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ORIGINAL ARTICLE

First distributional record of *Carupella banlaensis* from India

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ABSTRACT

The present study describes a new record of the rare portunid crab *Carupella banlaensis* from Goa, along the central west coast of India, based on carapace and appendage morphology and provides detailed morphometric measurements of two immature female specimens. *Carupella banlaensis* differs from its congeners in possessing less prominent median and lateral frontal lobes, the first eight anterolateral teeth alternating large and small and bluntly triangular, the cheliped merus with three large spines on the anterior margin and one distal spine on the posterior margin. Previously known only from the Gulf of Tonkin (China) and Somalia, the present observation of this crab is a new record for the entire South Asian region.

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Introduction

Swimming crabs (family Portunidae) are ubiquitous in marine and coastal environments, inhabiting mangrove swamps (Cannicci et al. 1996; Keenan et al. 1998), coral reefs (Spiridonov & Neumann 2008) and deep-sea ecosystems (Balasubramanian & Suseelan 2001). The family Portunidae represents a group of highly diverse crabs divided into seven subfamilies (Ng et al. 2008) based on variations in exoskeletal structures (Stephenson 1972). *Carupella* is a genus of mostly rarely occurring, inshore crabs (Crosnier 1962; Zarenkov 1970; Vannini & Innocenti 2000) within the subfamily Portuninae (Ng et al. 2008). This genus is known to be represented by three species, namely *Carupella banlaensis* Tien, 1969, *C. epibranchialis* Zarenkov, 1970, and *C. natalensis* Lenz & Strunck, 1914.

The genus *Carupella* Lenz & Strunck, 1914 was initially assumed to morphologically resemble *Carupa* and *Lupocyclus* owing to the slender basal antennal segment, which does not extend transversely and lacks any anterolateral extension. Hence, it was placed in the alliance Lupocycloidea within the subfamily Lupinae (Lenz & Strunck 1914). Subsequently, Stephenson (1972) placed the genera *Carupella* and *Lupocyclus* within the subfamily Portuninae owing to a 'relatively broader carapace' and 'chelipeds longer than walking legs'. However, *Carupella* possesses 'nine slightly alternate large and small anterolateral teeth, the ninth being the largest' and clearly differs from *Lupocyclus* with 'distinctly alternate large and small anterolateral teeth'. Recently, De Grave et al.

(2009) placed both the above genera in a separate subfamily Lupocyclinae.

The present study redescribes the rare crab *Carupella banlaensis* from Goa, along the west coast of India. The present finding of this species is a new geographical record of this species for the entire southern Asian region.

Materials and methods

The following abbreviations are used: AW, abdominal width; CL, carapace length; CW, extreme width of carapace; FOW, width of fronto-orbital margin of carapace; FW, width of frontal margin of carapace; PD, depth of propodus of cheliped; PL, length of propodus of cheliped; RL, rostral length.

The terminology used in the morphological description of crabs follows Wee & Ng (1995) and Velip & Rivonker (2015).

During regular sampling of the intertidal brachyuran fauna at Cortalim, Goa, along the west coast of India (15°24.525'N 073°54.466'E; Figure 1), two individuals of the portunid genus *Carupella* were collected at low tides during June 2014. The crab samples were hand-picked from the selected patch of shore, collected in plastic containers and brought to the laboratory for detailed examination.

At the laboratory, morphological characteristics of the crabs were photographed with a stereo-zoom microscope (Olympus SZX-16). Morphometric parameters were measured using vernier calipers with

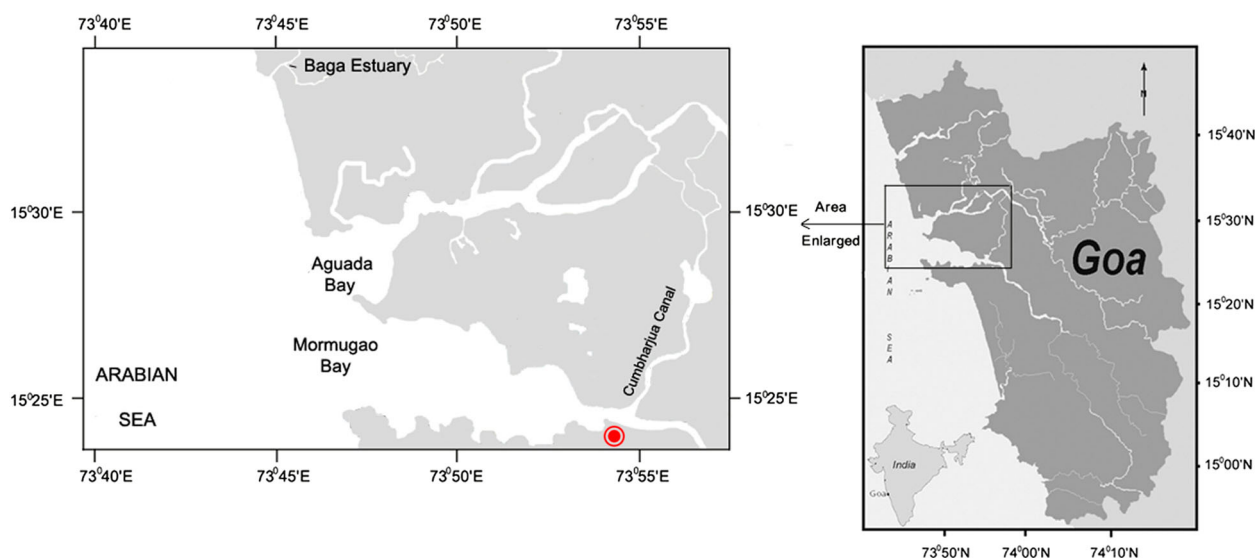


Figure 1. Map of the study area indicating the sampling site (red symbol).

an accuracy of 0.1 mm. Sternum, abdomen and cheliped segments (dactylus, propodus, carpus and merus) were measured using a micrometer. Line diagrams of the carapace, third maxillipeds, sternum, chelipeds (dactylus, propodus and merus) and abdomen were drawn to elucidate their detailed structures.

Generic-level identification of the crabs followed Stephenson (1972). For species-level identification, the specimens were compared with published descriptions of the three *Carupella* species (Lenz & Strunck 1914; Barnard 1950; Crosnier 1962; Tien 1969; Zarenkov 1970; Moosa 1981). Morphological characters such as frontal margin position and ornamentation, teeth on the anterolateral margin, the presence of ridges on the dorsal surface of the carapace, and ornamentation on the anterior margin of the merus of the cheliped were used as criteria to differentiate among the *Carupella* species.

The specimens were temporarily stored in a 5% buffered formalin (buffered with hexamethylene tetramine to prevent fragmenting of appendages) solution in prelabelled transparent plastic bottles, and later preserved in 80% ethanol. These are deposited in the type collections of the Crustacea section (C) of the National Zoological Collections at the Zoological Survey of India, Kolkata (ZSI/FPS/Kolkata; FPS-Fire Proof Spirit Building). The comparative material (*Scylla* instar juvenile and an immature female) is deposited at the Marine Biology Laboratory, Department of Marine Sciences, Goa University, Goa (GUMSIS).

Comparative material examined

GUMSIS1, *Scylla* instar juvenile, CL 0.4 mm, CW 0.5 mm, Rajiv Gandhi Centre for Aquaculture, Sirkali, Tamil Nadu.

GUMSIS2, *Scylla* immature female, CL 15.2 mm, CW 23.3 mm, Goa, west coast of India, 15°24.525'N 073°54.466'E, rocky patch near Cortalim Jetty, 18 October 2014.

Taxonomy

Family Portunidae Rafinesque, 1815

Genus *Carupella* Lenz & Strunck, 1914

Carupella Lenz & Strunck, 1914: 278–79. Type species *Carupella natalensis* Lenz & Strunck, 1914

Distribution

Crabs of this genus are sporadically distributed across the Indo-West Pacific regions, namely the Gulf of Tonkin–China, Somalia (*Carupella banlaensis*), southern Japan (*C. epibranchialis*), South Africa and Madagascar (*C. natalensis*).

Carupella banlaensis Tien, 1969

(Figures 2, 3)

Material examined (n = 2; 2.6–4.4 mm CL)

ZSI C 6458/2, immature female, CL 4.4 mm, CW 6 mm, Goa, west coast of India, 15°24.525'N 073°54.466'E, rocky patch near Cortalim Jetty, 18 June 2014.

ZSI C 6459/2, immature female, CL 2.6 mm, CW 3.4 mm, Goa, west coast of India, 15°24.525'N 073°54.466'E, rocky patch near Cortalim Jetty, 18 June 2014.

Diagnosis

Carapace subhexagonal, broader than long; metagastric and epibranchial ridges granulated, interrupted, forming the cardiac groove. Four frontal lobes, median and lateral lobes slightly subequal; lateral frontal lobes continuous with supraorbital margin. Nine anterolateral teeth, first eight teeth alternating large and small; ninth tooth longest, projecting laterally. Cheliped dactylus with large blunt tooth proximally; propodus armed with two distal and one proximal spine on the upper surface; merus with two large distal spines followed by three proximal spinules on the anterior margin.

Description

Carapace subhexagonal, broader than long (CW/CL = 1.3 ± 0.02). Dorsal surface of carapace longitudinally and transversely convex, microscopically granulated and sparsely pubescent; regions well marked; mesogastric ridge granulated, interrupted in middle; metagastric and epibranchial ridge granulated, interrupted

at cardiac groove. Frontal margin narrow (FW/CW = 0.4 ± 0.01). Margin of carapace granular, slightly in advance of external orbital teeth, divided into four lobes; median frontal lobes less prominent; notch separating median and lateral frontal lobes indistinct (Figure 2A). Anterolateral margin granulated, divided into nine teeth; first eight teeth alternating large and small; ninth tooth largest, projecting laterally. Posterolateral junction slightly curved, posterolateral margins granulated. Posterior margin of carapace narrow, sinuous, granulated. Antennules long, cylindrical, extending beyond frontal margin, folded obliquely in antennular fossae; antennules with distal tuft of hairs.

Orbits interrupted dorsally by two sutures, partially open at inner margin; orbital margin microscopically granulated, except at external orbital margin; roof and floor of orbit pubescent. Eyes globular, peduncle broad, short. Basal antennal segment located within orbital hiatus, antennal flagellum with 13 segments (Figure 2B). Pterygostomium region smooth, slightly pubescent.

Buccal cavity broader than long, wider anteriorly; epistome broad, with median projection into buccal cavity. Third maxillipeds not gaping, mouth parts not visible in closed position. Ischium 1.3 times longer than broad, with parallel sides, broader than merus; inner margin pubescent. Merus roughly hexagonal, as long as broad; inner margin completely pubescent. Palp short,

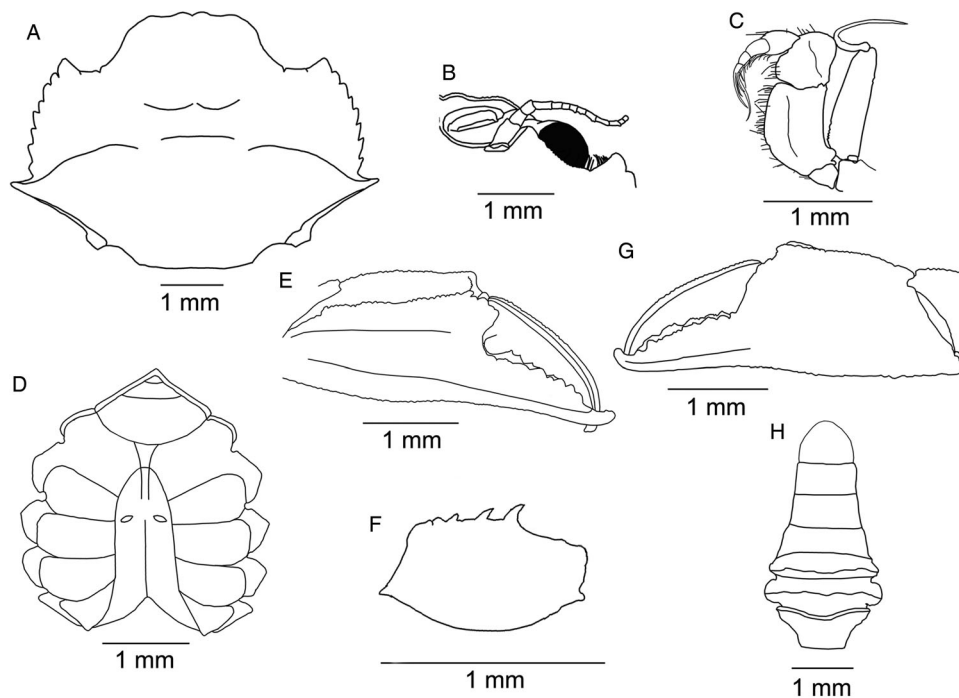


Figure 2. *Carupella banlaensis*. Line diagrams of (A) the dorsal surface of the carapace; (B) the ventral surface of the orbit and antennular fossa; (C) the ventral surface of the third maxilliped; (D) the ventral surface of the sternum; (E) the outer surface of the dactylus and the propodus of the right cheliped; (F) the ventral surface of the merus of the left cheliped; (G) the outer surface of the dactylus and the propodus of the left cheliped; (H) the ventral surface of the abdomen (female).

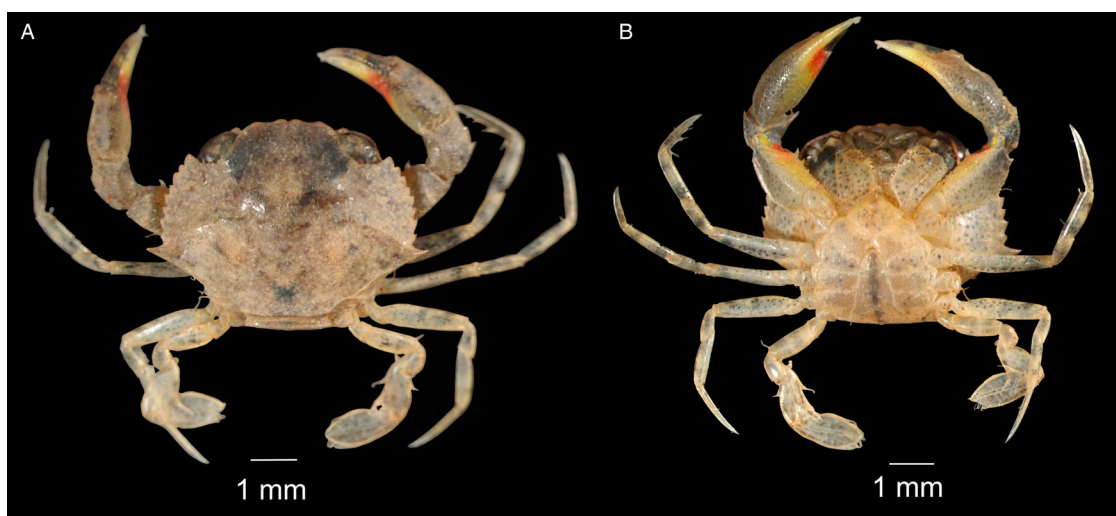


Figure 3. *Carupella banlaensis*. Colour photographs of (A) the dorsal surface of the carapace and (B) the ventral surface of the carapace.

reaches to half level of ischium, covered with long setae; distal segments progressively smaller. Exopod slender, with long flagellum (Figure 2C).

Thoracic sternum broad ($SW/CW = 0.5 \pm 0.03$), its surface smooth, pitted; lateral margins microscopically granulated. First three thoracic sternites narrow, sutures 1/2 and 2/3 prominent. Suture 3/4 wide and shallow. Sternite 4 widest, medially divided by shallow anterior extension of sterno-abdominal cavity. Abdominal cavity commences from middle of sternite 4 and covers sternites 5–8. Deep groove along abdominal cavity medially divides sternites 5–8. Pair of gonopores located at sternite 5 (Figure 2D).

Lengths of chelipeds of larger female heterodonts less than two times carapace length. Dactylus of right cheliped thick, glossy, pitted, curved distally with blunt tip; dorsal surface with two ridges; cutting edge proximally armed with large blunt tooth followed by six small, sharp teeth; distal one-third portion unarmed (Figure 2E). Pollex thick, glossy, pitted, slightly curved distally; cutting edge with proximal depression to accommodate corresponding dactyl tooth. Fingers crossed in closed position, not gaping. Propodus granulated, its length more than two times its depth ($PL/PD = 2.6$); outer surface bears two granulated costae; upper surface sparsely pubescent, bears two blunt spines on distal margin trailed by granulated costae; third spine anterior to articulation with carpus (Figure 2E). Carpus with granulated upper surface, bears one large spine at its inner angle and two small spines at outer angle; five ridges on outer surface. Merus glossy, granulated, sparsely pubescent, anterior margin serrated, bears three large spines followed by small proximal granules; posterior margin serrated,

bears distal spine (Figure 2F). Ischium, basis and coxa with granulated outer margins, glossy lower margins; inner margins pubescent. Dactylus of left cheliped devoid of proximal blunt tooth (Figure 2G); $PL/PD = 2.8$. Structures and ornamentations of left dactylus, propodus, carpus, merus, ischium, basis and coxa similar to those of right cheliped. Chelipeds of smaller female in deteriorated condition.

Pereiopods slender, dorsoventrally flattened, pubescent, shorter than chelipeds. Pereiopod 2 longest, its length less than two times CL; pereiopods 3 and 4 subequal, pereiopod 5 smallest. P2–P4 dactyli subcylindrical, pubescent, with pointed tips, their lengths subequal to propodi; propodi subcylindrical, pubescent; carpi pubescent; meri longest, subcylindrical, pubescent. P5 paddle-like, its dactylus oval-shaped, dorsoventrally flattened, thickly pubescent, bearing serrated margins and ending distally in spine; propodus dorsoventrally flattened, thickly pubescent, bearing serrated margins; carpus and merus subcylindrical, pubescent. Pereiopods 2–5 of smaller female in deteriorated condition.

Abdomen narrow ($AW/CW = 0.3 \pm 0.04$), of six somites and telson, its surface glossy and pitted. First somite narrower than second, second somite widest, somites 3–6 free, progressively narrow, sixth somite with slightly converging lateral margins; somites 2–3 with prominent transverse carinae; telson bluntly triangular (Figure 2H).

Colour

Carapace of fresh specimens light brown dorsally with dark greyish blotches on the anterior median portion; scattered dark blotches on the cardiac region (Figure 3A), light

brown ventrally, dotted with black melanophores (Figure 3B). Chelipeds light brown dorsally with scattered darker blotches on dactylus and propodus; inner surfaces of dactyli and propodi yellow with conspicuous reddish blotch at the base of fingers, finger tips whitish; outer surfaces of propodi, carpi and meri greyish to light brown, dotted with black melanophores; inner surfaces of meri yellowish with distal red blotch (Figure 3A,B). Pereiopods 2–5 light brown coloured, dotted with black melanophores and bear greyish bands on the distal four segments (Figure 3A,B). Colouration of formalin-preserved specimens is uniform light brown.

Distribution and habitat

Carupella banlaensis was previously known from the Gulf of Tonkin (China) and Somalia. The present observation of this species along Goa, on the west coast of India, is a new distributional record for the entire South Asian region. *Carupella banlaensis* specimens were collected from clayey substratum underneath loose oyster-covered rocks in the vicinity of mangrove vegetation at low tide.

Comparisons

The *Carupella banlaensis* specimens superficially resembled juveniles of the mud crab *Scylla*, and a comparison between the two revealed the following differences.

- (1) Carapace of *Carupella banlaensis* specimens opaque (Figure 4A) as compared to the translucent carapace of *Scylla* juvenile (Figure 4B).
- (2) Low RL:CL ratio (0.2) in *Carupella banlaensis* specimens as compared to the *Scylla* juvenile (0.36) (Figure 5).
- (3) The frontal lobe in *Carupella banlaensis* specimens is much less prominent (Figure 5A) compared to that of the *Scylla* juvenile (Figure 5B).

Comparison of the *Carupella banlaensis* specimens with an immature *Scylla* female collected from the study area revealed that the former specimens differed from the latter by virtue of 'narrow basal antennal segment devoid of distal lobule' (Figure 6A), as compared to 'broad basal antennal segment possessing conspicuous distal lobule' (Figure 6B).

The present specimens were compared with existing descriptions of three known species of the genus *Carupella* (Crosnier, 1962; Tien, 1969; Zarenkov, 1970).

- (1) The present specimens (Figure 7A) resembled Tien's (1969) diagrams of *C. banlaensis* (Figure 7B) by virtue of less-prominent median frontal lobes, which are separated from the lateral frontal lobes by a very shallow notch. Alternatively, the median frontal lobes of *C. epibranchialis* (Figure 7C) and *C. natalensis* (Figure 7D) are more prominent and separated from the lateral frontal lobes by a deep notch.
- (2) The present specimens possess 'bluntly triangular anterolateral teeth' (Figure 7A) as in *C. banlaensis* (Figure 7B). In *C. epibranchialis*, the first eight anterolateral teeth are spine-like, distinctly alternating long and short (Figure 7C). In *C. natalensis*, the first eight anterolateral teeth decrease in size posteriorly (Figure 7D). The ninth anterolateral tooth is directed laterally in the present specimens (Figure 7A) as in *C. banlaensis* (Figure 7B) and *C. epibranchialis* (Figure 7C), whereas in *C. natalensis*, it is directed anterolaterally (Figure 7D).
- (3) The present specimens possess mesogastric, meta-gastric and epibranchial ridges on the dorsal



Carupella banlaensis

Scylla juvenile

Figure 4. Colour photographs (live specimens) of the carapace and the appendages of (A) *Carupella banlaensis* and (B) *Scylla* juvenile.

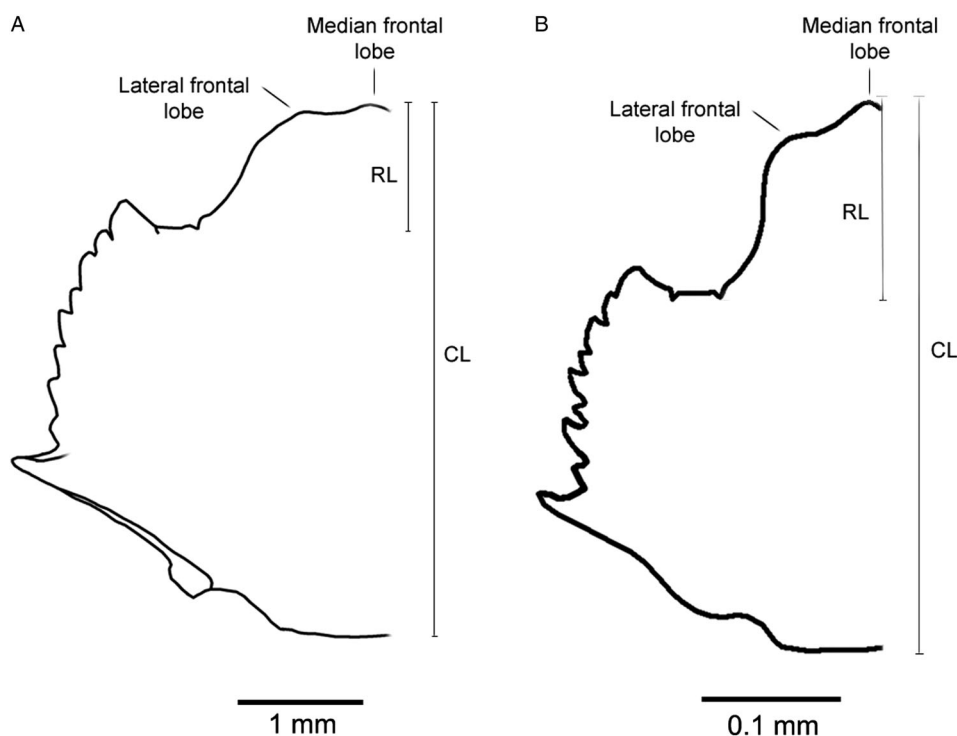


Figure 5. Line diagrams of dorsal surface of carapace of (A) *Carupella banlaensis* and (B) *Scylla* juvenile indicating the rostral length (RL) and the carapace length (CL).

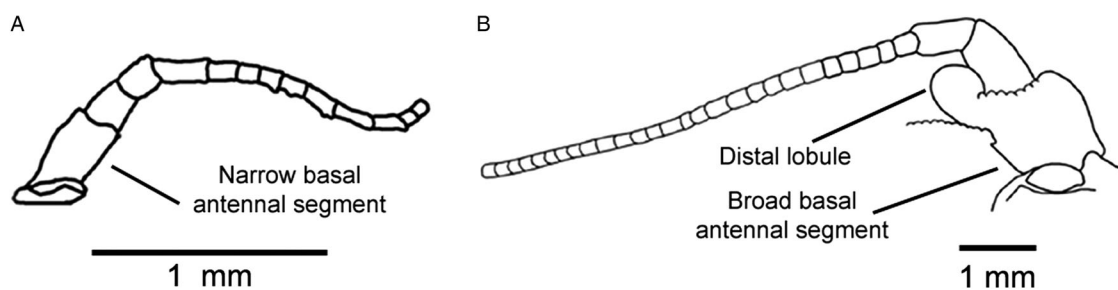


Figure 6. Line diagrams of the antenna (including the basal antennal segment) of (A) *Carupella banlaensis* and (B) immature *Scylla* female.

surface of the carapace (Figure 7A), which is similar to *C. banlaensis* (Figure 7B) and *C. natalensis* (Figure 7D); the metagastric ridge is interrupted in *C. natalensis* (Figure 7D). Alternatively, only a short epibranchial ridge is present in *C. epibranchialis* (Figure 7C).

The above comparisons revealed that the present specimens were morphologically most similar to *C. banlaensis*.

The present specimens were observed to be morphologically similar to Tien's (1969) original description of *C. banlaensis*, with the exception of the internal orbital tooth almost merging with the frontal margin, and two spines on the posterior margin of the merus

of the cheliped. In the present specimens, the internal orbital tooth is indistinguishable from the frontal margin and there is one distal spine on the posterior margin of the merus of the cheliped.

Remarks

The present observations describe a new distributional record of the rare portunid crab *Carupella banlaensis* from India and provide a detailed morphological description of this species complemented with illustrations and morphometric ratios. These observations indicate that *Carupella banlaensis* has an extremely patchy distribution within its known geographical range from China to eastern Africa.

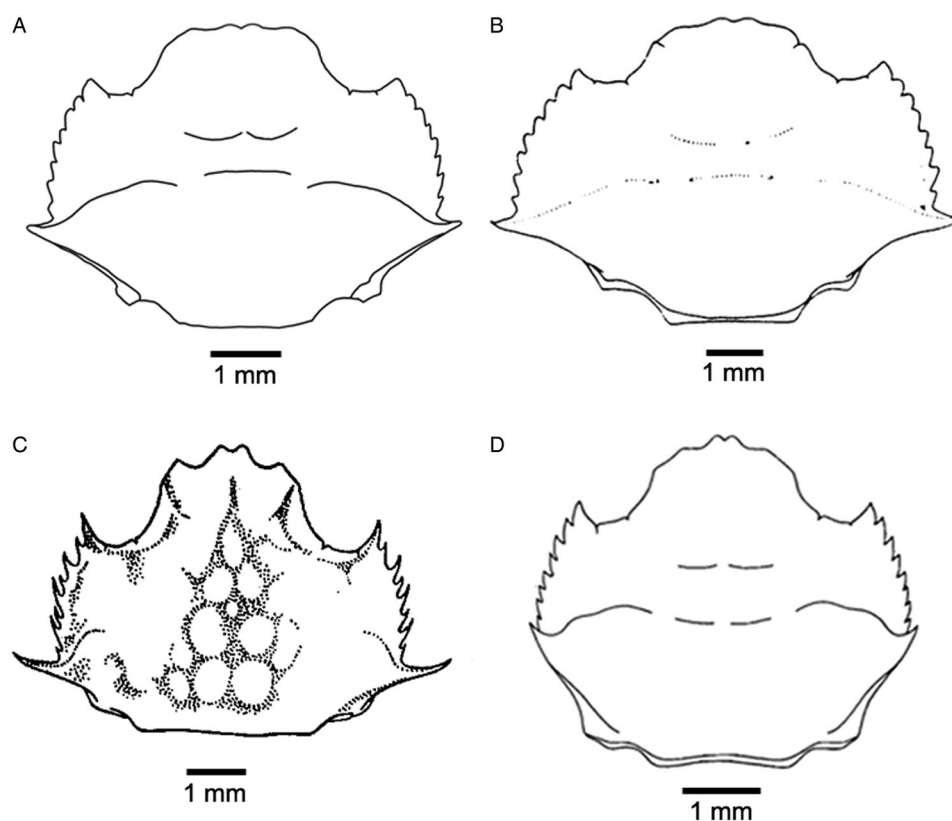


Figure 7. Line diagrams of the dorsal surface of the carapace of (A) *Carupella banlaensis* (present specimen), (B) *Carupella banlaensis* (type specimen – China; Tien 1969), (C) *Carupella epibranchialis* (type specimen – East China Sea; Zarenkov 1970) and (D) *Carupella natalensis* (Madagascar; Crosnier 1962).

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Disclosure statement

No potential conflict of interest was reported by the authors.

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