A new species of *Tortanus* (Atortus) (Copepoda, Calanoida, Tortanidae) from Minicoy Island, southeastern Arabian Sea

Sanu Vengasseril FRANCIS*, Sivasankaran BIJOY NANDAN
Department of Marine Biology, Microbiology, and Biochemistry, School of Marine Sciences, Cochin University of Science and Technology, Kerala, India

**Abstract:** A new species of the planktonic calanoid copepod genus *Tortanus*, subgenus *Atortus*, is described from a coral reef lagoon of Minicoy Island, southeastern Arabian Sea. The new species is included in the *tropicus* group, which is mainly distributed in the tropical and subtropical waters of Southeast Asia. The species can be distinguished from all other species of the *tropicus* group by the asymmetrical fifth pedigerous somite with notched left margin and triangular lobe in the right, hyaline coupling device with larger left process, 2 ventrolateral spines in the genital compound somite, and caudal rami with 2 medial rounded processes in the female. In the male, serrated ridge of the right antennule slightly raised from the surface plane, beak-shaped medial process on the right fifth leg coxa, triangular medial process on the basis, and strongly curved subdistal seta on the left fifth leg. Mitochondrial cytochrome oxidase subunit I sequences of the specimens obtained with 642 base pairs confirmed the female–male correspondence and revealed the genetic identity of the species, which is herein compared with mtCOI sequences of congeners.

**Key words:** Copepoda, *Tortanus*, southeastern Arabian Sea, new species

1. Introduction
The calanoid copepod genus *Tortanus* Giesbrecht, 1898 (Calanoida, Tortanidae) currently comprises 47 species (Walter and Boxshall, 2018; http://www.marinespecies.org); these are mainly distributed in coastal waters of the Indo-West Pacific and the northwestern Atlantic (Mulyadi et al., 2017). They are known to be typical carnivores, feeding on copepods and other zooplankters (Ambler and Frost, 1974; Uye et al., 1994; Hooff and Bollens, 2004; Nishida et al., 2015; Mulyadi et al., 2017). Five subgenera have so far been recognized in this genus: *Tortanus* (Tortanus) Giesbrecht, 1898; *T. (Eutortanus)* Smirnov, 1933; *T. (Boreotortanus)* Ohtsuka, 1992; *T. (Acutanus)* Ohtsuka, 1992; and *T. (Atortus)* Ohtsuka, 1992. The subgenus *Atortus*, accommodating 32 nominal species (Mulyadi et al., 2017), is regarded as the most advanced and is distributed exclusively in the Indo-West Pacific region. It tends to occur in more or less oligotrophic, clear, high-salinity (34–40 PSU) waters sometimes strongly influenced by warm currents, or in coral reefs and seagrass beds (Ohtsuka and Kimoto, 1989; Ohtsuka and Reid, 1998; Ohtsuka et al., 2000; Nishida and Cho, 2005; Nishida et al., 2015; Mulyadi et al., 2017). It must also be mentioned that cooccurrence of multiple closely related species of *Tortanus* (Atortus) makes it difficult to determine their female–male correspondence solely on the basis of morphology (Nishida et al., 2015; Mulyadi et al., 2017). Morphological studies with the analysis of genetic markers are essential to establish the female–male correspondence (Francis and Nishida, 2018; Francis et al., 2018). The present study describes a new species of *Tortanus* (Atortus) from a coral lagoon of Minicoy Island, southeastern Arabian Sea; molecular data of the new species are also provided to determine the female–male correspondence.

2. Materials and methods
The zooplankton samples were collected from two stations (S1 and S2) during the daytime on 24 January 2014, from the coastal lagoon waters of Minicoy Island (8°05′N, 73°37′E) in the southeastern Arabian Sea (Figure 1) using a plankton net (mesh size 200 µm; mouth area 0.28 m²). The net was towed horizontally just below the water surface at a speed of 1 knot for 10 min. For morphological analysis, the samples were fixed in 4% buffered formalin. *Tortanus* (Atortus) specimens were sorted from the original samples, and mouthparts and swimming legs were dissected with needles in a 50:50 solution of glycerin and distilled water. Line illustrations were made using a drawing tube.
attached to a Lynx bright-field compound microscope (LM 52-1704, Vision Engineering, Palmdale, CA, USA) with 40–1000× magnifications. Type specimens were deposited in the Zoological Survey of India (ZSI), Kolkata, and nontype specimens were deposited in the museum of the Department of Marine Biology, Microbiology, and Biochemistry, School of Marine Sciences, Cochin University of Science and Technology. The morphological terminology follows Huys and Boxshall (1991) and Ohtsuka and Reid (1998), and the total length of the specimen was measured from forehead margin to caudal rami.

For molecular analysis, the alcohol-preserved specimens were hydrated in 0.5 mL of sterile distilled water for 10–12 h at room temperature prior to extraction of DNA. Genomic DNA was extracted from adult individual copepods using the DNeasy Blood and Tissue Kit (QIAGEN, Hilden, Germany) following the spin column protocol. The PCR reaction mixture consisted of 25 µL of Master Mix (Takara Clontech EmeraldAmp GT PCR Master Mix; Takara Bio, Shiga, Japan), 1 µL of forward primer, 1 µL of reverse primer, 8 µL of template DNA, and 15 µL of distilled deionized H₂O. The amplification primers were LCO-1490 F (5’-GGTCAACAATCATAAGATATTGG-3’) and HCO-2198 R (5’-TAAACTTCAAGGGTGACCAAAAAATCA-3’), used for amplifying mtCOI gene sequences (Folmer et al., 1994). Amplification was carried out in an Agilent Technologies Sure Cycler 8800 thermal cycler (Agilent Technologies, Santa Clara, CA, USA). The amplification protocol was denaturation at 94 °C for 1 min, annealing at 37 °C for 2 min, and extension at 72 °C for 3 min. The amplification was carried out through 40 cycles. Amplified products exhibiting intense bands after agarose gel electrophoresis (1.2%) were purified and sent to AgriGenom Labs (AgriGenom Labs Pvt., Ltd., Ernakulam, India) for sequencing. Obtained sequences were assembled using BioEdit 7.0.9 (Hall, 1999), and alignment was performed using ClustalX (Thompson et al., 1997). Intraspecific pairwise sequence distance and a maximum likelihood tree (ML tree) were established using the Kimura 2-parameter model in MEGA5 (Tamura et al., 2011). Bootstrap analysis was performed using 1000 pseudo-replications. Intraspecific aligned sequences were submitted to the National Center for Biotechnology Information (NCBI) database (www.ncbi.nlm.nih.gov).

Figure 1. Map showing sampling locations at Minicoy Island, Union Territory of Lakshadweep, southeastern Arabian Sea.
3. Results and discussion
Order: Calanoida Sars, 1903
Superfamily: Diaptomoidea Baird, 1850
Family: Tortanidae Sars, 1902
Genus: *Tortanus* Giesbrecht & Schmeil, 1898

*Tortanus (Atortus) minicoyensis* sp. nov. (Figures 2–5)

3.1. Type
Holotype: Adult female, dissected parts were preserved in a small vial in 4% formaldehyde/seawater with a drop of glycerol (ZSI-C6655/2). Allotype: Adult male (ZSI-C6656/2). Paratypes: 5 females ZSI-C6657; 1 dissected and 4 intact males ZSI-C6658/2.

Fifteen intact females (MBM/DBT/10/15) and 15 intact males (MBM/DBT/09/15) preserved in a vial were deposited as nontype materials.

3.2. Description
Female: Total length, 2.66–2.94 mm (mean ± SD = 2.80 ± 0.07 mm, N = 20; holotype, 2.82 mm); prosome length 2.1–2.29 mm (2.19 ± 0.09 mm; holotype, 2.23 mm), width 0.82–0.97 mm (0.89 ± 0.07 mm; holotype, 0.83 mm). Prosome (Figure 2A) about 3.5 times as long as urosome. Cephalosome and first pedigerous somite separated; fourth and fifth somite fused. Fifth pediger asymmetrical: left margin with a notch, right margin with a single downward

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**Figure 2.** *Tortanus (Atortus) minicoyensis* sp. nov., female (holotype): A) habitus, dorsal view; B) antennule; C) urosome dorsal view (arrows indicate 2 rounded processes on the caudal rami); D) urosome ventral view; the coupling device is dotted in A, C, D.
directed triangular lobe. Urosome composed of 2 segments; genital compound somite asymmetrical; right margin with a prominent bulge at about midpoint (Figure 2C) with 2 ventrolateral pointed spines (Figure 2D). Genital operculum semicircular, ventrally located at anterior one-third of the genital compound somite. Second urosomite (anal somite) completely fused with caudal rami. Caudal rami asymmetrical, with 2 rounded processes. Left ramus slightly broader than right ramus (Figures 2A, 2C). All specimens carrying hyaline coupling device with left process larger than the right one, covering the dorsolateral process of fifth pedigerous somite and left lateral surface of genital compound somite (Figures 2A, 2C, 2D). Antennule (Figure 2B) 15-segmented, symmetrical, reaching posterior margin of caudal ramus. Ancestral segments I–IX (segment 1), XI–XIV (segment 3), and XXVI–XXVIII (segment 15) totally or partially fused. Armatures as follows: I–IX, 9 + 2ae (aesthetasc); X, 2; X–XIV, 7 + ae; XV, 1; XVI, 1 + ae; XVII, 0; XVIII, 2 + ae; XIX, 1; XX, 2; XXI, 1; XXII, 1; XXIII, 1; XXIV, 1; XXV, 1 + 1 + ae; XXVI–XXVIII, 6 + ae. Antenna (Figure 3A) coxa unarmed; basis and first endopodal segment completely fused with medial seta at proximal third, distomedial seta and distolateral row of spinules, second and distal segments incompletely fused,
distal segment with proximolateral setules and 6 apical setae. Exopod 3-segmented, proximal segment short, naked; middle and distal segment incompletely fused with 3 and 2 setae, respectively. Mandible blade (Figure 3C) with 5 cuspidate teeth, main tooth and second ventral-most tooth separated by wide diastema; both teeth with articulated tip; dorsal-most tooth monocuspidate while remaining 2 teeth bicuspidate, 4 dorsal-most teeth with 4 longitudinal spinule rows proximally; mandibular palp (Figure 3B) basis elongate, cylindrical and unarmed; endopod 2-segmented, proximal segment unarmed, distal segment with 6 setae. Exopod 1-segmented, with 5 setae. Maxillule (Figure 3D) basis absent, precoxal arthrite with 11 spinulose setae apically and 2 setae dorsally; coxal endite with 3 stout, spinulose terminal setae. Maxilla (Figure 3E) syncoxa endites with 1, 2, 2, and 3 setae from proximal to distal; basal endite with 1 developed and 2 rudimentary setae; endopod with 5 stout setae with claw-like tip and 2 rudimentary setae. Maxilliped (Figure 3F) syncoxa with 2 endites, each with spinulose seta; basis unarmed; endopod with 3 medial spinulose setae and lateral seta. Legs 1–4 with 2-segmented endopods and 3-segmented exopods (Figures 4A–4D). Distal endopodal segment of legs 1–4 with hair tuft on anterior surface subdistally. Seta and spine formula as in Table 1. Outer setae on leg 1 basis minute. Leg 5 uniramous (Figure 3G), 2-segmented, symmetrical with coxa, and intercoxal sclerite fused as a basal plate; exopodal lobe trapezoid with distolateral seta bearing fine hairs along its margin.

Male: Total length, 2.25–2.74 mm (mean ± SD = 2.35 ± 0.05 mm, N = 20; allotype, 2.27 mm), prosome length 1.62–1.73 mm (1.73 ± 0.05 mm; allotype, 1.72 mm), width 0.59–0.67 mm (0.65 ± 0.07 mm; allotype, 0.62 mm). Prosome about 3 times as long as urosome (Figure 5A). Posterior corners of pedigerous somite 5 symmetrical, rounded. Urosome of 5-somites. Second urosomite with posterolateral and posteroventral processes on right side (Figure 5D), of which latter smaller, each with minute setae on the tip. Caudal rami are nearly symmetrical. Cephalic appendages similar to those of female except right antennule. Right antennule geniculate (Figure 5B), 16-segmented; ancestral segment I–VIII (segment 1), XXI–XXIII (segment 15), and XXIV–XXVIII (segment 16) totally or partially fused; segments XVI–XIX expanded. Armature as follows: I–VIII, 11 + 2ae; IX, 2; X, 2; XI, 2 + ae; XII, 1; XIII, 1; XIV, 2; XV, 1; XVI, 2 + ae; XVII, 2; XVIII, 2 + ae, XIX, 1 + P (process); XX, 1 + P; XXI–XXIII, 2 + ae + 2P; XXIV–XXVIII, 9 + 2ae. The anterior surface of segment XX furnished with a serrated ridge that retroflexes near base of segment XX and extends to the triangular process of segment XIX (Figures 5B, 5C). Hinge joint formed between segment XX and fused segments XXI–XXIII. The distal end of the segment with a long spinous process extending the half-length of the fused segments XXIV–XXVIII. Legs 1–4 as in female. Right leg 5 coxa semitrapezoid (Figure 5E) with the beak-like medial process; basis semicircular with seta on posterior surface.
Figure 5. *Tortanus (Atortus) minicoyensis* sp. nov., male (allotype): A) habitus, dorsal view; B, C) antennule; D) urosome right lateral view; E) right leg 5 posterior view; F) left leg 5 posterior view; G) second exopodal segment of left leg 5. Cox, coxa; Bas, basis; Exp, exopod; Exp 1, first exopod; Exp 2, second exopod. Arrows indicate 3 rounded processes on the basis of left leg 5.
and digitiform medial process bearing 2 setae, one distal and the other basal (Figure 5E). Exopod 1-segmented, slightly curved medially, tapering distally into the narrow tip, bearing 1 minute seta on midanterior. Left leg 5 (Figure 5F) longer than the right, coxa without seta. Basis elongate, straight, with 3 low, rounded processes at regular intervals and lateral seta at distal third and medial seta halfway along the inner margin of the segment. Exopod 2-segmented, the proximal segment with proximomedial, digitiform process bearing subdistal seta, distal segment with patches of setules on the anterior surface, 2 lateral minute setae, 2 medial setae, and blunt subdistal seta strongly curved along the hemispherical tip of the segment with the granular surface (Figure 5G).

**Etymology:** The specific name *minicoyensis* refers to the name of the type locality of this species. It therefore is a toponymic term, agreeing in gender with the masculine generic name.

### 3.3. Molecular analysis

The mtCOI sequences were successfully generated using the primer pair, reaction mix, and thermal regime described above. The developed sequences of female and male *T. minicoyensis* sp. nov. were submitted to the NCBI database and assigned the following accession numbers: KP749951 to KP749953 for males, and KP749954 for females. ML analysis was performed, and pairwise sequence distances were generated and analyzed using the developed sequences as well as the mtCOI sequences of their 9 congeneric species acquired from the NCBI database (Table 2). *Nassodonta insignis* H. Adams, 1867 (KP739843) was selected as the outgroup. The ML tree clearly exhibited the differential assemblage of congeneric species of the genus *Tortanus* (Figure 6). Female and male *T. minicoyensis* sp. nov. sequences were arrayed within a single clade with a high bootstrap value (100%), which is distinct from all other sequences of subgenus *Atortus* based on 1000 bootstrap pseudo-replicas. The outgroup *N. insignis* exhibited maximum divergence array. The level of inter- and intraspecific divergence persisting within the genus *Tortanus* was evident from the distance matrix data. Specifically, *T. minicoyensis* sp. nov. possessed an intraspecific sequence divergence ranging from 0%–0.4% (Table 3).

### 3.4. Remarks

The subgenus *Atortus* has been classified into 2 morphological groups; the first one is the *tropicus* group sensu Othman, 1987, and the second is the *murrayi* group sensu Othman, 1987 (Ohtsuka and Kimoto, 1989; Mulyadi et al., 2017). From the structure of female leg 5, male antennule, and leg 5, *Tortanus* (*A.*) *minicoyensis* sp. nov. is assigned to the *tropicus* species complex within the subgenus *Atortus* Ohtsuka, 1992. The female of *T. minicoyensis* sp. nov. can be distinguished from all other species of the *tropicus* group (*T. bowmani* Othman, 1987).

| Species | Abbreviation | Accession No. | Remarks |
|---------|--------------|---------------|---------|
| *Tortanus* (*Atortus*) *minicoyensis* sp. nov. ♂ | TM ♂ | KP749951–KP749953 | Developed |
| *Tortanus* (*Atortus*) *minicoyensis* sp. nov. ♀ | TM ♀ | KP749954 | Developed |
| *T.* (*Boreotortanus*) discaudatus | TD | AF513648 | Obtained |
| *T.* (*Atortus*) erabuensis | TE | AF474113 | Obtained |
| *T.* (*Tortanus*) forcipatus | TF | AF513649, AY145431 | Obtained |
| *T.* (*Atortus*) ryukyuensis | TR | AF474114 | Obtained |
| *T.* (*Atortus*) insularis | TI | KC287905 | Obtained |
| *T.* (*Eutortanus*) derjugini | TDE | AF513647, AF474112 | Obtained |
| *T.* (*Eutortanus*) dextrilobatus | TDX | AY145430 | Obtained |
| *T.* (*Eutortanus*) komachi | TK | JN605792 | Obtained |
| *T.* (*Eutortanus*) vermiculus | TV | JN605791 | Obtained |
| *Nassodonta insignis* | NI | KT985464 | Obtained |

**Table 2.** Details of sequences incorporated and species abbreviations used in the molecular analysis, as applied in Table 3.
Table 3. Distance matrix showing inter- and intraspecific percentage divergence of *Tortanus minicoyensis* sp. nov. and other species of the genus *Tortanus*. See Table 2 for codes for specimens and species.

| Accession No. | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  |
|---------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1  | KP749952 TM ♂ |       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 2  | KP749953 TM ♂ | 0.0  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 3  | KP749951 TM ♂ | 0.0  | 0.0 |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 4  | KP749954 TM♀ | 0.4  | 0.4 | 0.4 |     |     |     |     |     |     |     |     |     |     |     |     |
| 5  | AF513648 TD   | 22.9 | 22.9| 22.9| 22.7|     |     |     |     |     |     |     |     |     |     |     |
| 6  | AF474113 TE   | 18.7 | 18.7| 18.7| 18.7| 16.9|     |     |     |     |     |     |     |     |     |     |
| 7  | AF513649 TF   | 21.9 | 21.9| 21.9| 21.9| 21.2| 19.9|     |     |     |     |     |     |     |     |     |
| 8  | AY145431TF    | 19.2 | 19.2| 19.2| 19.3| 18.4| 3.3 |     |     |     |     |     |     |     |     |     |
| 9  | KC287905 TI   | 20.9 | 20.9| 20.9| 19.0| 20.9| 22.8| 21.2|     |     |     |     |     |     |     |     |
| 10 | AF513647 TDE  | 17.9 | 17.9| 17.9| 19.6| 15.4| 22.5| 20.9| 21.4|     |     |     |     |     |     |     |
| 11 | AF474112 TDE  | 18.4 | 18.4| 18.4| 19.0| 15.7| 23.4| 21.5| 20.6| 1.4 |     |     |     |     |     |     |
| 12 | AY145430 TDX  | 20.3 | 20.3| 20.3| 19.0| 20.1| 23.6| 22.0| 20.0| 8.6 | 8.4 |     |     |     |     |     |
| 13 | AF474114 TR   | 22.5 | 22.5| 22.5| 22.5| 25.3| 20.1| 24.2| 23.7| 23.3| 18.0| 18.5| 20.9|     |     |     |
| 14 | JN605792 TK   | 21.0 | 21.0| 21.0| 18.2| 21.1| 24.2| 23.4| 20.8| 19.1| 19.1| 19.1| 25.5|     |     |     |
| 15 | JN605791 TV   | 18.4 | 18.4| 18.4| 18.5| 18.4| 23.6| 21.7| 18.8| 15.4| 14.6| 17.2| 22.5| 19.7|     |     |
| 16 | KT985464 NI   | 34.4 | 34.4| 34.4| 36.0| 34.4| 35.7| 33.1| 34.7| 35.7| 35.0| 34.0| 40.0| 38.7| 34.4|     |
The species of the subgenus *Atortus* hitherto known from the Indian Ocean are *Tortanus (Atortus) andamanensis* and *T. sigmoïdes* Nishida, Anandavelu & Padmavati, 2015; *T. magnonyx* Ohtsuka & Conway, 2005; *T. insularis* Ohtsuka & Conway, 2003; *T. nishidai* Ohtsuka, El Sherbiny & Ueda, 2000; *T. tropicus* Sewell, 1932; and *T. recticauda* Giesbrecht, 1889 (http://copepodes.obs-banyuls.fr/en). Among them, *T. tropicus* is the largest (female 2.71 mm; male 2.29 mm) (Sewell, 1932; and Sewell, 1932). However, the new species herein described has the largest length range known in the genus (female 2.66–2.74 mm). The differential diagnosis of *T. minicoyensis* sp. nov. with all other species of the subgenus *Atortus* from the Indian Ocean is represented in Tables 4 and 5. *T. minicoyensis* sp. nov. was found swarming along with *Acartia bispinosa* Carl, 1907, *Labidocera madurae* A. Scott, 1909, *Undinula vulgaris* Dana, 1849, and *Centropages orsinii* Giesbrecht, 1889 in the present collection. The swarming behavior of members of the subgenus *Atortus* have been observed in oligotrophic clear waters mainly in subtropical and tropical areas (Kimoto et al., 1988; Ohtsuka and Kimoto, 1989; Ohtsuka and Reid, 1998; Ohtsuka et al., 2000) as a response to the presence of prey copepods, and also to avoid visual predators (Ohtsuka et al., 2010). The mtCOI sequences were developed for *T. minicoyensis* sp. nov. to bring out the molecular variance from the congeners and establish the female–male correspondence of the species. The speciation of *T. minicoyensis* sp. nov. is exhibited in the genetic distance matrix, which showed an intraspecific divergence of 0%–0.4%, which is under the threshold value of 4% for calanoid copepods (Bucklin et al., 2010).

Key to the species of subgenus *Atortus* from the Indian Ocean:

**Adult females:**
1. Genital compound somite asymmetrical ........................................ 2
2. Genital compound somite right anterolateral margin slightly swollen ........................................ *T. andamanensis*
3. Caudal rami slightly asymmetrical with left ramus stouter and shorter than the right one .......... *T. insularis*
4. Genital compound somite with a bulge on the left or right side ........................................................................................................... 5
   - Genital compound somite strongly asymmetrical, with the pointed process on the right ventrolateral side .... ................................................................. *T. magnonyx*
5. Genital compound somite expanded anterolaterally on both sides ending in small papilla with apical spinule, right expansion strongly convex to straight laterally ........
   - Genital compound somite with a prominent bulge on the right side with 2 dorsoventral spines, caudal rami asymmetrical with left ramus slightly larger and right ramus not curved, fifth leg without spines at distal end .... ................................................................. *T. recticauda*
6. Genital compound somite with a small bulge on the left side, caudal rami asymmetrical with left ramus stouter and right ramus slightly curved, fifth leg with spine at distal end ............................................................................................. *T. tropicus*
   - Genital compound somite with a prominent bulge on the right side with 2 dorsoventral spines, caudal rami asymmetrical with left ramus slightly larger and right ramus not curved, fifth legs without spines at distal end .... ................................................................. *T. minicoyensis* sp. nov.

**Adult males:**
1. Left leg 5 subdistal seta strongly curved along hemispherical tip with the granular surface, and right coxa of leg 5 truncate with an uncinated corner, basis bearing medial bilobed process near midlength ................................................................. *T. recticauda*
2. Left leg 5 with subdistal spiniform terminal seta, and right leg coxa produced into the rectangular process, basis bearing rounded, flattened process located at inner distal corner ................................................................. *T. nishidai*
3. Right leg 5 coxa without any process ........................................ 4
   - Basis bearing small rounded process .......... *T. tropicus*
4. Left leg 5 subdistal seta serrated along inner margin, and right leg 5 basis tapering proximally with triangular process ................................................................. *T. magnonyx*
5. Left leg 5 terminal portion of second exopodal segment acutely pointed at tip, with serrated subdistal seta, and right leg 5 coxa bearing 3 acutely pointed prominences of unequal size, basis bearing large bilobed process at midlength ................................................................. *T. insularis*
6. Left leg 5 with subdistal blunt seta, and right leg 5 coxa semispherical with semispherical medial process, basis semicircular with the medial process being ocarina-shaped with depression on distomedial margin and with small rounded process at distal side of its base ................................................................. *T. andamanensis*
7. Left leg 5 with subdistal short seta, and right leg 5 coxa semicircular with small bilobed medial process, basis semicircular with fingerlike medial process ....... *T. sigmoides*

8. Left leg 5 subdistal seta strongly curved along hemispherical tip with the granular surface, and right leg 5 coxa semitrapezoid with a beak-shaped medial process, basis semicircular and bearing triangular medial process ...

7. Left leg 5 with subdistal short seta, and right leg 5 coxa semicircular with small bilobed medial process, basis semicircular with fingerlike medial process ....... *T. sigmoides*

8. Left leg 5 subdistal seta strongly curved along hemispherical tip with the granular surface, and right leg 5 coxa semitrapezoid with a beak-shaped medial process, basis semicircular and bearing triangular medial process ...

**Nomenclatural acts:** This work and the nomenclatural acts it contains have been registered in ZooBank. The ZooBank Life Science Identifier (LSID) for this publication is: urn:lsid:zoobank.org:pub:3F2596B8-E1F9-4321-9157-BED7BC773638

**Acknowledgments**
This study was funded by the Department of Biotechnology of the Government of India [BT/PR4258/AAQ/3/575/2011].
Table 5. Differential diagnosis of the male *T. minicoyensis* sp. nov. from all other species of the subgenus *Atortus* from Indian Ocean.

| Species                     | Serrated ridge of right antennule                     | Right leg 5 coxa | Right leg 5 basis | Left leg 5 subdistal seta                  |
|-----------------------------|-------------------------------------------------------|------------------|-------------------|------------------------------------------|
| *T. minicoyensis* sp. nov.  | Produced proximally over one-third of segment XIX and the ridge slightly raised from the surface plane of the segment (Figures 5B, 5C) | Semitrapezoid with a beak-shaped medial process (Figure 5E) | Bearing triangular shaped medial process with depression on distomedial margin and fused at the distal side of its base (Figure 5E) | Strongly curved along hemispherical tip with the granular surface (Figures 5F, 5G) |
| *T. andamanensis*           | Produced proximally over one-third of segment XIX (Nishida et al., 2015, fig. 4D) | Semitrapezoid with semispherical medial process (Nishida et al., 2015, figs 4F, 4G) | Semicircular and ocarina-shaped medial process with depression on distomedial margin and with the small rounded process at the distal side of its base (Nishida et al., 2015, figs. 4F, 4G) | Blunt distal seta (Nishida et al., 2015, figs. 4F, 4H) |
| *T. sigmoides*              | Sigmoid shape and produced proximally to the middle of segment XIX (Nishida et al., 2015, fig. 5D) | Semicircular with the small bilobed medial process (Nishida et al., 2015, figs. 5F, 5G) | Semicircular with the fingerlike medial process (Nishida et al., 2015, figs. 5F, 5G) | Short subdistal seta (Nishida et al., 2015, figs. 5F, 5H) |
| *T. magnonyx*               | Not produced over the segment XIX (Ohtsuka and Conway, 2005, fig. 3C) | Coxa unarmored (Ohtsuka and Conway, 2005, figs. 3D–3F) | Basis massive, tapering proximally, with triangular process bearing two spiniform setae on (Ohtsuka and Conway, 2005, figs. 3D–3F) | Terminal seta serrated along inner margin (Ohtsuka and Conway, 2005; figs. 3D, 3H) |
| *T. insularis*              | Not produced over the segment XIX (Ohtsuka and Conway, 2003, fig. 3D) | Unarmed bearing 3 acutely pointed prominences of unequal size (Ohtsuka and Conway, 2003, figs. 3G) | Massive basis, bearing large inner bilobed process at midlength (Ohtsuka and Conway, 2003, figs. 3E, 3G) | Pointed tip with serrated seta (Ohtsuka and Conway, 2003, figs. 3E, 3H) |
| *T. nishidai*               | Serrated ridge on segment XX extending almost along anterior margin of the segment (Ohtsuka et al., 2000, fig. 3D) | Coxa produced medially into rectangular process (Ohtsuka et al., 2000, figs. 3E, 3H) | Basis constricted proximally bearing minute seta at midlength on posterior surface (Ohtsuka et al., 2000; figs. 3E, 3H) | Spiniform terminal seta (Ohtsuka et al., 2000, figs. 3E–3G) |
| *T. tropicus*               | Produced completely over the segment XIX (Sewell, 1932, fig. 131f) | Without any process (Sewell, 1932, fig. 131g) | Small rounded process (Sewell, 1932, fig. 131g) | Not clear in the description (Sewell, 1932, fig. 131g) |
| *T. recticauda*             | Serrated ridge on segment XX slightly extended over segment XIX (Bowman, 1986, fig. 1E) | Coxa of leg 5 truncate with uncinate corner (Bowman, 1986, figs. 1G–1J) | Basis with bilobed process at midlength (Bowman, 1986, fig. 1G–1J) | Long spine with denticulated margin (Bowman, 1986, figs. 1G, 1H) |

The authors are thankful to the Head of the Department of Marine Biology, Microbiology, and Biochemistry, School of Marine Sciences, Cochin University of Science and Technology for facilities given, and gratefully acknowledge the assistance rendered by the Department of Science and Technology, Lakshadweep. Thanks also to the research fellowship provided to SVF under the University Grants Commission Basic Science Research Program of the Government of India. Special thanks are due to Dr Shuhei Nishida, Atmosphere and Ocean Research Institute, University of Tokyo, for specimen identification and initial preparation of the manuscript.
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