Body with dorsal projections ……...…... 3
- Body without dorsal projections ……..…….. 5
3. Dorsal projections present on pereonite 3 ……..... *Metaprotella excentrica*
- Dorsal projections absent on pereonite 3 …… 4

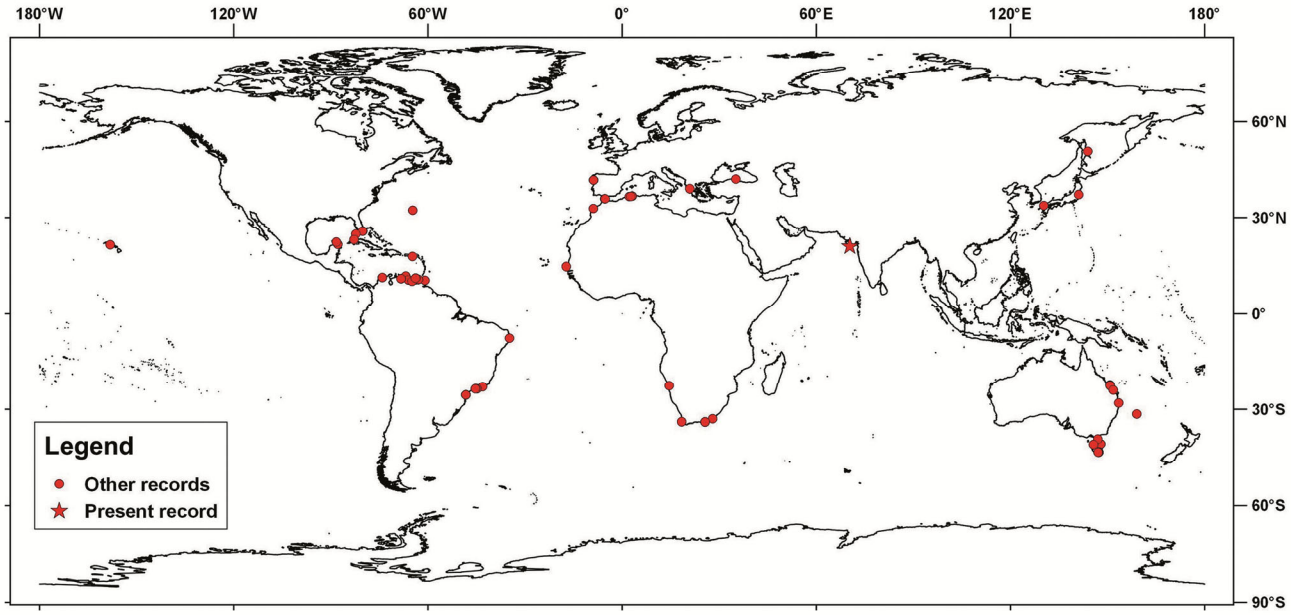

Fig. 9 — Global distribution of *Caprella danilevskii* Czerniavski, 1868 with present record

4. Two dorsal projections on pereonite 2. Pereopods 3 and 4 longer than half of gills ……. .....…. *Metaprotella haswelliana f. taprobanica*
- A single dorsal projection on pereonite 2. Pereopods 3 and 4 shorter than half of gills …….....……. *Paradeutella bidentata*
5. Gills present on pereonites 2, 3 and 4 ……. 6
- Gills present on pereonites 3 and 4 ……..….. 7
6. Gnathopod 2 very elongate, as long as the half of the body ……..... *Jigurru longimanus*
- Gnathopod 2 clearly shorter than half of the body ……..... *Pseudocaprellina pambanensis*
7. Lateral expansions on pereonites ……..…. 8
- Pereonites without lateral expansions ……..….. 9
8. Lateral expansions on pereonites 2 – 6, antennae 1 longer than half of the body …….....…. *Metaprotella problematica*
- Lateral expansions on pereonite 3 and 4, antennae 1 shorter than half of the body …….. ……..... *Paracaprella alata*
9. Pereonite 2 without anterolateral projection …. ……..…… 10
- Anterolateral projection present on pereonite 2 ... ……..…. 11
10. Dactyl longer than half of propodus of gnathopod 2 .....…… *Hemiaegina minuta*
- Dactyl shorter than half of propodus of gnathopod 2 ……..……..... ***Caprella danilevskii***
11. Antennae 1 peduncle provided with small setae. Gills rounded. Basis of gnathopod 2 with a proximal knob ……..…… *Paracaprella pusilla*
- Antennae 1 peduncle non-setose. Gills elongate. Basis of gnathopod 2 without proximal knob ……..……..… *Monoliropus falcimanus*

Supplementary Data

Supplementary data associated with this article is available in the electronic form at http://nopr.niscpr.res.in/jinfo/ijms/IJMS_51(01)33-44_SupplData.pdf

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Conflict of Interest

Authors declare no competing or conflict of interest.

Author Contributions

SS: conceptualized and supervised the study, also reviewed and edited the manuscript; SG: sorted and analysed the samples, made morphometric study as well as wrote the original draft of the manuscript.

References

1 McCain J C, The Caprellidae (Crustacea: Amphipoda) of the Western North Atlantic, *US Natl Museum Bull*, 278 (1968) 1-147.

2 Guerra-García J M & de Figueroa J MT, What do caprellids (Crustacea: Amphipoda) feed on? *Mar Biol*, 156 (2009) 1881–90. https://doi.org/10.1007/s00227-009-1220-3

3 Awal S, Christie A & Nieuwesteeg D, Substrate selectivity and food preference of the Caprellid Amphipod (*Caprella Penantis*); evaluation of a possible aquaculture resource for marine hatcheries, *J Aquac Mar Biol*, 4 (2016) 1–8. https://doi.org/10.15406/jamb.2016.04.00073

4 Caine E A, Caprellid amphipod behavior and predatory strikes by fish, *J Exp Mar Bio Ecol*, 126 (1989) 173–80. https://doi.org/10.1016/0022-0981(89)90088-9

5 Caine E A, Caprellid amphipods: fast food for the reproductively active, *J Exp Mar Bio Ecol*, 148 (1991) 27–33. https://doi.org/10.1016/0022-0981(91)90144-L

6 Guerra-García J M & Koonjul M S, *Metaprotella sandalensis* (Crustacea: Amphipoda: Caprellidae): A bioindicator of nutrient enrichment on coral reefs? *Environ Monit Assess*, 104 (2005) 353–67. https://doi.org/10.1007/s10661-005-1621-9

7 Guerra-García J M, Ruiz-Tabares A, Baeza-Rojano E, Cabezas M P, Díaz-Pavón J J, *et al.*, Trace metals in ***Caprella* (Crustacea: Amphipoda). A new tool for** monitoring pollution in coastal areas? *Ecol Indic*, 10 (2010) 734–43. https://doi.org/10.1016/j.ecolind.2009.12.003

8 Momtazi F & Sari A, Intertidal caprellids (Crustacea: Amphipoda) of the Persian Gulf and the Gulf of Oman, with description of three new species, *Zootaxa*, 3717 (2013) p. 195. https://doi.org/10.11646/zootaxa.3717.2.5

9 Larsen K, A new species of *Metaprotella* (Crustacea: Amphipoda: Caprellidae) from east Africa, with key to the genera of Protellidae and discussion of generic characters, *J Nat Hist*, 31 (1997) 1203–12. https://doi.org/10.1080/00222939700770641

10 Takeuchi I & Guerra-García J M, *Paraprotella saltatrix*, a new species of the Caprellidea (Crustacea: Amphipoda) from Phuket Island, Thailand, *Phuket Mar Biol Cent Spec Publ*, 23 (2002) 273–80.

11 Guerra-García J M, Littoral caprellids (Crustacea: Amphipoda: Caprellidea) from Philippines, with the description of a new species, *Raffles Bull Zool*, 50 (2002) 395–406.

12 Guerra-García J M & Takeuchi I, The Caprellidea (Malacostraca: Amphipoda) from Mirs Bay, Hong Kong, with the description of a new genus and two new species, *J Crustac Biol*, 23 (2003) 154–68. https://doi.org/10.1651/0278-0372(2003)023

13 Guerra-García J M, Caprellids (Crustacea: Amphipoda) from Papua New Guinea, with the description of a new species, *Helgol Mar Res*, 57 (2003) 100–109. https://doi.org/10.1007/s10152-003-0144-4

14 Guerra-García J M, The Caprellidea (Crustacea, Amphipoda) from Western Australia and Northern Territory, Australia, *Hydrobiologia*, 522 (2004) 1–74. https://doi.org/10.1023/B

15 Guerra-García J M, Redescription of five rare caprellids (Crustacea: Amphipoda: Caprellidea) collected from Tanzanian coasts, *Helgol Mar Res*, 55 (2002) 221–231. https://doi.org/10.1007/s101520100083

16 Guerra-García J M, The Caprellidea (Crustacea: Amphipoda) from Mauritius Island, Western Indian Ocean, *Zootaxa*, 232 (2003) 1–24.

17 Zeina A F & Guerra-García J M, Caprellidae (Crustacea: Peracarida: Amphipoda) from the Red Sea and Suez Canal, with the redescription of *Metaprotella africana* and *Paradeutella multispinosa*, *Zootaxa*, 4098 (2016) 227–253. https://doi.org/10.11646/zootaxa.4098.2.2

18 Lim J H C, Othman B H R & Takeuchi I, Description of *Orthoprotella bicornis*, new species, and *Paraprotella teluksuang*, new species (Crustacea: Amphipoda) from Johor, Malaysia with special reference to unusual sexual bias towards females in *Paraprotella*, *Raffles Bull Zool*, 63 (2015) 33–48. https://doi.org/10.1186/s12888-016-0768-y

19 Lim J H C, Azman B A R, Takeuchi I & Othman B H R, *Pseudaeginella telukrimau* sp. nov., a new species of caprellid (Crustacea: Amphipoda) from Malaysia, *Zootaxa*, 4282 (2017) 62–72. https://doi.org/10.11646/zootaxa.4282.1.3

20 Ingole B S, Gaonkar U V, Deshmukh A, Mukherjee I, Sivadas S K, *et al.*, Macrobenthic community structure of coastal Arabian Sea during the fall intermonsoon, *Indian J Geo-Mar Sci*, 43 (2014) 2223–2232.

21 Ravinesh R & Bijukumar A, Comparison of intertidal biodiversity associated with natural rocky shore and sea wall: A case study from the Kerala coast, India, *Indian J Geo-Mar Sci*, 42 (2013) 223–235.

22 Bhave V J & Deshmukh V D, A record of skeleton shrimp *Paracaprella pusilla* Mayer, 1890 from Mumbai waters, *J Mar Biol Assoc India*, 51 (2009) 7–9.

23 Guerra-García J M, Ganesh T, Jaikumar M & Raman A V, Caprellids (Crustacea: Amphipoda) from India, *Helgol Mar Res*, 64 (2010) 297–310. https://doi.org/10.1007/s10152-009-0183-6

24 Swarupa K M C & Radhakrishna Y, *Heterocaprella krishnaensis* n. sp, a new caprellid from Indian waters (Amphipoda, Caprellidea), *Crustaceana*, 44 (1983) 54–60. https://doi.org/10.1163/156854083X00046

25 Guerra-García J M & Takeuchi I, The Caprellidea (Crustacea: Amphipoda) from Tasmania, *J Nat Hist*, 38 (2004) 967–1044. https://doi.org/10.1080/00222930210 00054497

26 Guerra-García J M, Krapp-Schickel T & Müller H G, Caprellids from the caribbean coast of Colombia, with description of three new species and a key for species identification, *Boletín Investig Mar y Costeras*, 35 (2006) 149–194.

27 Clarke K R & Gorley R N, *PRIMER v6: User Manual/Tutorial*, (Prim. Plymouth UK), 2006, pp. 192. https://doi.org/10.1111/j.1442-9993.1993.tb00438.x

28 Gillon A, Costa A C & Micael J, *Caprella scaura* Templeton, 1836: an invasive caprellid new to the Azores archipelago, *Mar Biodivers*, (2016) 499–510. https://doi.org/10.1007/s12526-016-0485-2

29 Ros M, Guerra-García J M, Navarro-Barranco C, Cabezas M P & Vázquez-Luis M, The spreading of the non-native caprellid (Crustacea: Amphipoda) Caprella scaura Templeton, 1836 into southern Europe and northern Africa: A complicated taxonomic history, *Mediterr Mar Sci*, 15 (2014) 145–155. https://doi.org/10.12681/mms.469

30 Coolen J W P, Lengkeek W, Degraer S, Kerckhof F, Kirkwood R J, *et al.*, Distribution of the invasive Caprella mutica Schurin, 1935 and native *Caprella linearis* (Linnaeus, 1767) on artificial hard substrates in the North Sea: Separation by habitat, *Aquat Invasions*, 11 (2016) 437–449. https://doi.org/10.3391/ai.2016.11.4.08

31 Cabezas M P, Xavier R, Branco M, Santos A M & Guerra-García J M, Invasion history of *Caprella scaura* Templeton, 1836 (Amphipoda: Caprellidae) in the Iberian Peninsula: multiple introductions revealed by mitochondrial sequence data, *Biol Invasions*, 16 (2014) 2221–2245. https://doi.org/10.1007/s10530-014-0660-y

32 Astudillo J C, Bravo M, Dumont C P & Thiel M, Detached aquaculture buoys in the SE Pacific: Potential dispersal vehicles for associated organisms, *Aquat Biol*, 5 (2009) 219–231. https://doi.org/10.3354/ab00151

33 Caine E A, Habitat adaptations of the North American Caprellid Amphipoda (Crustacea), *Biol Bull*, 155 (1978) 288–296. https://doi.org/10.2307/1540953

34 Díaz Y J, Guerra-García J M & Martín A, Caprellids (Crustacea: Amphipoda: Caprellidae) from shallow waters of the Caribbean coast of Venezuela, *Org Divers Evol*, 5 (2005) 249–251. https://doi.org/10.1016/j.ode.2004.11.010

Appendix

Appendix 1 — Abbreviations

A1PA1	Length of Peduncle Article 1 of Antenna 1
A1PA2	Length of Peduncle Article 2 of Antenna 1
A1PA3	Length of Peduncle Article 3 of Antenna 1
A1PT	length of Peduncle of Antenna 1
A1F	Length of Flagellum of Antenna 1
A1T	Length of Antenna 1
A2PA1	Length of Peduncle Article 1 of Antenna 2
A2PA2	Length of Peduncle Article 2 of Antenna 2
A2PA3	Length of Peduncle Article 3 of Antenna 2
A2PA4	Length of Peduncle Article 4 of Antenna 2
A2PT	Length of Peduncle of Antenna 2
A2F	Length of Flagellum of Antenna 2
A2T	Length of Antenna 2
PR1	Length of Pereonite 1
PR2	Length of Pereonite 2
PR3	Length of Pereonite 3
PR4	Length of Pereonite 4
PR5	Length of Pereonite 5
PR6	Length of Pereonite 6
PR7	Length of Pereonite 7
T	Length of Body
G2B	Length of Basis of Gnathopod 2
G2I	Length of Ischium of Gnathopod 2
G2M	Length of Merus of Gnathopod 2
G2C	Length of Carpus of Gnathopod 2
G2P	Length of Propodus of Gnathopod 2
G2D	Length of Dactylus of Gnathopod 2
G2T	Length of Gnathopod 2