



A taxonomic review of the branchial fish parasitic genus *Elthusa* Schioedte & Meinert, 1884 (Crustacea: Isopoda: Cymothoidae) from Indian waters, with the description of three new species

Panakkool Thamban Aneesh¹ · Ameri Kottarathil Helna¹ · Appukuttannair Biju Kumar¹ · Jean-Paul Trilles²

Received: 17 January 2020 / Revised: 9 May 2020 / Accepted: 13 May 2020 / Published online: 6 August 2020
© Senckenberg Gesellschaft für Naturforschung 2020

Abstract

The genus *Elthusa* Schioedte & Meinert, 1884 from Indian waters is reviewed and three new species are described from India. A revised generic diagnosis is provided based on the type species and 13 species of *Elthusa* are regarded as *Elthusa incertae sedis*. Female stages of *Elthusa fistularia* sp. nov. collected from *Fistularia petimba* Lacepède, 1803 and *Elthusa pseudorhombus* sp. nov. from *Pseudorhombus duplicioccellatus* Regan, 1905 are described based on the female. *Elthusa uranoscopus* sp. nov. from *Uranoscopus guttatus* Cuvier, 1829 described from female and male. The female and male stages of *Elthusa samariscii* (Shiino, 1951) are redescribed and the transitional and larval (premanca and manca) stages are described. All the species were collected from the southwest coast of India. *Elthusa fistularia* sp. nov. is distinguished by cephalon 1.20 times wider than long; pleotelson broadly rounded, 1.70 times as wide as long, lateral margin convex; widest pleon 0.80 width of widest pereon; uropod rami subequal; and antenna 9-segmented, antennular bases moderately wide set. *Elthusa pseudorhombus* sp. nov. is characterized by cephalon 1.70 times wider than long; widest pleon 0.75 width of widest pereon; pleotelson 1.50 times as wide as long, evenly rounded; antenna with 10 articles, antennular bases widely separated; and uropod endopod shorter than exopod. *Elthusa uranoscopus* sp. nov. can be identified by cephalon 1.60 times wider than long, moderately immersed in the pereonite 1; widest pleon 0.84 width of widest pereon; pleotelson 1.80 times as wide as long posterior margin rounded, lateral margins convex; antenna 11 articulated, slightly longer than antennula, greatly wider antennular bases; and uropod rami, endopod longer than exopod.

Keywords Fish parasites · India

Introduction

The monotypic genus *Elthusa* Schioedte & Meinert, 1884 was established for *Livoneca emarginata* Bleeker, 1857. Bruce, (1990) gave a new provisional diagnosis to the genus, transferring 20 species from *Livoneca* Leach, 1818 into *Elthusa* along with the description of two new species, *Elthusa myripristae* Bruce, 1990 and *Elthusa sigani* Bruce,

1990. A further six species have since been described from New Caledonia, Mexico, Japan, and Hawaii (Trilles & Justine, 2004, 2006, 2010; Rocha-Ramírez et al., 2005; Saito & Yamauchi, 2016; Hadfield et al., 2017, respectively). Hadfield et al., (2016a) transferred *Ceratothoa parva* Richardson, 1910 to the genus *Elthusa* and an *Elthusa* homonym was corrected (Hadfield et al., 2016b). Ökter et al. (2018) redescribed *Livoneca sinuata* (Koelbel, 1879) and transferred the species to the genus *Elthusa*. Most recently, van der Wal et al., (2019) described three species of *Elthusa* (viz. *Elthusa xena* van der Wal et al., 2019, *Elthusa acutinasa* van der Wal, et al., 2019, and *Elthusa rotunda* van der Wal et al., 2019) from Africa. At present, there are 36 species placed in *Elthusa* (Boyko et al., 2008 onwards).

Elthusa has a wide distribution, with species reported from all oceans except the Antarctic Ocean and northern Polar waters (Bruce, 1990; Trilles & Justine, 2004, 2006, 2010; Rocha-Ramírez et al., 2005; Saito & Yamauchi, 2016; Hadfield et al., 2017; Ökter et al., 2018; Van der Wal et al., 2019). Among

This article is registered in ZooBank under <http://zoobank.org/234B232A-52C8-4256-AD51-09FEADCAF9BF>

Communicated by S. Kaiser

✉ Panakkool Thamban Aneesh
ane3716@gmail.com

¹ Department of Aquatic Biology & Fisheries, University of Kerala, Karyavattom, Thiruvananthapuram, Kerala 695 581, India

² University of Montpellier, Montpellier, France

the described species, only two species, *Elthusa raynaudii* (Milne Edwards, 1840) from Travancore (currently part of Kerala state) by Pillai, (1954) and *Elthusa samariscii* (Shiino, 1951), from Kerala, southwest coast of India by Kumar & Bruce, (1997), have been reported from India. The report of *E. raynaudii* from Travancore by Pillai, (1954) is regarded as doubtful, as there are no figures and description, no voucher specimens, and the identification is based on Hale, (1926) rather than type material or the original description.

In the present study, we describe *Elthusa fistularia* sp. nov., *E. pseudorhombus* sp. nov., and *E. uranoscopus* sp. nov., all collected from the Muttom, southwest coast, India; *E. samariscii* is also redescribed based on the various life stages. A detailed diagnosis of the genus *Elthusa* is presented based on the redescription of the type species by Trilles & Randall, (2011). Based on the revised generic diagnosis, 13 species of *Elthusa* which are deviating from the generic characters are now placed into *Elthusa incertae sedis*, while the remaining 23 species are retained in combination with *Elthusa*.

Materials and methods

Specimens of *Elthusa* spp. were collected at Muttom, Kanyakumari district, Tamil Nadu state (8° 07' 48.00" N, 77° 19' 12.00" E) and Neendakara (08° 30.0' N, 76° 53.30' E), Kollam district, Kerala state, southwest coast of India. The cymothoids were collected from the branchial cavity of the host fish, fixed in 5% formaldehyde, preserved in 90% ethanol (after Aneesh et al., 2019a, b). Methods for dissection, mounting, and drawings of appendages were according to the techniques described in Aneesh et al., (2019a, b). Drawings were digital inked using Adobe Illustrator and WACOM CTL-472/K0-c drawing pad. The specimens were microphotographed using multi-focusing dissection microscope Leica-M205A and image capturing software (Leica Application Suit). Fish taxonomy and host nomenclature were taken from FishBase (Froese & Pauly, 2020) and Catalogue of Fishes (Fricke et al., 2020). The types and voucher specimens are deposited in the Western Ghat Field Research Centre of Zoological Survey of India, Kozhikode (ZSI/WGRC).

Results

Taxonomy

Suborder Cymothoidea Wägele, 1989
 Superfamily Cymothoidea Leach, 1814
 Family Cymothoidae Leach, 1814

Genus *Elthusa* Schioedte & Meinert, 1884

Elthusa Schioedte & Meinert, 1884: 337.—Bruce, 1990: 254.—Trilles & Randall, 2011: 453–454.—Hadfield et al., 2017: 125–135.—van der Wal et al., 2019: 3.

Type species: Livoneca emarginata Bleeker, 1857, by monotypy (Schioedte & Meinert, 1884).

Diagnosis of adult female. Body asymmetrical, slightly twisted to one side or symmetrical; weakly vaulted to flat dorsally. Cephalon anterior margin weakly to moderately produced, truncate; posterior margin not trilobed. Coxae all conspicuous in dorsal view. Pleon wide (greater than 0.75 maximum width of pereon), pleonite 1 as wide as pleonite 2 or only slightly narrower; pleonite 5 as wide as pleonite 4 or only slightly narrower, with free lateral margins. Antennula shorter than the antenna, bases set moderately to widely apart. Pereopods basis with carina; dactylus short.

Description. Female—Body asymmetrical, slightly twisted to one side or symmetrical; weakly vaulted to flat dorsally; about 1.8–2.3 times as long as wide. Cephalon deeply to moderately immersed in pereonite 1; posterior margin not trilobed, anterior margin moderately to weakly produced, frontal margin thickened, ventrally folded, forming broad subtruncate rostrum. Eyes close to lateral margin of cephalon, partially concealed by amphicephalic processes of pereonite 1. All coxae conspicuous, visible in dorsal view, equal size on both sides; gradually increasing the size posteriorly. Coxae, 2–5 shorter than pereonites, 5–7 flat, broad; 6–7 equal to pereonite or extending beyond, overlapping the lateral margin of pleonites. Pereonite 1 longest, 7 shortest, posterior margins of pereonites. Pleon wide, moderately or deeply immersed in pereonite 7; pleon narrower than pereonite 7; pleonite 1 as wide or slightly narrower than pleonite 2; pleonite 5 as wide as or slightly narrower than pleonite 4, with free lateral margins. Antennula shorter than antenna or subequal; bases not in contact, close to each other to wide apart. Antennula usually composed of 8 articles, rarely less (6 or 7); antenna usually composed of 8 to 12 articles. Mandibular molar process present, mandible palp slender; article 3, or 2 and 3 with disto-lateral setae. Maxilliped without oostegial lobe, or rarely with oostegial lobe. Pereopods with relatively short dactylus; basis with carina, merus weakly to strongly dilated. All pleopods simple and lamellar, without lobes and folds, slightly decreasing in size from 1 to 5; protopod without coupling hooks; endopod rounded, or with straight medial margin, never indented, without lobes or folding, 2–5 with proximo-medial lobe. Uropods short, not reaching the posterior margin of pleotelson. Brood pouch with 4–5 pairs of alternatively overlapping oostegites arising from the bases of pereopods 1–5 or 2–5 or 2–6; oostegites of pereonite 5 and 6 and sometimes 4 larger than that of anterior brood plate, with fleshy lobe on the posterior margin of the sternite 7.

Composition: The diagnosis for *Elthusa* presented in this work was based on the type species redescribed by Trilles & Randall, (2011).

Species included (sensu stricto): *Elthusa acutinasa* van der Wal et al., 2019, *Elthusa atlantiroi* (Kononenko, 1988), *Elthusa caudata* (Schioedte & Meinert, 1884), *Elthusa emarginata* (Bleeker, 1857), *Elthusa foveolata* (Hansen, 1897), *Elthusa frontalis* (Richardson, 1910), *Elthusa menziesi* (Brusca, 1981), *Elthusa methepia* (Schioedte & Meinert, 1884), *Elthusa nanoides* (Stebbing, 1905), *Elthusa nierstraszi* Hadfield et al., 2016a, b, *Elthusa ochotensis* (Kussakin, 1979), *Elthusa philippinensis* (Richardson, 1910), *Elthusa poutassouiensis* (Penso, 1939), *Elthusa raynaudii* (Milne Edwards, 1840), *Elthusa rotunda* van der Wal et al. 2019, *Elthusa samoensis* (Schioedte & Meinert, 1884), *Elthusa sigani* Bruce, 1990, *Elthusa sinuata* (Koelbel, 1879), *Elthusa splendida* (Sadowsky & Moreira, 1981), *Elthusa tropicalis* (Menzies & Kruczynski, 1983), *Elthusa vulgaris* (Stimpson, 1857), *Elthusa winstoni* Hadfield et al., 2017, *Elthusa xena* van der Wal et al., 2019, *Elthusa fistularia* sp. nov., *Elthusa pseudorhombus* sp. nov., and *Elthusa uranoscopus* sp. nov.

Species retained in *Elthusa* but regarded as incertae sedis: Based on the revised generic diagnosis, the following species currently placed under *Elthusa* differ in certain “key” generic characters, *Elthusa arnoglossi* Trilles and Justine 2006, *Elthusa alvaradoensis* Rocha-Ramírez et al., 2005, *Elthusa californica* (Schioedte & Meinert, 1884), *Elthusa myripristae* Bruce, 1990, *Elthusa parva* (Richardson, 1910), *Elthusa propinqua* (Richardson, 1904), *Elthusa sacciger* (Richardson, 1909), *Elthusa epinepheli* Trilles & Justine, 2010, *Elthusa moritakii* Saito & Yamauchi, 2016, *Elthusa neocyttia* (Avdeev, 1975), *Elthusa parabothis* Trilles & Justine, 2004, *Elthusa samariscii* (Shiino, 1951), and *Elthusa turgidula* (Hale, 1926).

Remarks: The original description of *Elthusa* Schioedte & Meinert, 1884 was brief and in Latin, and at the time, the genus contained one species. Bruce, (1990) gave a new generic diagnosis, provisional at that time as the type species had not been fully described, at the same time transferring 20 species from *Livoneca* Leach, 1818. Trilles & Randall, (2011) redescribed the type species and provided a detailed revised genus description based on their species redescription. As more than half the species of *Elthusa* are either reasonably well described or re-described, we now have the opportunity to critically assess the composition of the genus against a restrictive genus diagnosis.

Here, we provide a revised generic diagnosis based on the syntype specimen of the type species examined by JP Trilles and the description of the same provided by Trilles & Randall, (2011). Critical to this diagnosis is that we recognize that within the Cymothoidae certain character (or character) states

are consistent within the speciose genera of the family. These characters are discussed individually with regard to the species composition of *Elthusa* as here defined, and include the shape of the rostrum (truncate or with a rostral point), pleon width, and in particular, the relative width of both pleonite 1 and pleonite 5.

The genus *Elthusa*, *sensu stricto* is characterized and separated from other branchial-attaching cymothoid genera by: having a weakly vaulted pereon, wide pleon with all pleonites wide, antennulae shorter than, or subequal in length to antennae with their bases not in contact, cephalon posterior margin that is not trilobed, coxae equal size on both sides, coxae 5–7 flat, broad, 6–7 equal to pereonite or extending beyond, overlapping the lateral margin of pleonites; mandible palp slender, article 3, or 2 and 3 with disto-lateral spines setae, pereopods with relatively short dactylus, uropods short, not reaching the posterior margin of pleotelson. Based on the revised generic diagnosis, 13 species previously included in the genus *Elthusa* is now retained in *Elthusa* but as *incertae sedis*, since its characters not fit for the genus *E. arnoglossi*, *E. alvaradoensis*, *E. californica*, *E. myripristae*, *E. propinqua*, *E. sacciger*, *E. epinepheli*, *E. moritakii*, *E. neocyttia*, *E. parabothis*, *E. parva*, *E. samariscii*, and *E. turgidula*. All the species will require correct generic placement based on the examination of the type species.

Based on the following character states, 13 species were placed into *incertae sedis*: species having the head anterior margin with a rostral point namely *E. arnoglossi*, *Elthusa epinepheli*, *E. myripristae*, *E. neocyttia*, *E. propinqua*, *E. parva*, *E. sacciger*, *E. parabothis*, *E. moritakii*, and *E. samariscii*; species with a pleon maximum width of less than 0.75 width of pereon, namely *E. arnoglossi* (0.53), *E. sacciger* (0.41), *E. moritakii* (0.70), *E. neocyttia* (0.70), *E. parabothis* (0.45), and *E. samariscii* (0.72); species with a very narrow pleonite 1 are excluded, namely *E. turgidula*; pereopod dactylus long in *E. sacciger*; pleonites 2–5 progressively narrower towards posterior in *E. arnoglossi*; pleopod peduncle with coupling hook in *E. neocyttia*. The following characters of *Elthusa parva* differ from the generic diagnosis of *Elthusa*: the dorsum strongly vaulted, and pleonite 5 is much narrower than the pleonite 4. In *E. alvaradoensis*, the coxal plates are not conspicuous in dorsal view, pleon wider than pereon, pleonite 1 manifestly shorter than 2, and pleonites 2–5 subequal in width.

Elthusa differs from *Idusa* Schioedte & Meinert, 1884 in the shape and size of the coxae, which are narrow, all shorter than the respective segment; the pleon is not immersed in the pereon; pereopods are slender, basis without carina, dactylus long (Schioedte & Meinert, 1884; Bruce, 1990).

Mothocya Costa in Hope, 1851 differs from *Elthusa* in having the antennula longer and more robust than the antenna

whereas in *Elthusa* the antennula is shorter than the antenna; cephalon with rostrum in *Mothocya* (vs. cephalon anterior margin truncate (or subtruncate ["bluntly rounded"]) in *Elthusa*); pereopods all robust, articles without carina in *Mothocya* (vs. pereopods basis with carina in *Elthusa*) (Bruce, 1986).

Elthusa can be separated from *Ryukyua* Williams Jr & Bunkley-Williams, 1994 by the body being nearly as wide as long; coxae all shorter than respective pereonites; the distal article of the mandibular palp is very short compared to other articles and is distally rounded; and the pleon is narrower and deeply immersed in the pereon (Williams Jr & Bunkley-Williams, 1994).

In *Agarna* Schioedte & Meinert, 1884, the posterior of the pereon is strongly elevated mid-dorsally, pereonites 4–7 are greatly expanded laterally, antennula narrowly separated at their bases, and the mandibular palp without robust setae (Bowman & Tareen, 1983; Aneesh et al., 2018).

Catoessa Schioedte & Meinert, 1884 can be separated from *Elthusa* by the following characters: in *Catoessa*, the pleon is narrow, not immersed into the pereon, the pleon is twisted about its axis, and there are gaps between the pleonites; all pleonites are visible, pleonite 1 narrower than pleonite 2; pereopods 1–7 without carina on the basis and the merus is dilated on the inferior margin or with slender carina on basis 6–7 (Bruce, 1990).

Elthusa can be separated from *Joryma* Bowman & Tareen, 1983: in *Joryma*, pereonite being produced into lobe along one or both lateral margins of the head whereas in *Elthusa* it is not produced. The coxae of pereonites 2 and 3 in *Joryma* are medially inflated, much larger than the remaining coxae and in *Elthusa* the coxae of the posterior pereonites are much larger and flattened. The mandible palp is un-segmented or distinctly or incompletely segmented in *Joryma* whereas in *Elthusa* the mandible palp is segmented with few robust setae article 2 and article 3 or only on article 3. In *Joryma*, the maxilla has scales on both lobes, but in *Elthusa*, the scales are absent on the maxillary lobes (Aneesh et al., 2019a, b).

By excluding 13 species from the genus in the present study, the genus *Elthusa* now has 26 species, including the three species described in the present study. Among them, nine species are known from the East Pacific region (*E. caudata*, *E. foveolata*, *E. frontalis*, *E. menziesi*, *E. ochotensis*, *E. philippinensis*, *E. samoensis*, *E. sigani*, and *E. splendida*). Four species are known from the Atlantic (*E. atlantiroi*, *E. methepia*, *E. tropicalis*, and *E. winstoni*), while only one species (*E. sinuata*) is reported from the Mediterranean Sea. Ten species are known from the Indo-West Pacific and Indian Ocean region (*E. acutinasia*, *E. fistularia* sp. nov., *E. pseudorhombusi* sp. nov., *E. nanoides*, *Elthusa nierstraszi* Hadfield et al., 2016a, b, *Elthusa parva* (Richardson, 1910), *E. raynaudii*, *E. rotunda*, *E. vulgaris*, and *E. uranoscopus* sp. nov., *E. xena*).

Most species of *Elthusa* are found to be infesting demersal fish species and they exhibit oligoxenous host specificity and few others, particularly cool-water species, like *E. raynaudii*, prefers a wide range of host fishes (see van der Wal et al., 2019). Akin to that, all the three new species are known only from their type host; *Elthusa fistularia* sp. nov. from *Fistularia petimba*, *Elthusa pseudorhombus* sp. nov. from *Pseudorhombus dupliciocellatus*, and *Elthusa uranoscopus* sp. nov. from *Uranoscopus guttatus*.

Elthusa fistularia sp. nov.

<http://zoobank.org/BA8382B0-CF4B-4E8B-AF91-1DEB15C158B4>.

Material examined: *Holotype*—female [ovigerous, 20.00 mm L, 10.00 mm W (maximum width)], from *Fistularia petimba* Lacepède, 1803 (Fistulariidae), Muttom, southwest coast, India (8° 07' 48.00" N, 77° 19' 12.00" E), 03 September 2019, coll. PT Aneesh (Reg. No. ZSI/WGRC/IR/INV/13243). *Paratype*: Same information as the holotype with the following measurements and registration details: 1 female (non-ovigerous, 21.00 mm TL; 10.50 mm W) (Reg. No. ZSI/WGRC/IR/INV/13244).

Description

Holotype female (Figs. 1, 2, 3, 4 and 5): Length 20.00 mm, maximum width 10.00 mm. Body symmetrical, two times as long as greatest width, widest at pereonite 5, most narrow at pereonite 1. Cephalon 1.20 times wider than long, anterio-lateral margin narrowed in front of the eyes, anterior margin straight and turned down, rostrum subtruncate rostrum. Eyes 0.20 times as wide as cephalon, 0.30 times as long as the cephalon; each eye made up of ~5–6 transverse rows of ommatidia, each row with ~10–14 ommatidia. Pereonite 1 anterior border slightly concave; antero-lateral margin rounded, extending up to half the length of the eye. Posterior margin—convex slightly curved laterally. Coxae 2–5 shorter than pereonites; 6 equal to pereonite length; 7, extending beyond, overlapping the lateral margin of pleonite 3–4. Coxae 6–7, posterolateral angles broadly rounded. Pereonite 1 longest, 7 shortest, 3, 4, 6 subequal in length; pereonite 2 slightly shorter than 3, subequal to 5. Pereonites 4–7 progressively curved posteriorly. Pereonites 3, 4, and 6 subequal in width and wider than pereonite 2. All pleonites visible dorsally. Pleonites 1–4 laterally overlapped by coxa 7 and posterior margin of pereonite 7. Pleonite 2, 0.80 width of pereonite 5; pleonite 1 slightly narrower than 2, pleonites 2 widest, 3–5 progressively narrower towards posterior. Pleonites 1–5 subequal in length; posterolateral margin broadly rounded; lateral margin of pleonites curving posteriorly. Pleotelson 1.7 times as wide as long, narrower than pleonite 5, posterior margin broadly rounded, lateral margins convex (pleotelson of holotype is partially damaged at the right side).

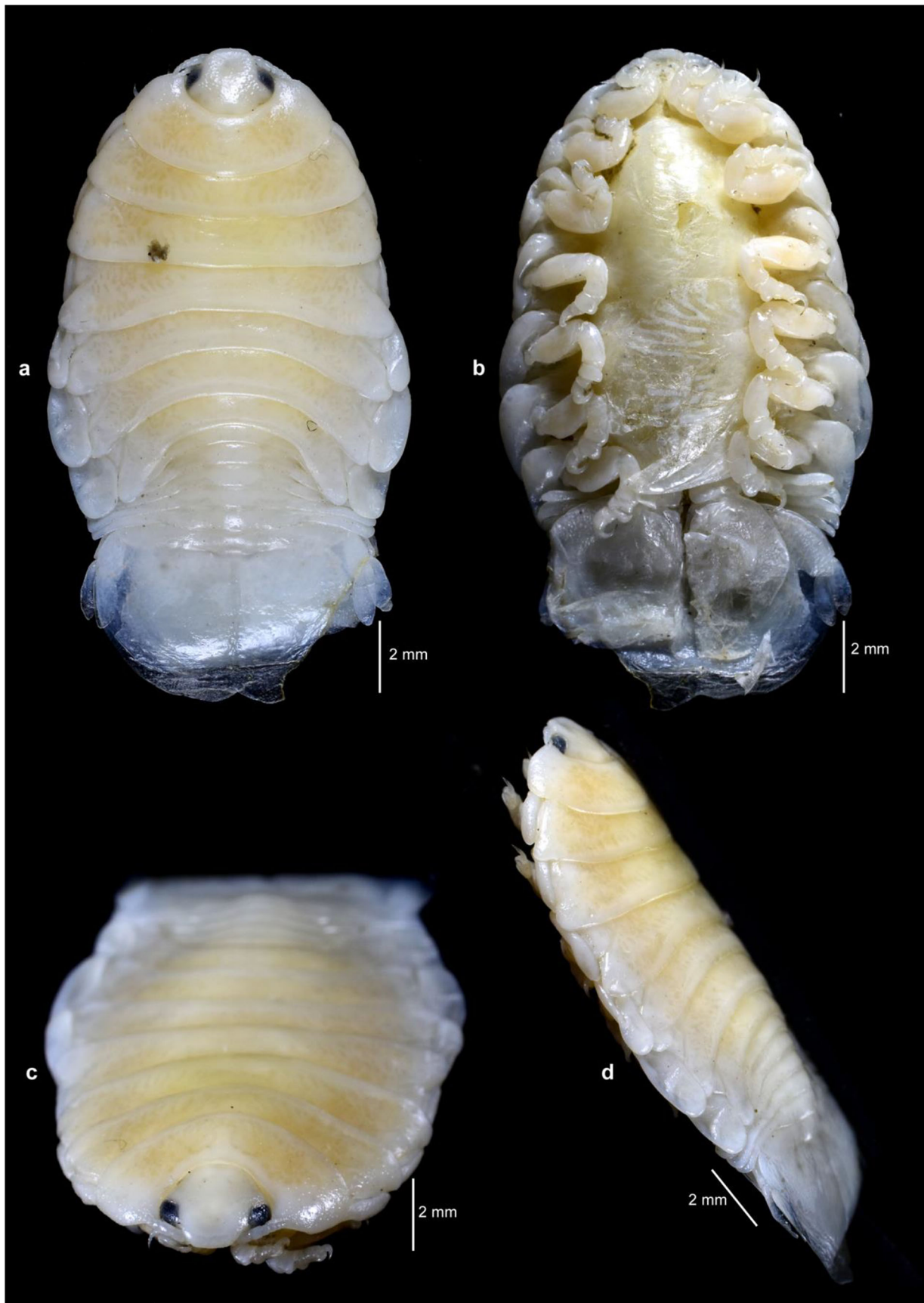


Fig. 1 *Elthusia fistularia* sp. nov. from *Fistularia petimba* Lacepède, holotype; **a** Dorsal view; **b** Ventral view; **c** Dorso-frontal view; **d** Lateral view

Antennula more stout and slightly longer than the antenna, with eight articles, widely separated at the base; articles 5–8 each with distal robust spine. Antenna with nine articles, slightly longer than antennula, decreasing gradually in width, articles 6–9 with distal robust spine. Mandibular molar process present, with acute and slightly curved incisor processes. Mandible palp slender, article 1 longest, terminal article with one long terminal and 4–5 disto-lateral setae, gradually decreasing the length. Maxillule with one large and three small subequal slightly recurved robust setae (RS). Maxilla mesial lobe with two large and lateral lobe with two small, slightly recurved RS. Maxilliped without oostegial lobe; apical segment with three lateral recurved RS.

Pereopods 1–3, basis with weak carina, all the pereopods without setae or spine. Ischium gradually increasing in the length from pereopods 1–7. Pereopod 1 basis, 1.60 times as long as greatest width; ischium 0.60 times as long as basis; merus lateral margin with bulbous protrusion; propodus 1.70 times as long as wide; dactylus slender, 0.70 times as long as propodus, 2 times as long as basal width. Pereopod 2 basis, 1.40 times as long as greatest width; ischium 0.50 times as long as basis; merus lateral margin with bulbous protrusion; propodus 1.6 times as long as wide; dactylus slender, 1.30 times as long as propodus, 2.50 times as long as basal width. Pereopod 6 basis 1.90 times as long as width; ischium 0.70 times as long as basis; propodus as long as wide, 0.60 times as long as ischium; dactylus slender, 1.6 times as long as propodus, 3.00 times as long as basal width. Pereopod 7 basis with carina, 1.90 times as long as greatest width; ischium 0.80 times as long as basis; merus 0.65 times as long as wide, 0.40 times as long as ischium; propodus as long as wide, 0.50 times as long as ischium; dactylus slender, 1.90 times as long as propodus, 3.30 times as long as basal width.

Pleopods exopod larger than endopod, all rami laminar. Pleopods without coupling hooks on the peduncle. Pleopod 1 exopod 1.30 times as long as wide, lateral margin strongly convex, distally broadly rounded, mesial margin weakly convex. Uropods 0.70 times as the length of pleotelson; peduncle 0.90 times longer than rami, lateral margin without setae, apices narrowly rounded. Endopod apically rounded, 3.20 times as long as greatest width, without setae. Exopod subequal to endopod, 2.60 times as long as greatest width, apically rounded, lateral margin distally convex, without setae. Brood pouch as for the genus.

Body Size: Female 20.00 and 21.00 mm.

Color: Female, body pale tan.

Distribution: Known only from the type locality Muttom, southwest coast of India.

Host: Only known from the type host *Fistularia petimba*.

Etymology: The species name is derived from the genus name of the type host *Fistularia* Linnaeus, 1758; noun in apposition.

Remarks

Elthusa fistularia sp. nov. can be distinguished from its congeners by the body elongate and asymmetrical, cephalon, 1.20 times wider than long, antero-lateral margin narrowed in front of the eyes, forming a subtruncate rostrum; coxae 7, posteroventral angles broadly rounded to sub-acute; pereonite 1 anterior margin concave; widest pleon 0.80 width of widest pereon; pleotelson 1.70 times as wide as long, narrower than pleonite 5, posterior margin broadly rounded, lateral margins convex; uropods 0.70 times as the length of pleotelson, rami subequal. Antenna, with 9 articles, antennal bases not much wider; as 0.20 times the maximum width of cephalon. Maxilliped without oostegial lobe, apical segment with three lateral recurved RS. *Elthusa fistularia* sp. nov. is generally similar to *Elthusa pseudorhombus* sp. nov.; it can be separated by the following characteristic features: cephalon 1.35 times wider than long (vs. 1.70 times wider than long in *Elthusa pseudorhombus* sp. nov.); coxae 6 equal to pereonite 6 and coxae 7 extending beyond the corresponding pereonite, coxae 6–7, posteroventral angles bluntly rounded (vs. coxae 6–7 longer than the pereonites, posteroventral angles narrowly rounded in *Elthusa pseudorhombus* sp. nov.); pleotelson broadly rounded, 1.70 times as wide as long, lateral margin convex (vs. pleotelson 1.50 times as wide as long, evenly rounded, lateral margins converge more in *Elthusa pseudorhombus* sp. nov.); uropod more than half the length of pleotelson, rami subequal (vs. uropod rami, endopod shorter than exopod in *Elthusa pseudorhombus* sp. nov.); antenna 9-segmented antennula bases moderately wide set (vs. antenna with 10 articles, greatly wider than antennal bases in *Elthusa pseudorhombus* sp. nov.). In *E. fistularia* sp. nov. widest pleon 0.80 width of widest pereon (vs. 0.75 in *Elthusa pseudorhombus* sp. nov.). The interspecific character between all the three new species is listed in Table 1.

Elthusa pseudorhombus sp. nov.

<http://zoobank.org/2EEDC374-2E6C-4214-82C9-8784258C4A95>.

Material examined: Holotype—female [11.00 mm L, 5.50 mm W (maximum width) ovigerous], from *Pseudorhombus dupliciocellatus* Regan 1905 (Paralichthyidae), Muttom, southwest coast, India (8° 07' 48.00" N, 77° 19' 12.00" E), 25th March 2019, coll. PT Aneesh (Reg. No. ZSI/WGRC/IR/INV/13245). **Paratype:** Same information as the holotype with the following measurements and registration details: female [11.00 mm L, 5.50 mm W (maximum width) ovigerous], (Reg. No. ZSI/WGRC/IR/INV/13246).

Description

Holotype female (Figs. 6, 7, 8, 9 and 10): Length 11.00 mm, maximum width 5.50 mm. Body slightly asymmetrical,

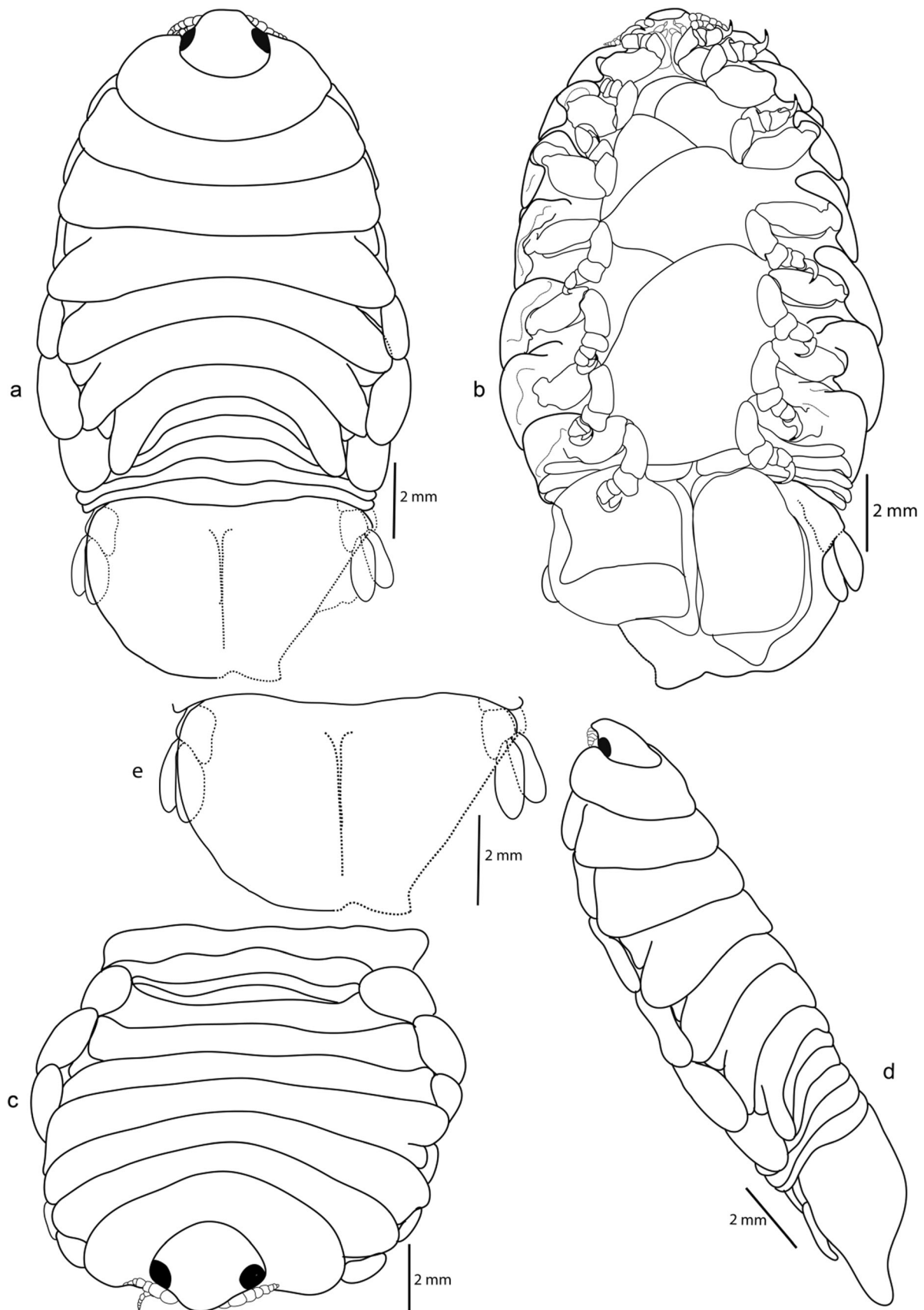


Fig. 2 *Elthusia fistularia* sp. nov. from *Fistularia petimba* Lacepède, holotype; **a** Dorsal view; **b** Ventral view; **c** Dorso-frontal view; **d** Lateral view; **e** Pleotelson and uropods



Fig. 3 *Elthusa fistularia* sp. nov. from *Fistularia petimba* Lacepède, paratype; **a** Dorsal view; **b** Ventral view; **c** Lateral view

weakly hunched one side, 2 times as long as greatest width, widest at pereonite 5, most narrow at pereonite 1. Cephalon symmetrical 1.70 times wider than long, anterior margin rounded, turned down form a rostrum. Eyes distinct, dorso-lateral to the cephalon, 0.60 times as long as cephalon, visible dorsally. Coxae 2–4 narrow, 2–5 shorter than

pereonites, coxae 5–7, flat, broad, 6–7 longer than the pereonites; coxae 6–7, posteroventral angles acute. Coxae 7 overlapping lateral margin of pleonite 1–2. Pereonites 1 longest, 7 shortest, 2, 3, and 6 subequal; pereonite 4 slightly shorter than 1. Pereonites, 3, 4, and 7 subequal and wider than pereonite 1; pereonite 6 narrower than 5. All pleonites

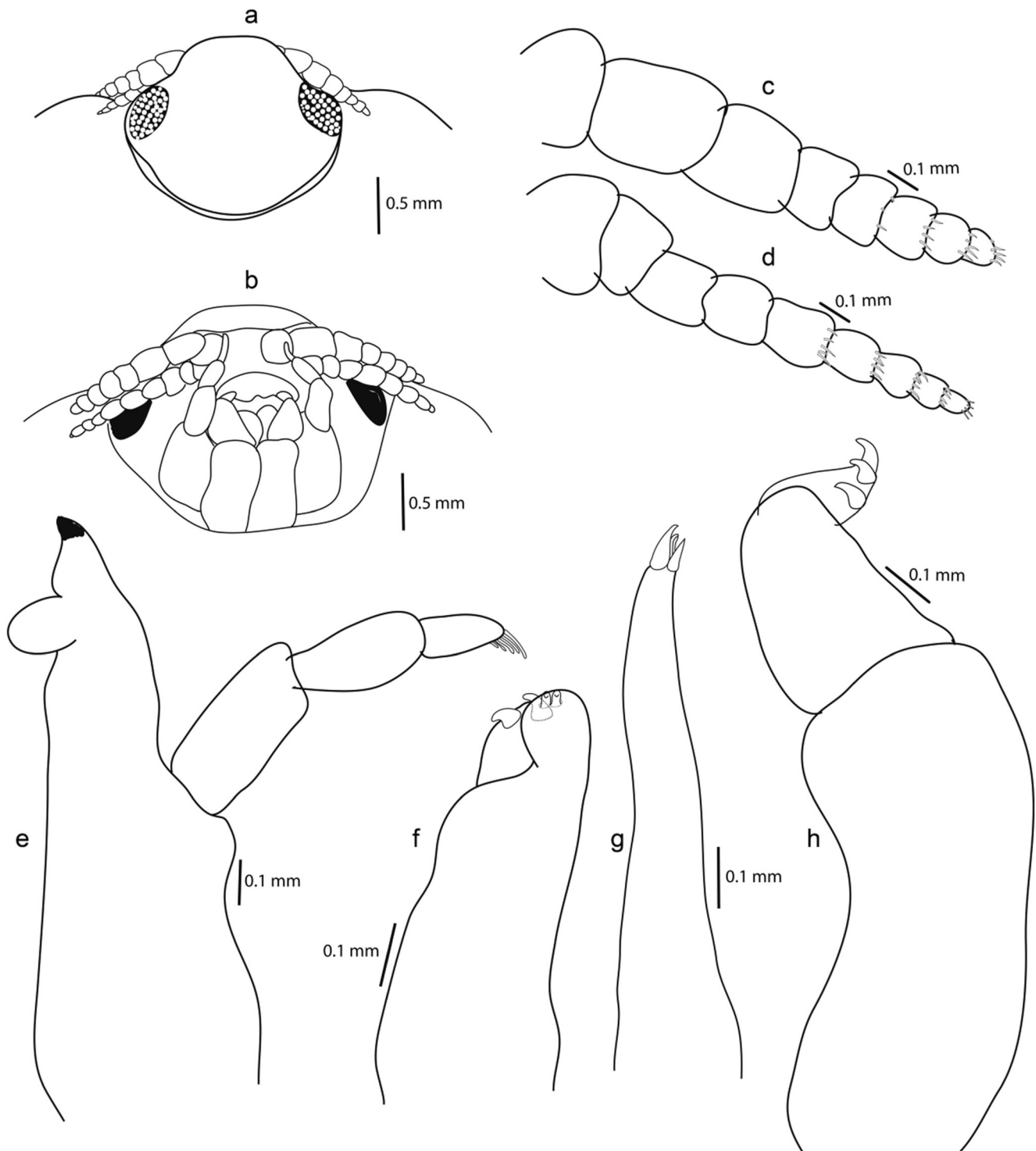


Fig. 4 *Elthusa fistularia* sp. nov. from *Fistularia petimba* Lacepède, ovigerous female cephalon (a–b); a Dorsal view; b Ventral view; c Antennula; d Antenna; e Mandible; f Maxilla; g Maxillule; h Maxilliped

visible. Pleonites 1 and 2 completely overlapped by coxa 7 and posterior margin of pereonite 7. Pleonite 1 narrower than others, pleonites 1–4 progressively wider towards posterior. Pleonites 1–5 subequal in length; pleonite 4, 0.75 width of pereonite 5; posterior margin broadly rounded lateral margin of pleonites curving posteriorly. Pleotelson 1.50

times as wide as long, much narrower; 0.80 width of pleonite 5, posterior margin rounded.

Antennula stouter than antenna, with eight articles, widely separated at base. Antenna 10-articled, slightly longer than antennula, decreasing gradually in width, terminal article with distal robust spine. Mandibular molar

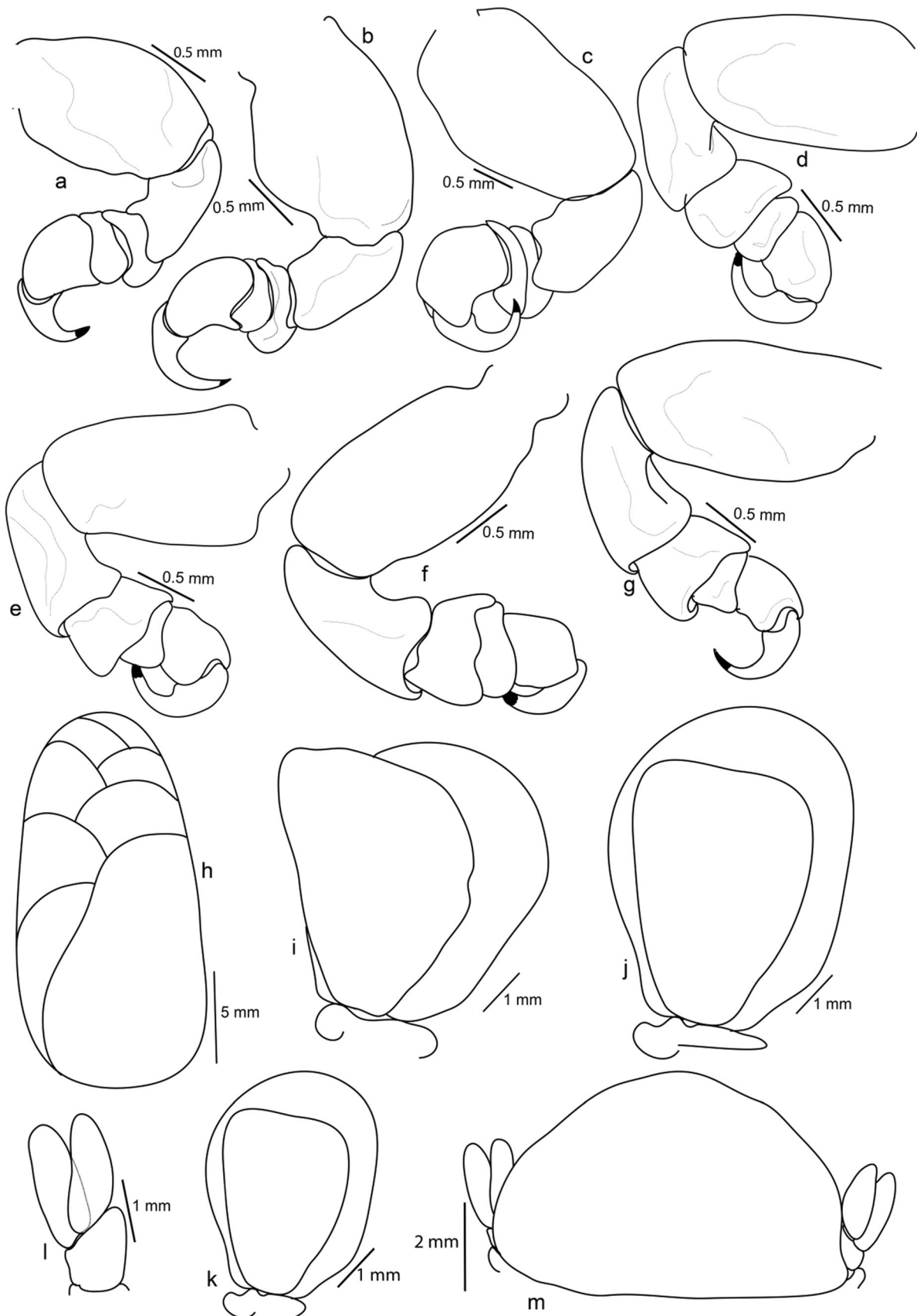


Fig. 5 *Elthusia fistularia* sp. nov. from *Fistularia petimba* Lacepède ovigerous female **a–g** Pereopods 1–7; **h** Brood pouch; **i–j** Pleopod 1–2 (of paratype female); **k** Pleopod 5; **l** Uropod; **m** Pleotelson and uropods (of paratype female)

process present, with curved incisor processes. Mandible palp slender, article 1 longest, terminal article with one long terminal and 4–5 short disto-lateral RS. Maxillule with one large and three small subequal slightly recurved spines. Maxilla, medial with one and lateral lobe with two small, slightly recurved RS. Maxilliped without oostegial lobe; an apical segment with two terminal and one lateral recurved RS.

Pereopods merus dilated with bulbous protrusion, slightly decreasing the size from anterior to posterior. Pereopod 1, basis, 2.00 times as long as greatest width; ischium 0.50 times as long as basis; propodus 1.40 times as long as wide; dactylus slender, 1.50 times as long as propodus, 3.30 times as long as basal width. Pereopod 2 basis, 2.20 times as long as greatest width; ischium 0.63 times as long as basis; propodus 1.5 times as long as wide; dactylus slender, 1.33 times as long as propodus, 2.50 times as long as basal width. Pereopod 6 basis with carina, 2.40 times as long as greatest width; ischium 0.62 times as long as basis; merus 0.66 times as long as wide, 0.33 times as long as ischium; propodus as long as wide, 0.33 times as long as ischium; dactylus slender, 2.00 times as long as propodus, 2.80 times as long as basal width. Pereopod 7 basis with carina, 1.50 times as long as greatest width; ischium 0.90 times as long as basis; merus 0.40 times as long as wide, 0.25 times as long as ischium; propodus 1.10 times as long as wide, 0.35 times as long as ischium; dactylus slender, 1.90 times as long as propodus, 3.50 times as long as basal width.

Pleopods exopod larger than endopod, all rami laminar. Pleopods without coupling hooks on the peduncle. Pleopod 2 exopod 1.40 times as long as wide, lateral margin strongly

convex, distally broadly rounded, mesial margin weakly convex. Uropods 0.75 times as the length of pleotelson; peduncle 0.65 times long as exopod, lateral margin without setae, apices rounded. Endopod apically rounded, 2.50 times as long as greatest width, without setae. Exopod 1.20 times longer than endopod, 3.00 times as long as greatest width, apically rounded, lateral margin distally convex, without setae. Brood pouch as for the genus.

Body Size: Female 11.00 mm.

Color: Female, body pale tan.

Distribution: Known only from the type locality Muttom, southwest coast, India.

Host: Only known from the type host.

Etymology: The species name is derived from the genus name of the type host *Pseudorhombus* Linnaeus; noun in apposition.

Remarks: *E. pseudorhombus* sp. nov. can be separated from its congeners in having: an elongate ovoid body; subtruncate and anteriorly rounded cephalon; pereonite 1 anterior margin slightly concave; widest pleon 0.75 width of widest pereon; evenly rounded pleotelson; much antennal bases wide apart; uropod rami, endopod shorter than exopod. This new species shows a close resemblance to *E. sinuata* in having a similar general body shape. However, it can be distinguished from *E. sinuata* by multiple characters: number of articles in the antenna (10 in *E. pseudorhombus* sp. nov. vs. 11 in *E. sinuata*); maxilliped (without oostegial lobe in *E. pseudorhombus* sp. nov. vs. oostegial lobe present in *E. sinuata*); shape of the coxae (coxae 5–7, more expanded in *E. pseudorhombus* sp. nov.). The interspecific character between all the three new species is listed in Table 1.

Table 1 Interspecific character between *Elthusa fistularia* sp. nov., *Elthusa pseudorhombus* sp. nov., and *Elthusa uranoscopus* sp. nov., described from Indian waters

	<i>Elthusa fistularia</i> sp. nov.	<i>Elthusa pseudorhombus</i> sp. nov.	<i>Elthusa uranoscopus</i> sp. nov.
Cephalon	1.2 times wider than long	1.7 times wider than long	1.6 times wider than long
Coxae	Coxae 6 equal to pereonite, 7, extending beyond, coxae 6–7, posteroventral angles broadly rounded	6 and 7 longer than the pereonites, Coxae 7 overlapping lateral margin of pleonite 1–2 posteroventral angles acute.	coxae 6 and 7, flat, broad, longer than the corresponding pereonite; posteroventral margin rounded
Antenna	With 9 articles	With 10 articles	With 11 articles, slightly longer than antennula
Maximum pleon width to maximum pereon width	0.80	0.75	0.84
Pleonites	Pleonite 1 narrower than 2, pleonites 2 widest, 3–5 progressively narrower towards posterior	Pleonite 1 narrower than others, pleonites 1–4 progressively wider towards posterior, pleonite 5 narrower than pleonite 4	Pleonite 1 narrower than others, pleonites 2–5 progressively narrower towards posterior
Pleotelson	Broadly round, 1.7 times as wide as long, lateral margins convex	Evenly rounded, 1.5 times as wide as long	Pleotelson 1.8 times as wide as long, lateral margins convex
Rami	Subequal	Endopod shorter than exopod	Endopod longer than exopod



Fig. 6 *Elthusa pseudorhombus* sp. nov. from *Pseudorhombus dupliocellatus*, holotype; **a** Dorsal view; **b** Ventral view; **c** Dorso-frontal view; **d** Lateral view

***Elthusa samariscii* (Shiino, 1951)**

Livoneca samariscii Shiino, 1951: 81, 86, Fig. 5.

Elthusa samariscii—Bruce, 1990: 254, 287.—Kumar & Bruce, 1997, 780–787, Figs. 1, 2, 3 and 4.

Lironeca samariscii—Trilles 1994: 190.

Material examined: All from *Samaris cristatus* Gray, 1831 (Samaridae) coll. Aneesh from Muttom, southwest coast, and Quilon, Kerala coast, India. One hundred twenty-six females (10.50–13.40 mm L; 5.60–7.10 mm W) (88 ovigerous and 38 non-ovigerous); 97 males (7.00–9.50 mm L; 3.00–5.20 mm W); 13 transitional (8.00–10.00 mm L; 4.00–6.00 mm W); 43 manca (2.10–3.00 mm); 28 premanca (1.70–2.20 mm).

Nontype: 1 ovigerous female (10.00 mm), from Muttom, southwest coast, India, 22 May 2018, (Reg. No. ZSI/WGRC/IR/INV/11723); 1 Transitional stage (8.50 mm), from Muttom, southwest coast, India (8° 07' 48.00" N, 77° 19' 12.00" E), 17 July 2018, (Reg. No. ZSI/WGRC/IR/INV/11724); 1 ovigerous female (14.00 mm), from Muttom, southwest coast, India, 04 March 2018 (Reg. No. ZSI/WGRC/IR/INV/11725); 1 male (7.00 mm), from Neendakara fish landing center (08° 30.0' N, 76° 53.30' E), Quilon, Kerala Coast, 17 August 2018, (Reg. No. ZSI/WGRC/IR/INV/11726); 1 male (8.00 mm), from Muttom, southwest coast, India, 04 March 2018, (Reg. No. ZSI/WGRC/IR/INV/11727).

Description

Female (Figs. 10, 11, 12, 13 and 14): Body sub-oval, asymmetrical, slightly twisted to one side, slightly valuated dorsally, 1.70–1.90 times longer than wide, widest at pereonite 4. Cephalon, dorsally conspicuous, anterior margin slightly triangular, 1.20–1.30 times wider than long, slightly constricted anterior to eyes, posterior margin smoothly rounded. Eyes ovate, distinct, visible dorsally, with distinct ommatidia, 0.35 times the width of the cephalon. Pereon broad, dorsally convexed, twisted to one side. Pereonite 4 longest, 7 shortest. Pereonites gradually increasing the width from 1 to 4, gradually decreasing posteriorly. Posterolateral margins of pereonite 1 not produced; 2–7 progressively produced. Posterolateral margins of pereonite 7 indented. Coxa of pereopods 2–5 not visible dorsally; 6 and 7 moderately visible. All pleonites distinct, extending beyond the lateral margins of pereonite 7 and pleotelson to some extent; pleonite 1 and 2 slightly overlapped by pereonite 7. Pleonite 1 shorter and narrower than pleonite 2; pleonites 2–5 progressively narrower towards posterior; lateral borders free, slightly expanded, pleonite 2 longest in dorsal view. Pleotelson 1.50–1.60 times wider than long, posterior margin hemispherical, anterior margin slightly narrower than pleon.

Antennula shorter than antenna, separated at base, reaching anterior one half portion of the eye, composed of eight articles;

proximal article slightly expanded; article 8 with few terminal setae. Antenna with 12 articles, longer than antennula, extending up to or slightly beyond the posterior margin of the cephalon, article 8 with few spines on a posterodistal angle and 12 with few terminal setae. Both antennula and antenna with a tuft of very fine setae on distal margin of all articles. Mandible with prominent molar lobe and dorsolateral lobe; mandible palp article 3 with 1 long and 8–10 short spines on disto-lateral margin, article 2 with 2–3 spines. Maxillule with one large and three small slightly recurved apical RS. Maxilla basally widest; inner median lobe with one and outer lateral lobe with four small, slightly recurved RS. Maxilliped article three with two terminal recurved RS. Ovigerous female maxilliped article one modified into oostegial lobe with plumose setae, distal article with two terminal recurved RS.

Pereopod 1 basis, 1.70 times as long as greatest width; ischium 0.75 times as long as basis; merus lateral margin without bulbous protrusion; propodus as long as wide; dactylus slender, as long as propodus, three times as long as basal width. Pereopod 2 basis, 2.33 times as long as greatest width; ischium 0.60 times as long as basis; merus lateral margin with bulbous protrusion; propodus 1.5 times as long as wide; dactylus slender, 0.65 times as long as propodus, 1.65 times as long as basal width. Pereopod 6 basis 2.5 times as long as wide; ischium 0.85 times as long as basis; propodus 0.77 times as long as wide, 0.40 times as long as ischium; dactylus as long as propodus, 2.10 times as long as basal width. Pereopod 7 basis with carina, 2.50 times as long as greatest width; ischium 0.80 times as long as basis; merus 0.65 times as long as wide, 0.33 times as long as ischium; propodus 1.75 as long as wide, 0.58 times as long as ischium; dactylus 0.85 times as long as propodus, 2.40 times as long as basal width.

Pleopods not visible in dorsal view, peduncles without accessory lobes, bases with poorly developed accessory lamellae. Pleopod 2 without appendix masculina. Pleopods 1–5 endopod without proximo-medial lobe. Uropods short, reaching up to the anterior one fourth of the pleotelson; exopod slightly longer than endopod.

Brood pouch with four pairs of alternatively overlapping oostegites arising from the bases of pereopods 2–5; oostegites of pereonites 4 and 5 are larger than that of pereopods 2 and 3. Anteriorly covered by maxilliped oostegial lobes.

Eggs in brood pouch: The number of eggs or larvae in the brood pouch ranges from 70 to 220 according to the size of the female.

Male (Figs. 15, 16, 17 and 18): Body symmetrical, smaller than the female, 2.00–2.10 times longer than wide. Cephalon anterior border slightly triangular, 1.50–1.60 times wider than long, not immersed in pereonite 1. Eyes much prominent than that of the female. Pereonites more or less equal in width; pereonite 1 longest. Coxae of anterior pereonites not visible dorsally, coxae 6–7 posterior part visible. Pleonite 1 slightly

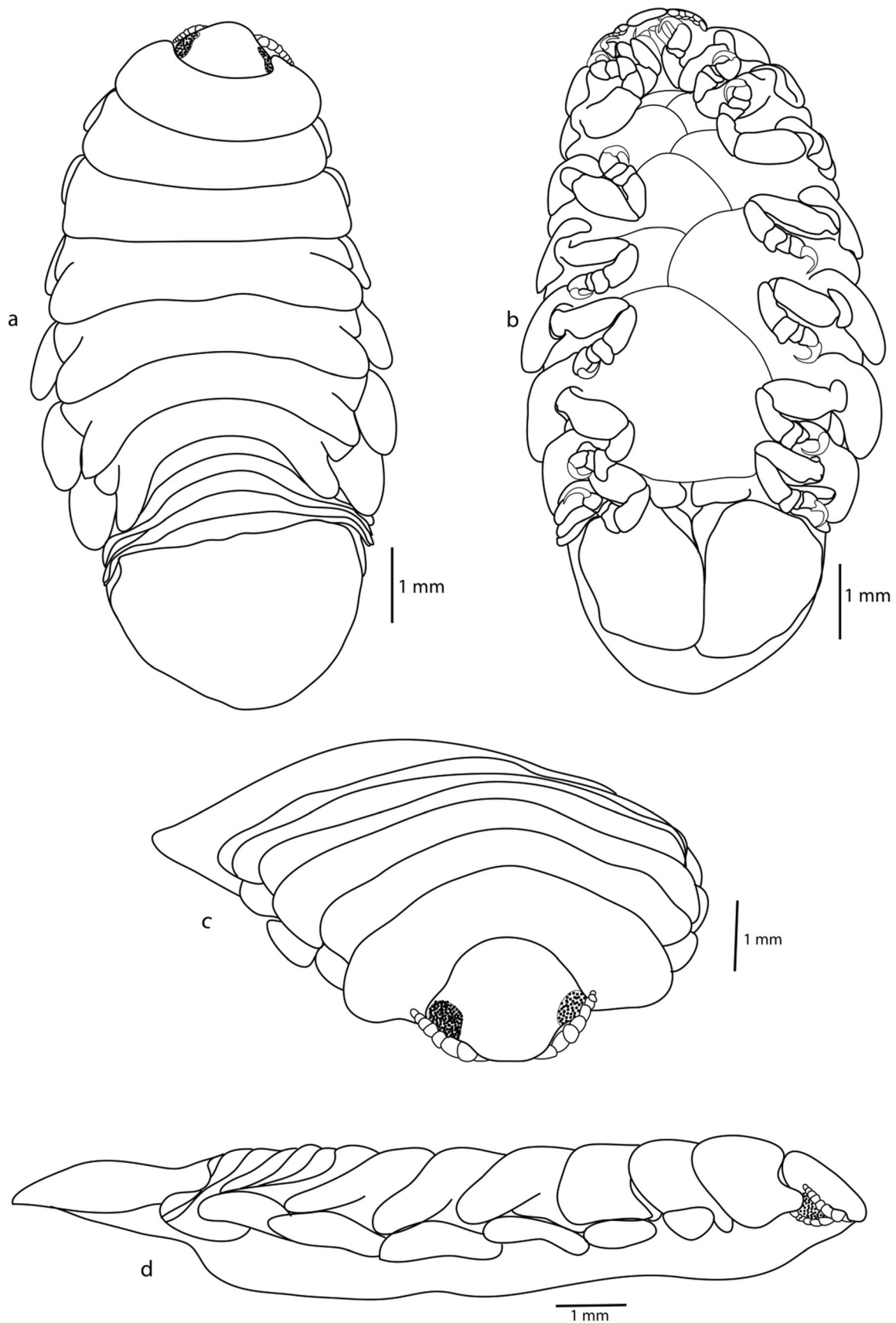


Fig. 7 *Elthusa pseudorhombus* sp. nov. from *Pseudorhombus dupliocellatus*, holotype; **a** Dorsal view; **b** Ventral view; **c** Dorso-frontal view; **d** Lateral view

overlapped laterally by pereonite 7. Pleonites subequal in length and width, similar to that of the female. Pleotelson 1.50 times wider than long, shorter than pleonite 5, posterior margin broadly rounded.

Antennula, antenna maxillule, and mandible are similar to that of the female. Maxilla basally widest; inner median lobe with one and outer lateral lobe with three small, slightly recurved RS. Maxilliped slightly narrower than in non-ovigerous female, article three with 2 terminal recurved RS.

Pereopods similar to that of the female. Penes, a conical projection of flesh with a blunt apex, visible on sternite 7, united medially. Appendix masculina of pleopod 2 straight, small, shorter than endopod. Uropod slightly larger than in female, about half the length of pleotelson; rami unequal in length, curved and apically rounded, exopod longer than endopod.

Transitional stage (Figs. 19a, b, 20): Body 2.00 times longer than wide; slightly hunched towards one side,

Cephalon similar to that of the male. Eyes distinct, dorsally visible. Pereonites, pleonites, antennula, antenna, and mandible palp are similar to those of the ovigerous female and maxilla, maxilliped similar to those of the male. Coxae similar to that of the female. Penes not prominent. Pleotelson 1.40 times wider than long, shorter than pleonite 5. Uropods longer than that of female reaches up to 0.50 length of the pleotelson. Rami unequal, similar to that of the male. Pereopods and pleopods similar to those of male and female.

Manca (Figs. 19c, d, 21): Body elongated and transparent, 3.00 times longer than wide. Eyes black, prominent, similar to that of premanca. Cephalon 1.40 times wider than long. Pereonite 3 widest, progressively decreasing the width from 3 to 7. Pereonites subequal in length; 7 short and narrow. All pleonites visible, similar to that of premanca. Pleotelson slightly wider than long; apical margin with 6–8 plumose setae.

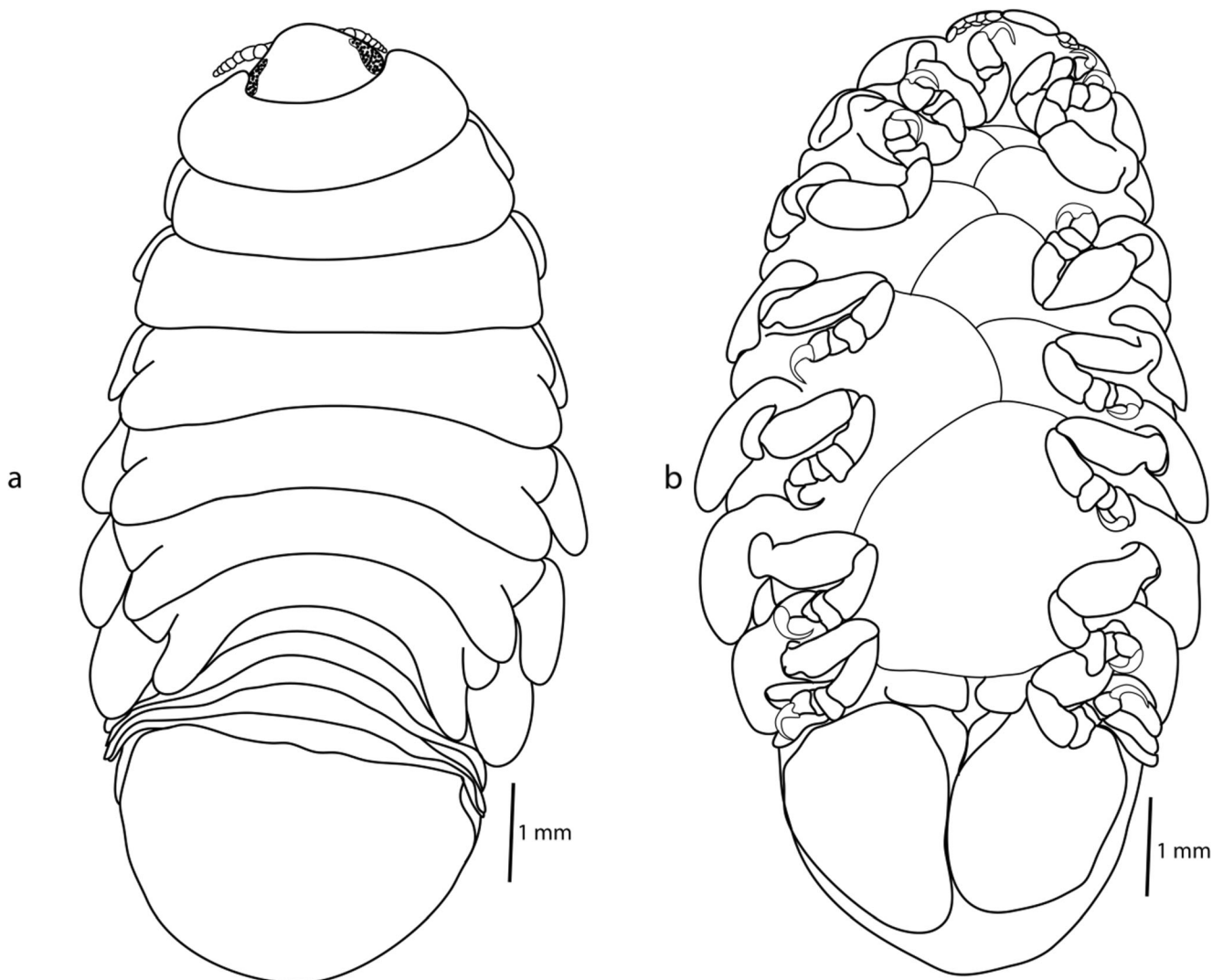


Fig. 8 *Elthusa pseudorhombus* sp. nov. from *Pseudorhombus dupliocellatus*, paratype; **a** Dorsal view; **b** Ventral view

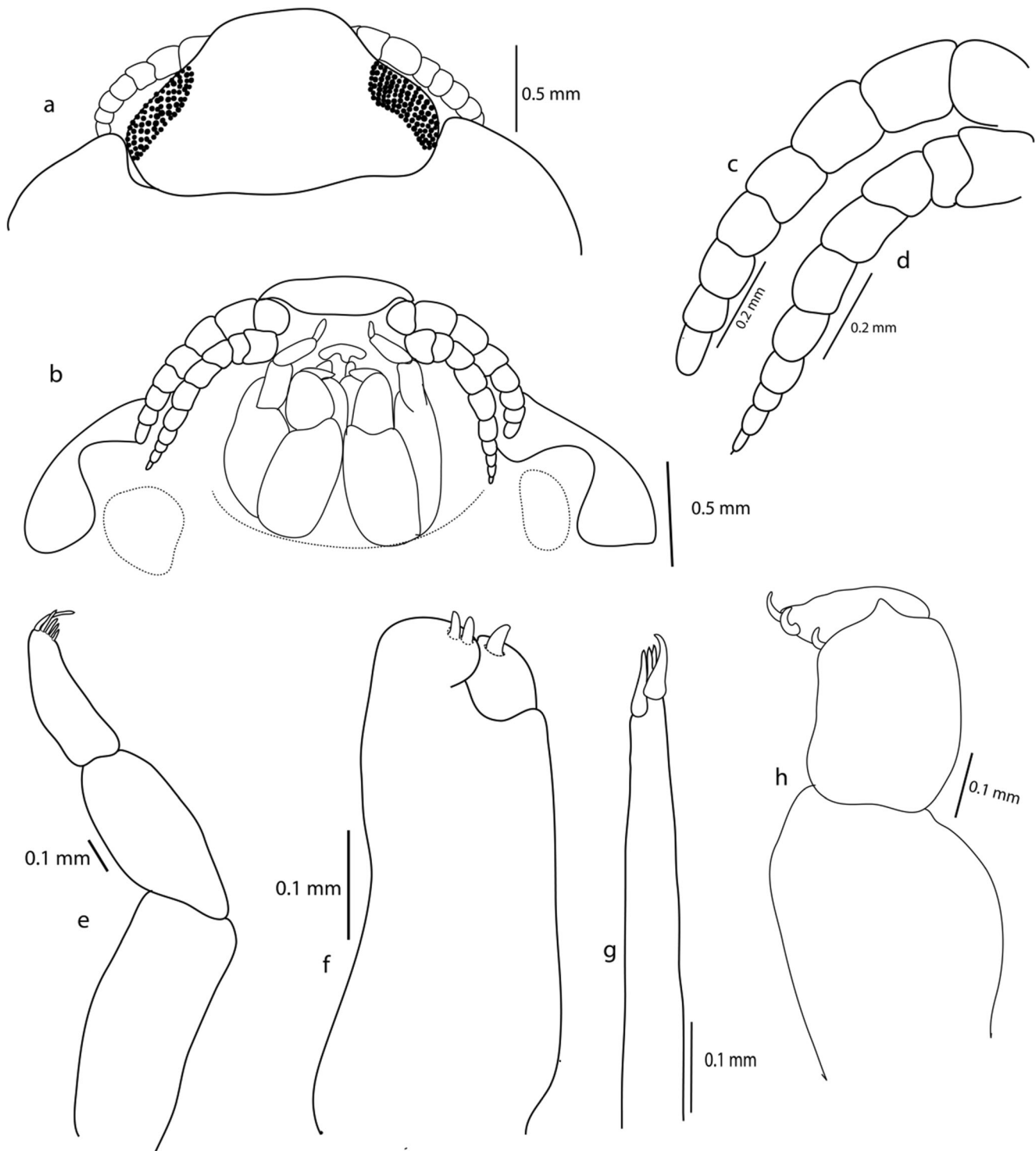


Fig. 9 *Elthusa pseudorhombus* sp. nov. from *Pseudorhombus dupliocellatus*, ovigerous female (a-b) Cephalon; **a** Dorsal view; **b** Ventral view; **c** Antennula; **d** Antenna; **e** Mandible palp; **f** Maxilla; **g** Maxillule; **h** Maxilliped

Antennula with eight articles extending beyond the anterior margin of pereonite 1; all articles with few spinules; article 8 with 2 elongate setae. Antenna longer than antennula, with 12 articles that extend beyond the anterior margin of pereonite 2;

all the articles with spinules and article 7 with one elongate seta and 12 with few setae and terminal aesthetascs. Article 3 of the mandible palp with two marginal setae. Maxillule, maxilla, and maxilliped similar to those of the male stage.

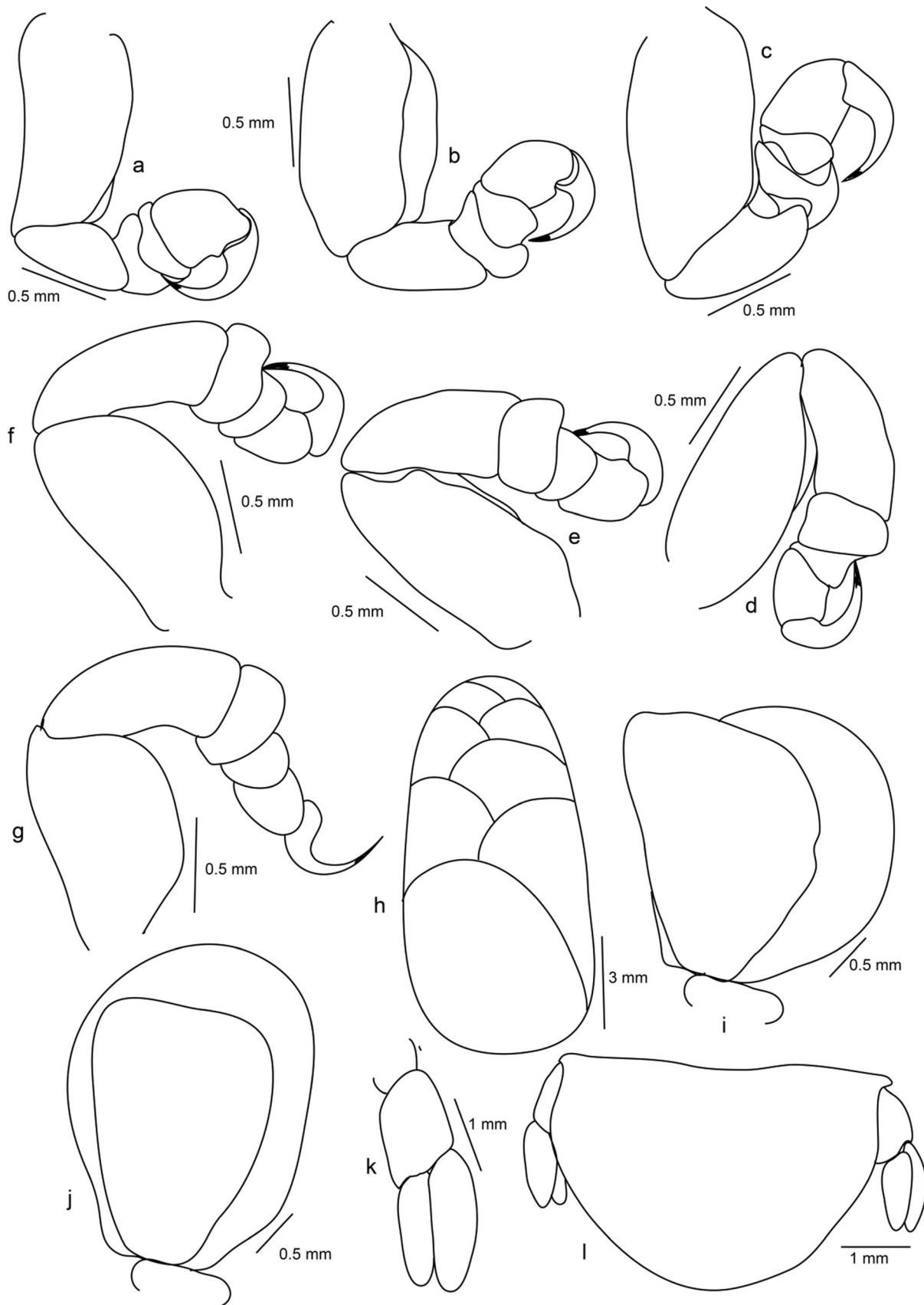


Fig. 10 *Elthusa pseudorhombus* sp. nov. from *Pseudorhombus dupliocellatus*, ovigerous female **a–g** Pereopods 1–7; **h** Brood pouch; **i** Pleopod 2; **j** Pleopod 5; **k** Uropod; **l** Pleotelson and uropods

Six pereopods; pereopods 1–3 without spines. Dactylus of all pereopods without spines. Merus, carpus, and propodus of pereopod 3–6 with few spines on distal margin. Pleopods not distinctly visible in dorsal view. Pleopod 1–5 with 6–8 plumose setae on apical margin of both endopod and exopod. Uropod rami endopod broader than exopod, extending strongly beyond the distal margin of pleotelson. Exopod with 4–6 and endopod with 6–8 plumose setae.

Premanca (Figs. 19e, 22): Elongated and transparent body, 2.80–3.00 times longer than wide. Eyes prominent and conspicuous in dorsal view. Cephalon 1.20 times wider than long. Yolk globules are visible in the pereon, between pereonites 1 and 6. Pereonite 2 widest; gradually decreasing the width from 4 to 7. All pleonites visible and subequal in length and width. Pleotelson 1.40 times wider than long, without plumose setae.

Antennula with eight articles, extending slightly behind the anterior margin of pereonite 1. Antenna longer than antennula,

with 12 articles; all the articles without setae and spinules, extending beyond the posterior margin of pereonite 1. Mouthparts not well developed; mandible palp articles without setae and spines; maxillule, maxilla and maxilliped with poorly developed apical spines. Apical spines not recurved.

Six pereopods, all pereopods without spines. Propodus and dactylus of pereopods not toothed. Pleopods not visible in dorsal view. All pleopods without plumose setae. Uropod rami subequal, extending beyond the distal margin of pleotelson, apically rounded without plumose setae.

Body Size: Female 9.00–14.00 mm; male 7.00–9.00 mm; transitional stage 8.00–11.00 mm; manca 2.20–3.00 mm; premanca 1.80–2.20 mm.

Color: Female, male, and transitional stage—light pink color with scattered chromatophores throughout the pereon; premanca and manca—clear with scattered chromatophores.

Distribution: Known from the type locality, Japan (Shiino 1951), Neendakara, Quilon, Kerala coast, (Kumar and Bruce

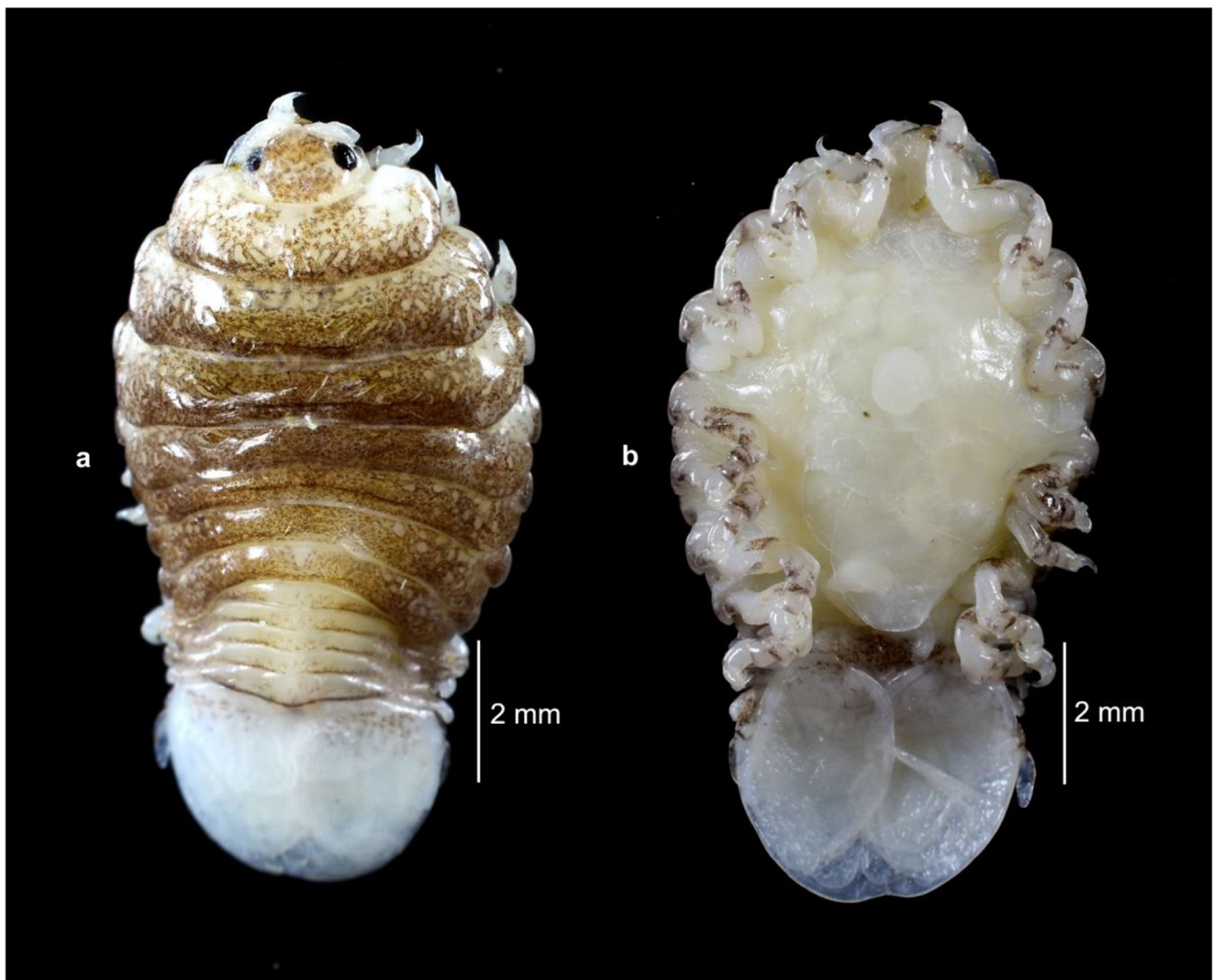


Fig. 11 *Elthua samariscii* (Shiino, 1951) from *Samaris cristatus* (Samaridae) nontype female; **a** Dorsal view; **b** Ventral view

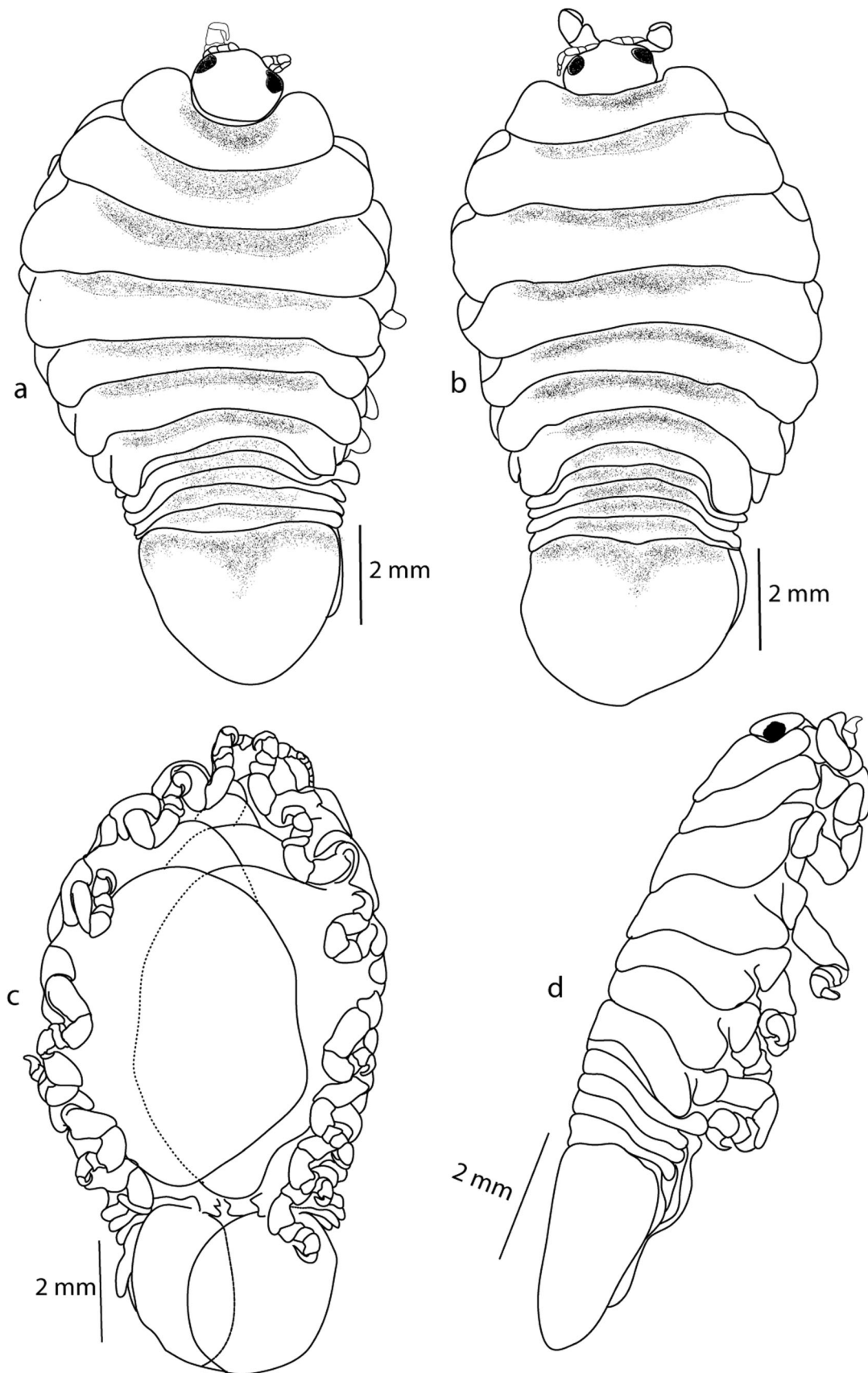


Fig. 12 *Elthusa samariscii* (Shiino, 1951) from *Samaris cristatus* (Samaridae) nontype female; **a** Dorsal view (Reg No ZSI/WGRC/IR/INV/11723); **b–d** (Reg No ZSI/WGRC/IR/INV/11725); **b** Dorsal view; **c** Ventral view; **d** Lateral view

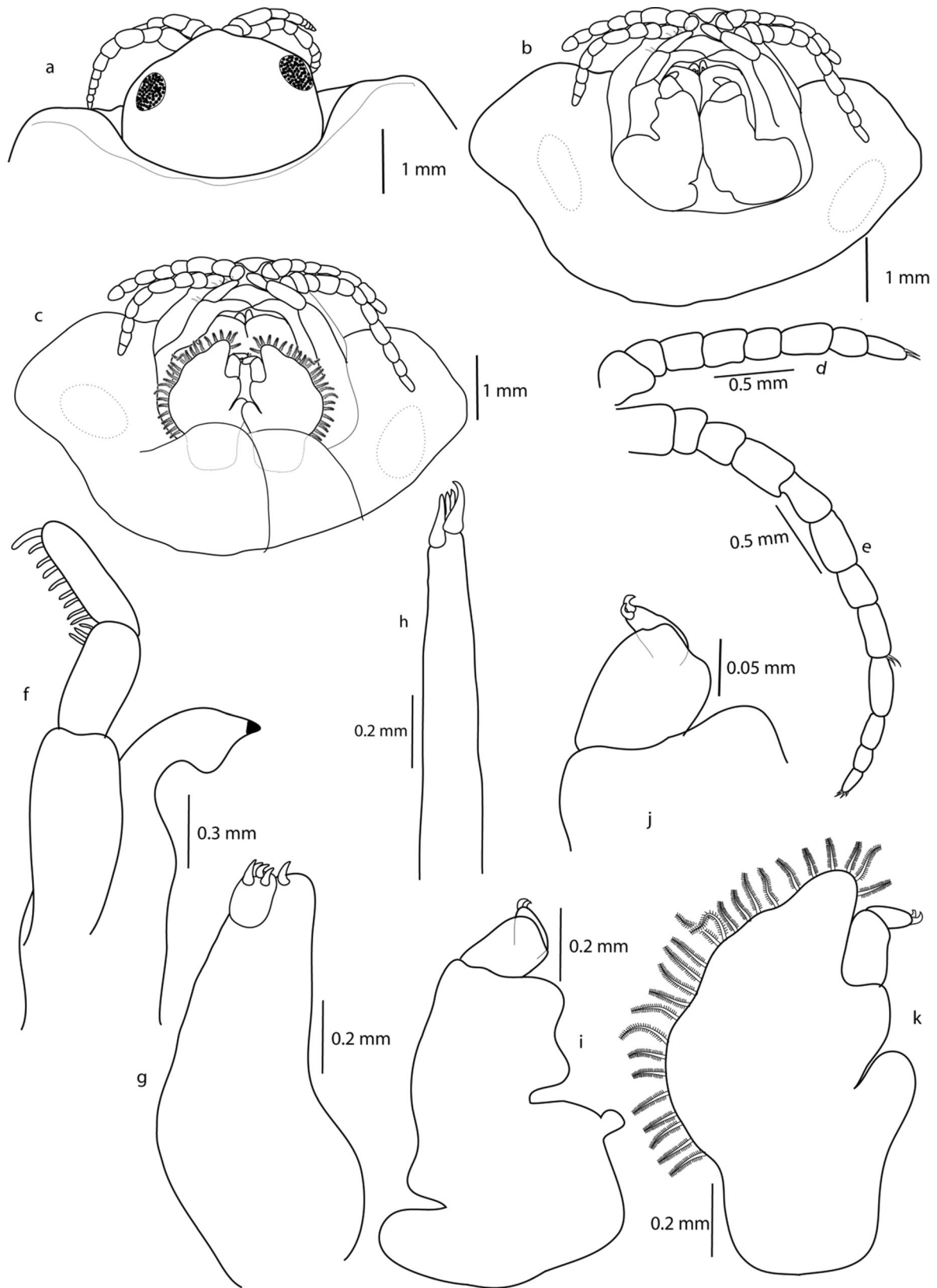


Fig. 13 *Elthusa samariscii* (Shiino, 1951) from *Samaris cristatus* (Samaridae) nontype female **a–c** cephalon; **a** Dorsal view; **b** Ventral view of non-ovigerous female; **c** Ventral view of ovigerous female; **d**

Antennae; **e** Antennula; **f** Mandible; **g** Maxilla; **h** Maxillule; **i** Maxilliped of non-ovigerous female; **j** Distal segment of maxilliped palp; **k** Maxilliped of ovigerous female

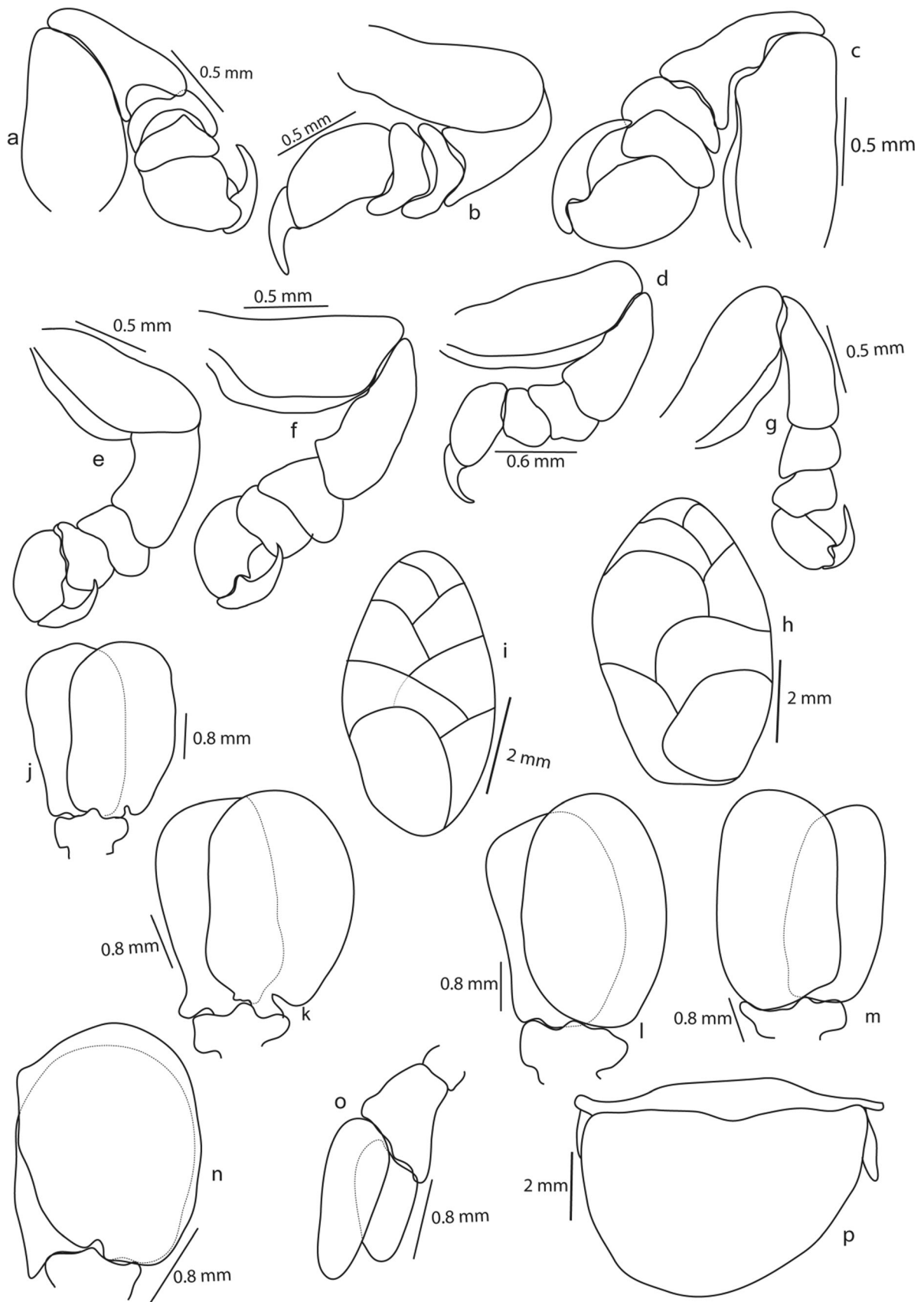


Fig. 14 *Elthusa samariscii* (Shiino, 1951) from *Samaris cristatus* (Samaridae) nontype female **a–g** Pereopods 1–7; **h–i** Brood pouch; **j–n** Pleopods 1–5; **o** Uropod; **p** Pleotelson and uropods

1997; present study), Muttom, Tamil Nadu, southwest coast, India (present study).

Hosts: Recorded from two Samaridae fishes, *Samaris japonicus* Kamohara (type host) (Shiino 1951); *Samaris cristatus* (Kumar and Bruce 1997; present study).

Remarks: The species succinctly described by Shiino (1951) was later redescribed by Kumar and Bruce (1997) from several ovigerous females and males from Kerala. *E. samariscii* shows some morphological variation especially the size of the antenna and the posterolateral margin of pereonite 7. Type material of this species was not designated by Shiino (1951). Based on the following characters, *E. samariscii* is placed into *incertae sedis*: the head anterior margin with a rostral point (vs. head anterior margin truncate (or subtruncate ["bluntly rounded"]) in *Elthusa*); a pleon width of less than 0.72 width of pereon (vs. above 0.75 in *Elthusa*); coxa of pereopods 2–5 not visible dorsally, 6 and 7 moderately visible (vs. in *Elthusa* all coxae visible dorsally). *E. samariscii* shows some similarity to *E. arnoglossi*, another species currently included under *Elthusa incertae sedis*. *E. samariscii* can be separated from *E. arnoglossi* by: female body slightly twisted to one side or another while *E. arnoglossi* is more asymmetrical, dissimilar in shape and

always deeply twisted only to the right side; antenna composed of 12 articles (18 in *E. arnoglossi*), and extending to the posterior margin of the cephalon (vs. beyond the margin of pereonite 1 in *E. arnoglossi*); uropods barely reaching beyond anterior quarter of pleotelson (vs. longer and almost reaching posterior margin of pleotelson in *E. arnoglossi*).

***Elthusa uranoscopus* sp. nov.**

<http://zoobank.org/BB0A3C5F-B70C-4242-98B8-3C7CD0F1EC21>.

Type material: *Holotype*—female [14.50 mm L, 8.10 mm W (maximum width) ovigerous], partially dissected, from *Uranoscopus guttatus* Cuvier, 1829 (Uranoscopidae), Muttom, southwest coast, India (8° 07' 48.00" N, 77° 19' 12.00" E), 25 November 2017, coll. PT Aneesh (Reg. No. ZSI/WGRC/IR/INV/11721). *Paratype*: Same information as the holotype with the following measurements and registration details: 1 male (Fig. 5) (4.50 mm TL; 2.00 mm W), (Reg. No. ZSI/WGRC/IR/INV/11722).

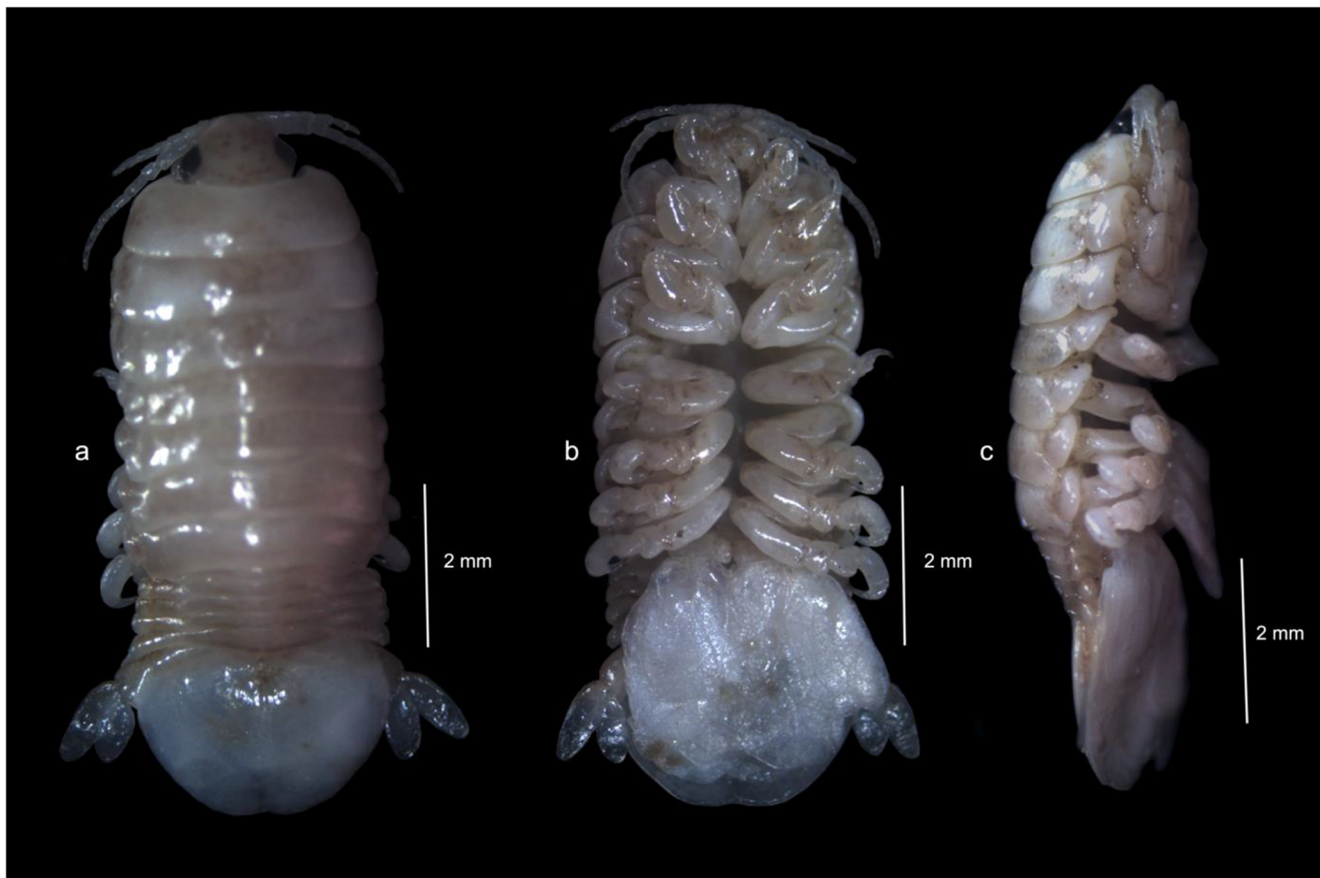


Fig. 15 *Elthusa samariscii* (Shiino, 1951) from *Samaris cristatus* (Samaridae) nontype male (Reg No ZSI/WGRC/IR/INV/11726); **a** Dorsal view; **b** Ventral view; **c** Lateral view

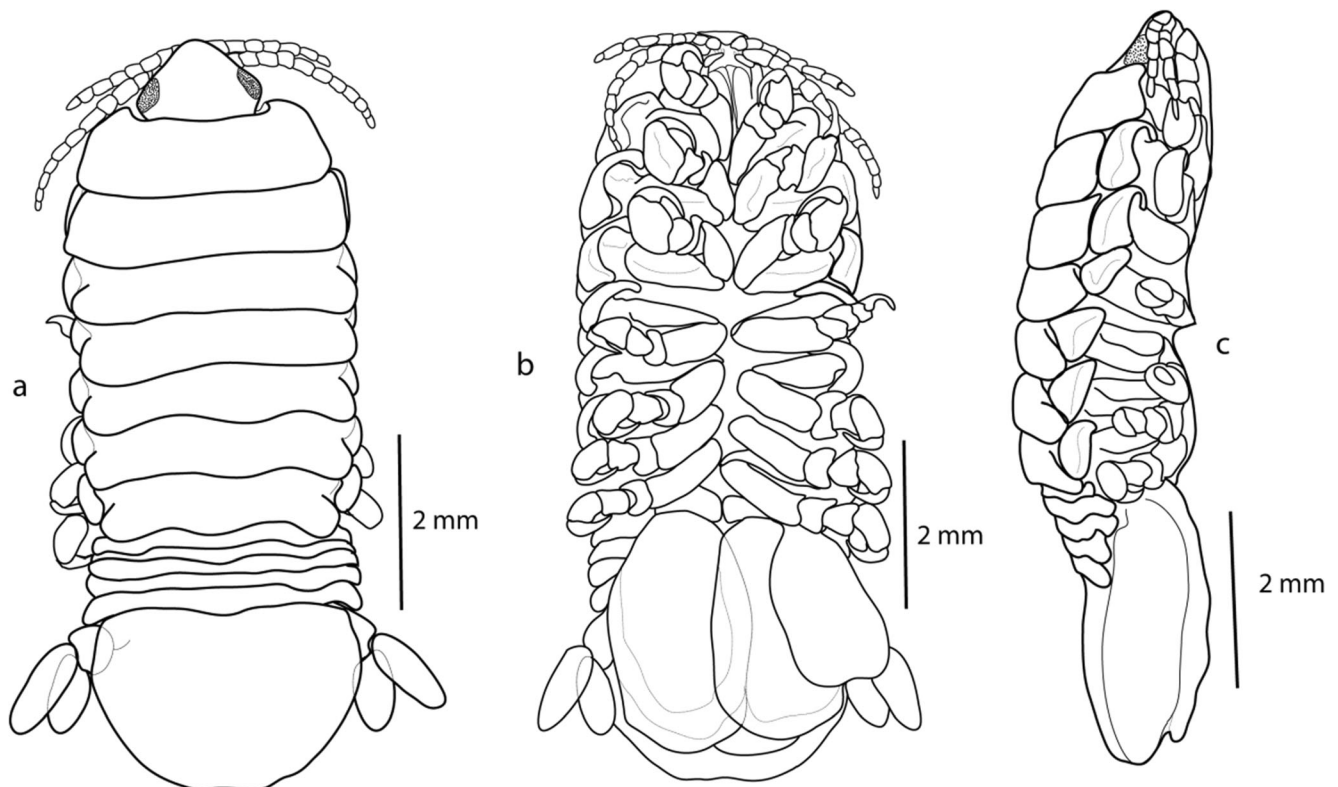


Fig. 16 *Elthusa samariscii* (Shiino, 1951) from *Samaris cristatus* (Samaridae) nontype male (Reg No ZSI/WGRC/IR/INV/11726); **a** Dorsal view; **b** Ventral view; **c** Lateral view

Description

Holotype female (Figs. 23, 24, 25 and 26): Length 14.50 mm, maximum width 8.10 mm. Body compact, slightly asymmetrical, weakly hunched to one side, 1.80 times as long as greatest width, widest at pereonite 6, most narrow at pereonite 1. Symmetrical cephalon, 1.60 times wider than long, anterior margin rounded and turned down. Cephalon conspicuous dorsally, moderately immersed in the pereonite 1. Eyes distinct, dorsolateral to the cephalon, 0.40 times as long as cephalon, visible dorsally. Coxae 2–5 small and shorter than pereonites, coxae 6 and 7, flat, broad, longer than the corresponding pereonite; posterior margin rounded. Coxae 7 partially overlapping pleonite lateral margin. Pereonites 1 longest, 7 shortest, 2 and 6 subequal; pereonite 4 slightly shorter than 1; pereonites 3 and 5 subequal, longer than pereonite 2. Pereonite 3, 4 and 7 subequal and wider than pereonite 1; pereonite 5 narrower than 6. All pleonites visible dorsally not immersed in the pereonite 7. Pleonites 1 and 2 completely overlapped, 3 partially overlapped by coxa 7 and posterior margin of pereonite 7. Pleonite 1 narrower than others, pleonites 2–5 progressively narrower towards posterior. Pleonite 2, 0.84 width of pereonite 6; Pleonites 1–4 subequal in length, 5 longest; posterior margin broadly rounded. Pleonites lateral margin curving posteriorly.

Pleotelson 1.80 times as wide as long, much narrower than pleonite 5, posterior margin broadly rounded, lateral margins convex.

Antennula faintly stouter than antenna, with 8 articles, well separated at base, reaching one half portion of pereonite 1. Antenna, 11-articled, slightly longer than antennula, decreasing gradually in width, terminal article with distal setae. Mandible palp slender, article 1 longest, terminal article with two long terminal and 4–5 short disto-lateral recurved spines. Maxillule with one large and three small subequal RS. Maxilla, mesial, and lateral lobe with two small, RS. Maxilliped without oostegial lobe; an apical segment with three apical and one lateral RS.

Pereopods merus dilated with bulbous protrusion. Pereopod 1, basis, 1.25 times as long as greatest width; ischium 0.80 times as long as basis; propodus 1.50 times as long as wide; dactylus 1.45 times as long as propodus, 2.00 times as long as basal width. Pereopod 2 basis, 1.60 times as long as greatest width; ischium 0.50 times as long as basis; propodus 1.5 times as long as wide; dactylus slender, 1.35 times as long as propodus, 2.80 times as long as basal width. Pereopod 6 basis with carina, 1.60 times as long as greatest width; ischium 0.75 times as long as basis, 0.4 times as wide as long; merus 0.50 times as long as wide, 0.25 times as long as ischium; propodus as long as wide, 0.35 times as long as ischium; dactylus 1.50 times as long as propodus, 3.00 times as long

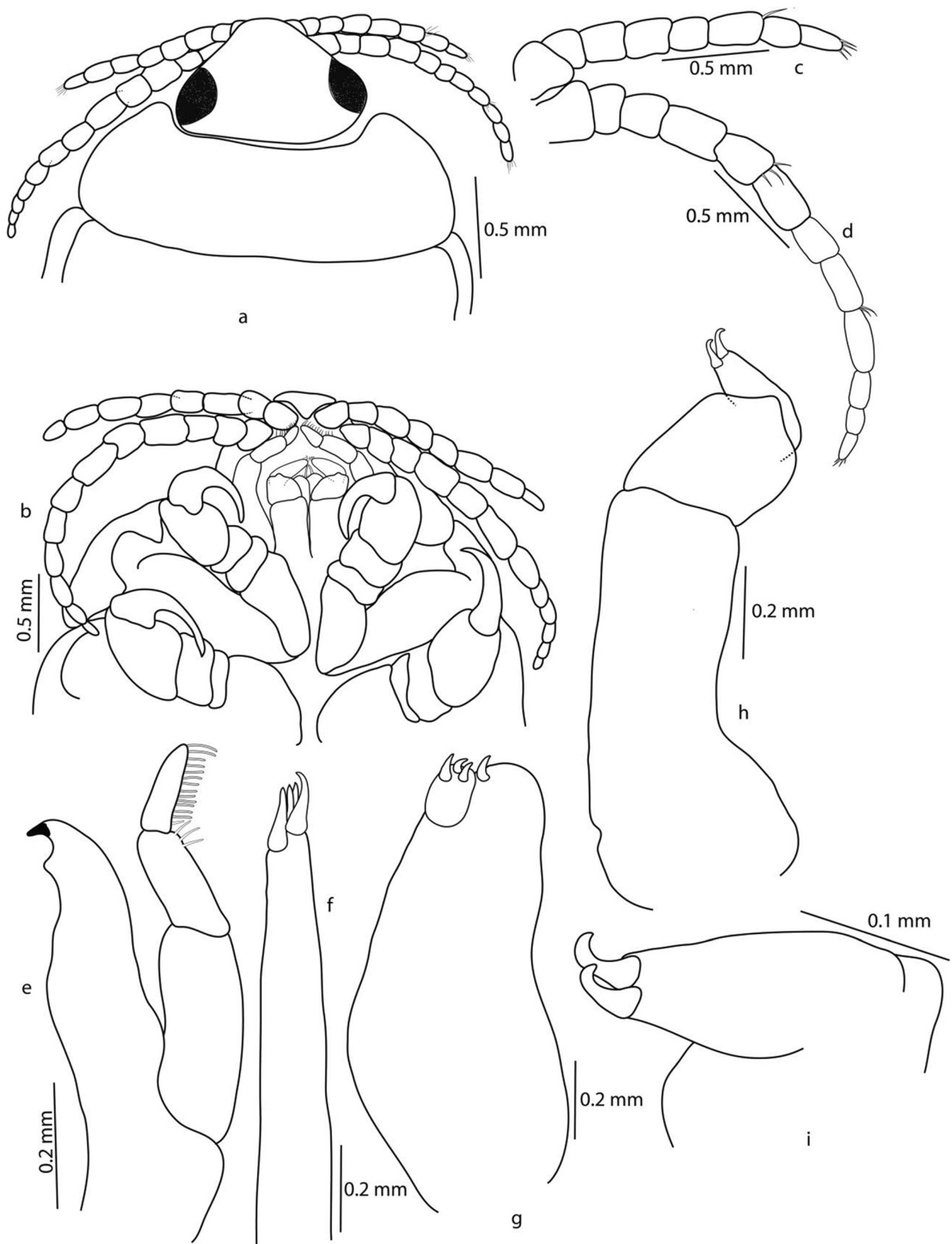


Fig. 17 *Elthusa samariscii* (Shiino, 1951) from *Samaris cristatus* (Samaridae) nontype male (**a–b**) Cephalon; **a** Dorsal view; **b** Ventral view; **c** Antennula; **d** Antenna; **e** Mandible; **f** Maxillule; **g** Maxilla; **h** Maxilliped; **i** Distal segment of maxilliped palp

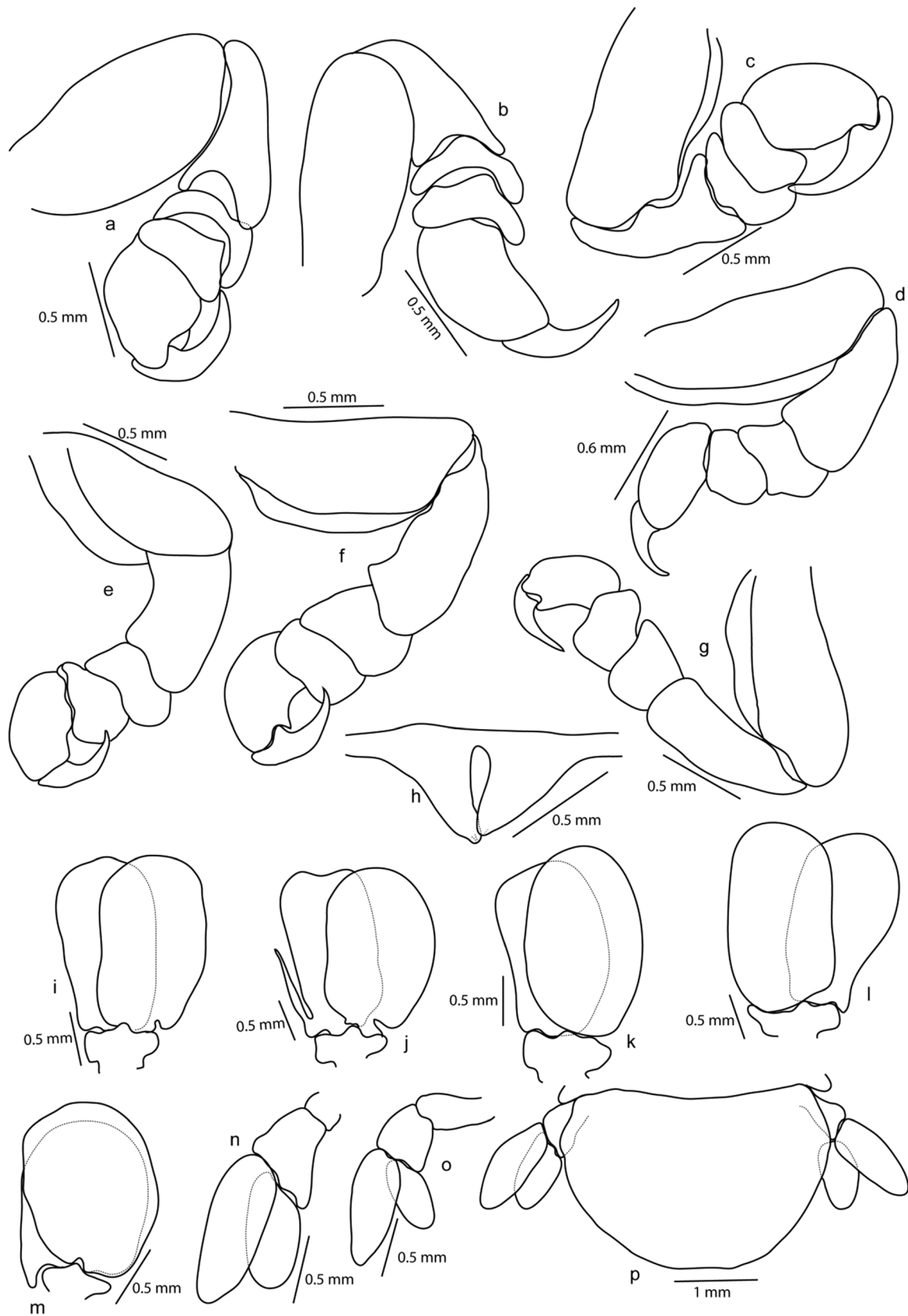


Fig. 18 *Elthusa samariscii* (Shiino, 1951) from *Samaris cristatus* (Samaridae) nontype male **a–g** Pereopod 1–7; **h** Penes; **i–m** Pleopods 1–5; **n–o** Uropod **p** Pleotelson and uropods



Fig. 19 *Elthusa samariscii* (Shiino, 1951) from *Samaris cristatus* (Samaridae); **a–b** Transitional (Reg No ZSI/WGRC/IR/INV/11724); **a** Dorsal; **b** Ventral; **c–d** Manca larva; **e** Premanca larva

as basal width. Pereopod 7 basis with carina, 1.25 times as long as greatest width; ischium as long as basis, 0.5 times as wide as long; merus 0.50 times as long as wide, 0.33 times as

long as ischium; propodus 0.85 times as long as wide, 0.33 times as long as ischium; dactylus slender 2.00 times as long as propodus, 2.50 times as long as basal width.

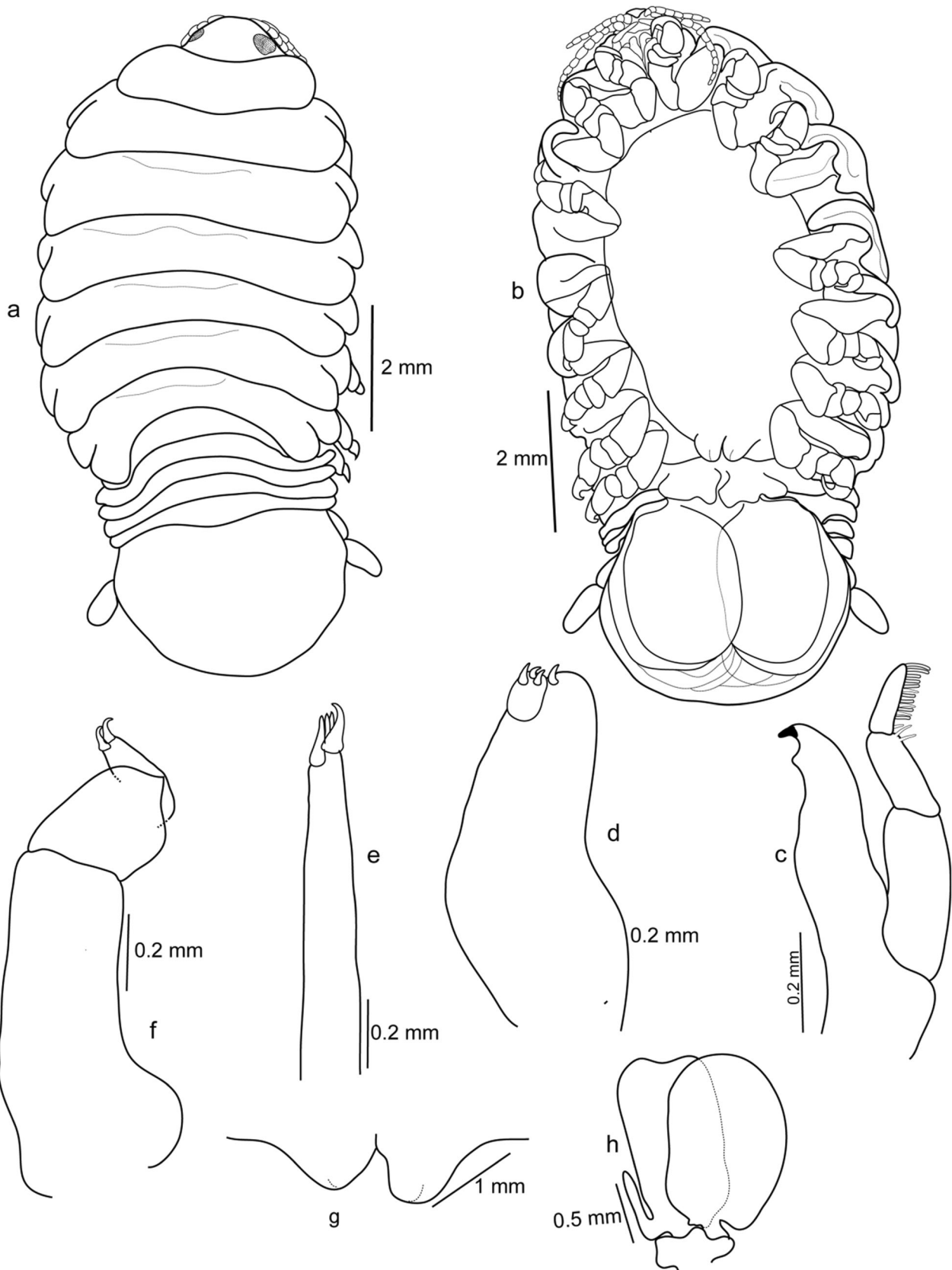


Fig. 20 *Elthusa samariscii* (Shiino, 1951) from *Samaris cristatus* (Samaridae), transitional stage; **a** Dorsal view; **b** Ventral view; **c** Mandible; **d** Maxilla; **e** Maxillule; **f** Maxilliped; **g** Penes; **h** Pleopod 2

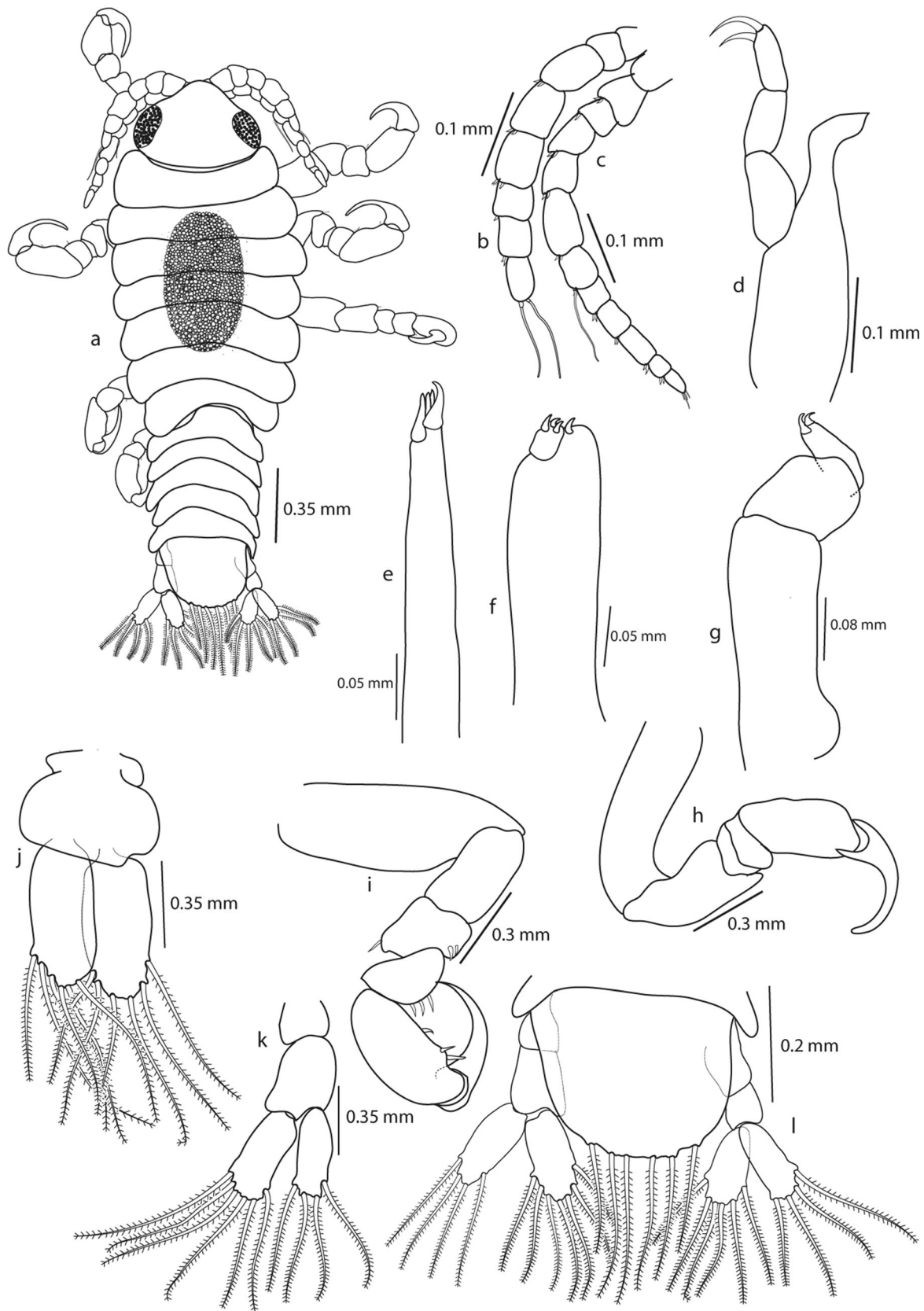


Fig. 21 *Elthusa samariscii* (Shiino, 1951), manca larva; **a** Dorsal view; **b** Antennula; **d** Mandible; **e** Maxillule; **f** Maxilla; **g** Maxilliped; **h** Pereopod 1; **i** Pereopod 6; **j** Pleopod 2; **k** Uropod; **l** Pleotelson and uropods

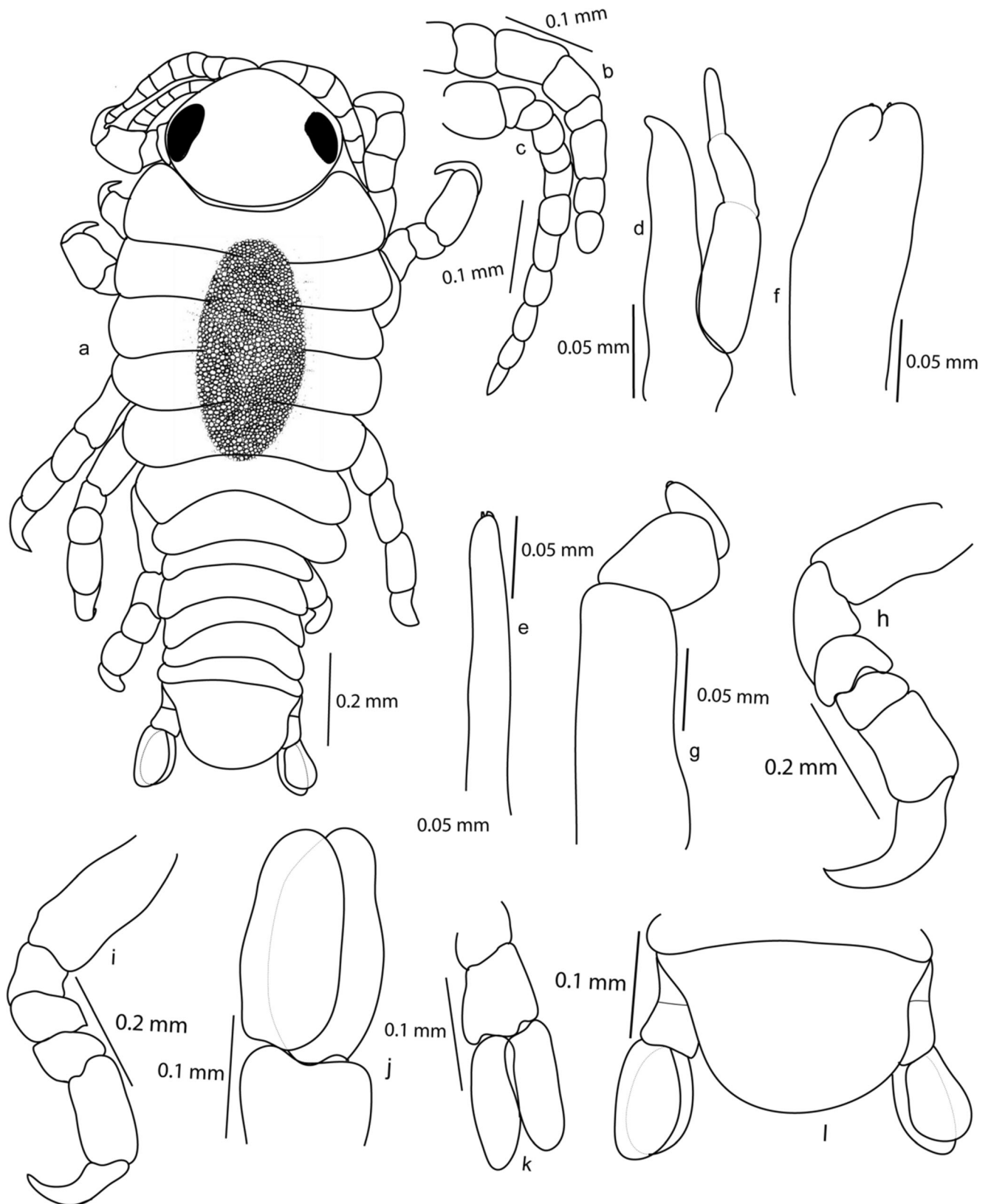


Fig. 22 *Elthusa samariscii* (Shiino, 1951), premanca larva; **a** Dorsal view; **b** Antennula; **c** Antenna; **d** Mandible; **e** Maxillule; **f** Maxilla; **g** Maxilliped; **h** Pereopod 1; **i** Pereopod 6; **j** Pleopod 2; **k** Uropod; **l** Pleotelson and uropods



Fig. 23 *Elthusa uranoscopus* sp. nov. from *Uranoscopus guttatus* (Uranoscopidae), holotype female (Reg. No. ZSI/WGRC/IR/INV/11721); **a** Dorsal view; **b** Ventral view

Pleopods simple, without setae, all rami laminar; decreasing in size from 1 to 5, without coupling hooks on the peduncle. Pleopods endopod larger than endopod; accessory endopod lobes absent in all pleopods. Pleopod 1 exopod 1.35 times as long as wide, lateral margin weakly convex, distally narrowly rounded, mesial margin straight. Pleopod 5 exopod 1.25 times as long as wide, distally narrowly rounded, mesial margin weakly convex. Uropod more than half the length of pleotelson; rami unequal, exopod shorter than endopod. Uropod peduncle 0.55 times longer than endopod, lateral margin without setae; apices broadly rounded. Endopod 2.30 times as long as greatest width, apically rounded. Exopod 0.66 times the long as endopod, 2.40 times as long as greatest width, apically rounded.

Brood pouch formed by five pairs of alternatively overlapping oostegites arising from the bases of pereopods 2–6; second oostegites small, sixth largest, fourth and third medium.

Male (Figs. 27, 28 and 29): Length 4.80 mm, maximum width 1.70 mm. Symmetrical body, 2.80 times longer than greatest width, widest at pereonite 2. Cephalon anterior margin rounded and wider than long, slightly immersed in pereonite 1. Eyes more prominent than that of the female. Pereonites more or less equal in width; pleonite 1 slightly narrower than others. All coxae visible. Pleonites subequal in length and width. Pleotelson 1.30 times as wider than long, shorter than pleonite 5, posterior margin rounded.

Antennula with 12 articles. Antenna, maxillule, and mandible are similar to that of the female. Bilobed maxilla basally widest; inner median lobe with one and outer lateral lobe with two small, slightly recurved RS. Maxilliped without oostegial lobe slightly narrower than female, article three with three terminal and one disto-lateral recurved RS.

Pereopods slightly narrower than that of the female. Penes opening flush on sternite 7, tubercles separate, united

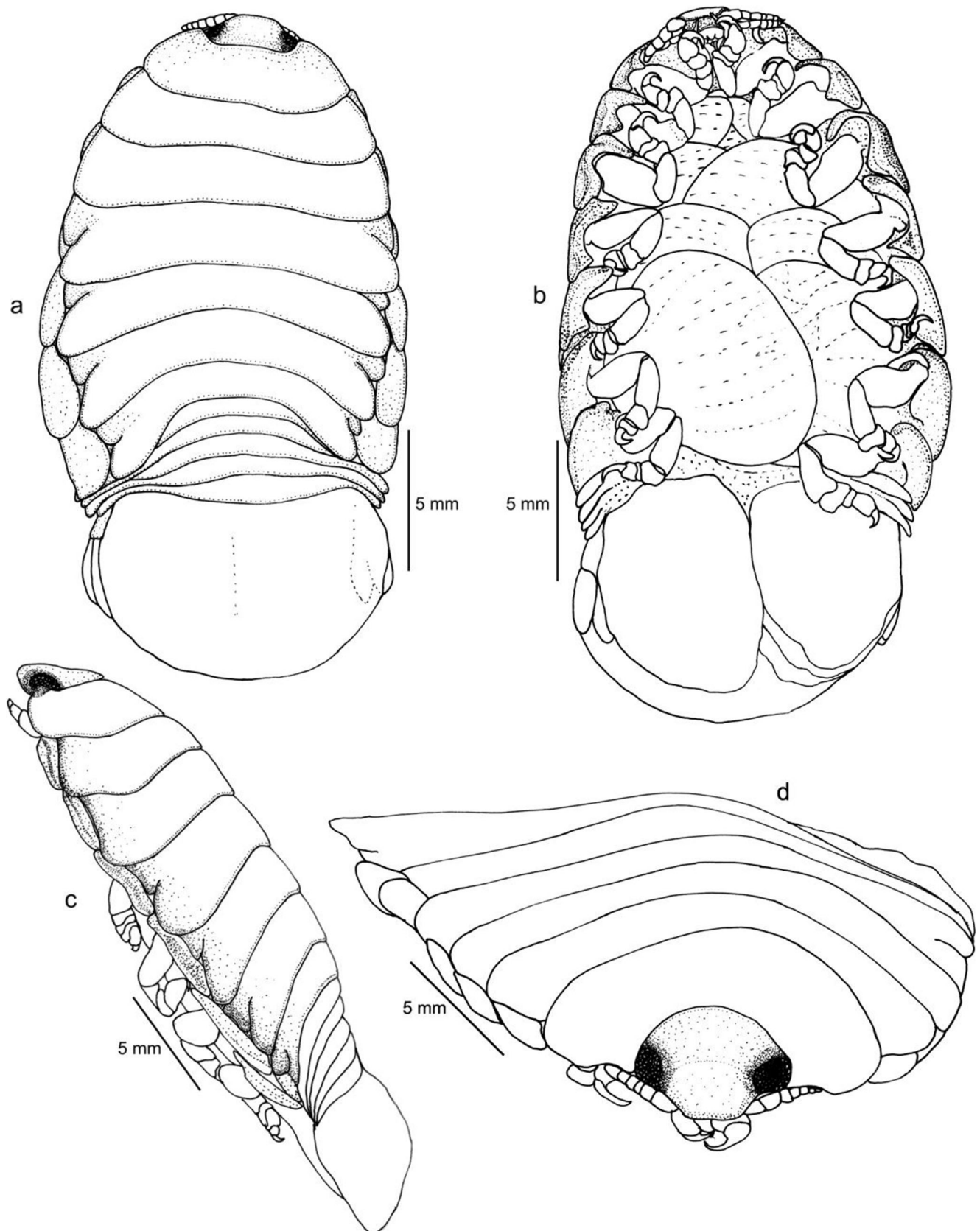


Fig. 24 *Elthusia uranoscopus* sp. nov. from *Uranoscopus guttatus* (Uranoscopidae), holotype female (Reg No ZSI/WGRC/IR/INV/11721); **a** Dorsal view; **b** Ventral view; **c** Lateral view; **d** Dorso-frontal view

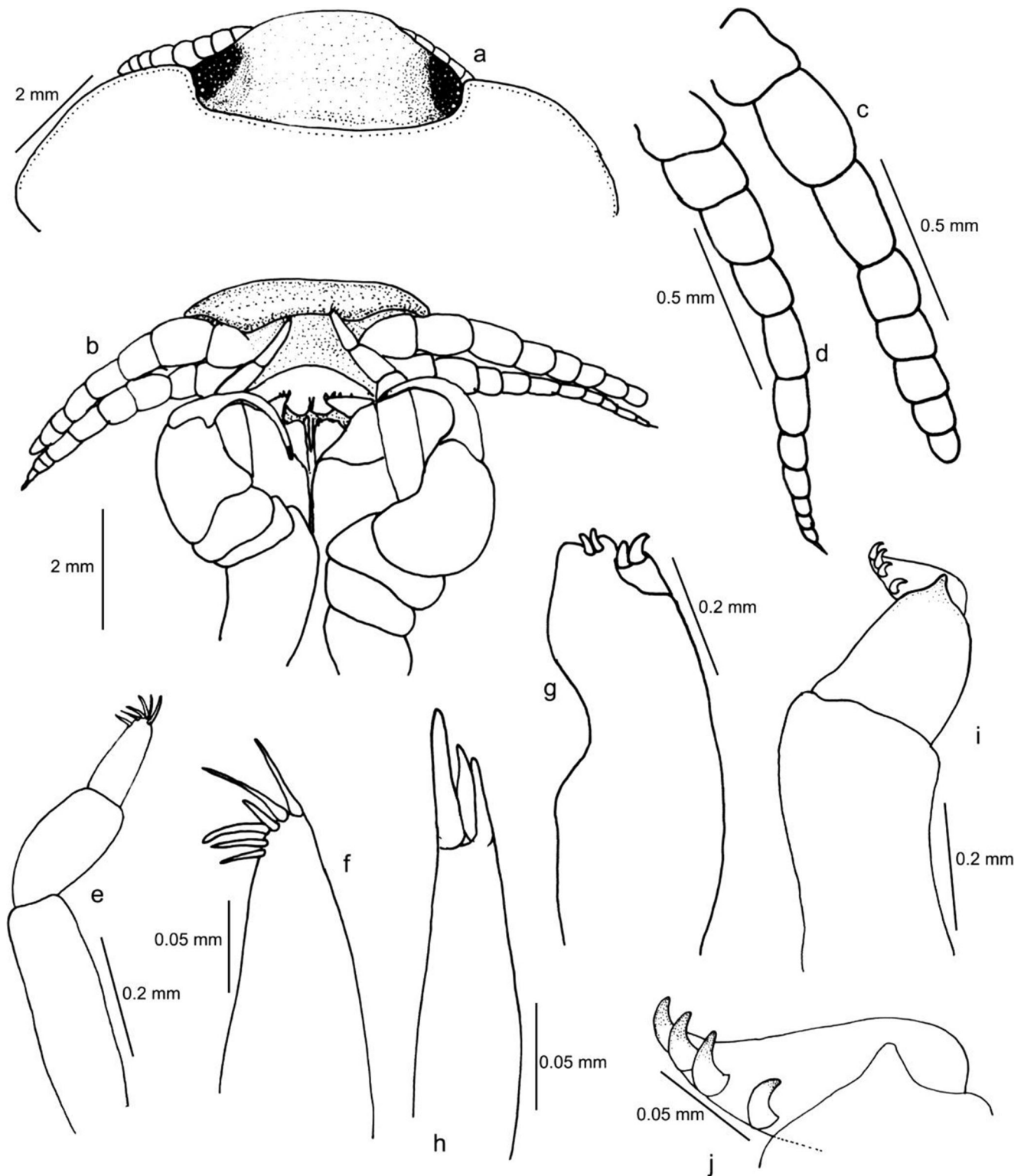


Fig. 25 *Elthusa uranoscopus* sp. nov. from *Uranoscopus guttatus* (Uranoscopidae), holotype female (**a–b**) Cephalon. **a** Dorsal view; **b** Ventral view; **c** Antennula; **d** Antenna; **e** Mandible palp; **f** Mandible palp apex; **g** Maxilla; **h** Maxillule apex; **i** Maxilliped; **j** Distal segment of maxilliped palp

medially with a blunt apex, penial process about 0.60 times as long as basal width. Appendix masculina of pleopod 2 straight, small, shorter than endopod. Uropod proportionately

larger than in female, reaches just beyond the length of pleotelson; rami unequal in length, curved and apically rounded, endopod slightly larger than exopod.

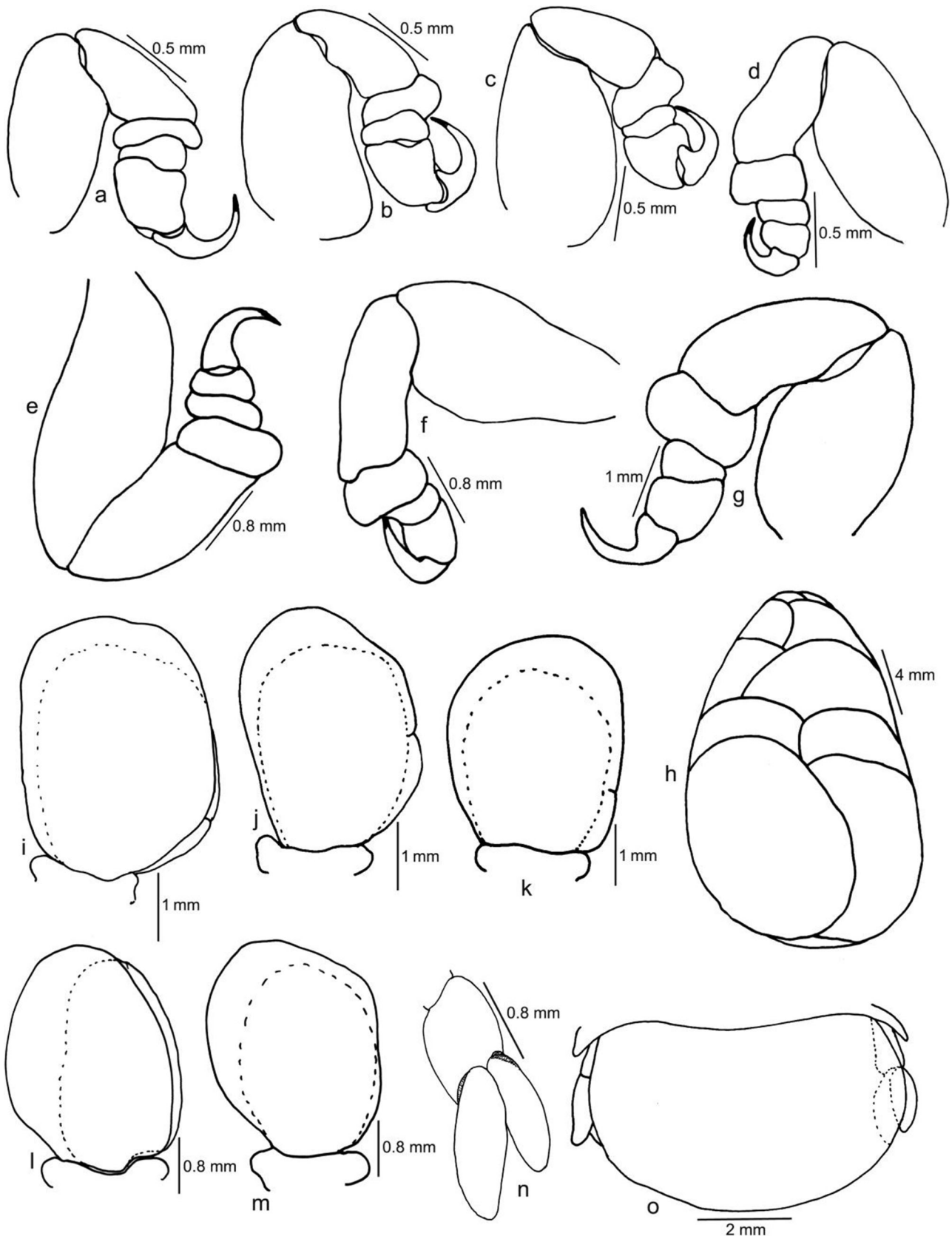


Fig. 26 *Elthusa uranoscopus* sp. nov. from *Uranoscopus guttatus* (Uranoscopidae), holotype female **a–g** pereopods 1–7; **h** Brood pouch; **i–m** Pleopods 1–5; **n** Uropod; **o** Pleotelson and uropods



Fig. 27 *Elthusa uranoscopus* sp. nov. from *Uranoscopus guttatus* (Uranoscopidae), paratype male (Reg No ZSI/WGRC/IR/INV/11722); **a** Dorsal view; **b** Ventral view

Body Size: Female 14.50 mm; male 4.50 mm.

Color: Both ovigerous female and male—body pale tan.

Distribution: Known only from the type locality Muttom, southern west coast, India (type locality).

Host: Only known from the type host *Uranoscopus guttatus*.

Etymology: The species name is derived from the genus name of the type host *Uranoscopus* Linnaeus 1758; noun in apposition.

Remarks: *Elthusa uranoscopus* sp. nov. can be separated from most species within the genus that have maxilliped

without oostegial lobe (*E. sigani* and *E. emarginata*). Among them, the type species *E. emarginata*, recently redescribed by Trilles & Randall, (2011) and *E. sigani* shows some similarities with *E. uranoscopi*. *E. uranoscopus* can be separated from *E. emarginata* by the cephalon which being moderately immersed in the pereonite 1 and about 1.60 times wider than long, with the anterior margin rounded and turned ventrally while in *E. emarginata*, the cephalon about 1.3 times longer than wide and anterior margin produced, forming a broad subtruncate rostrum. The pleotelson of *E. uranoscopus* is 1.80 times wider than long, much narrower

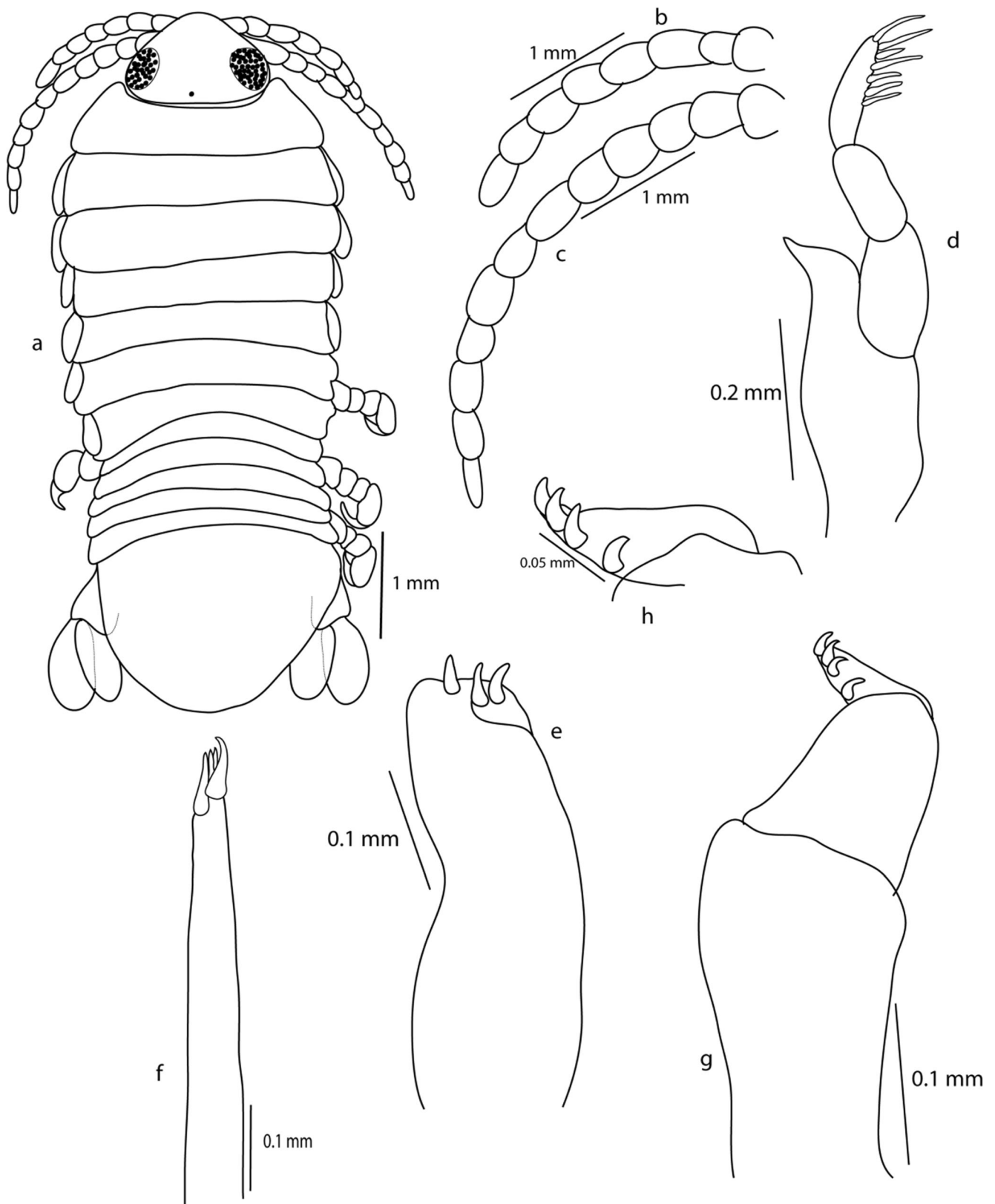


Fig. 28 *Elthusa uranoscopus* sp. nov. from *Uranoscopus guttatus* (Uranoscopidae) paratype male; **a** Dorsal view; **b** Antennula; **c** Antenna; **d** Mandible; **e** Maxilla; **f** Maxillule; **g** Maxilliped; **h** Distal segment of maxilliped palp

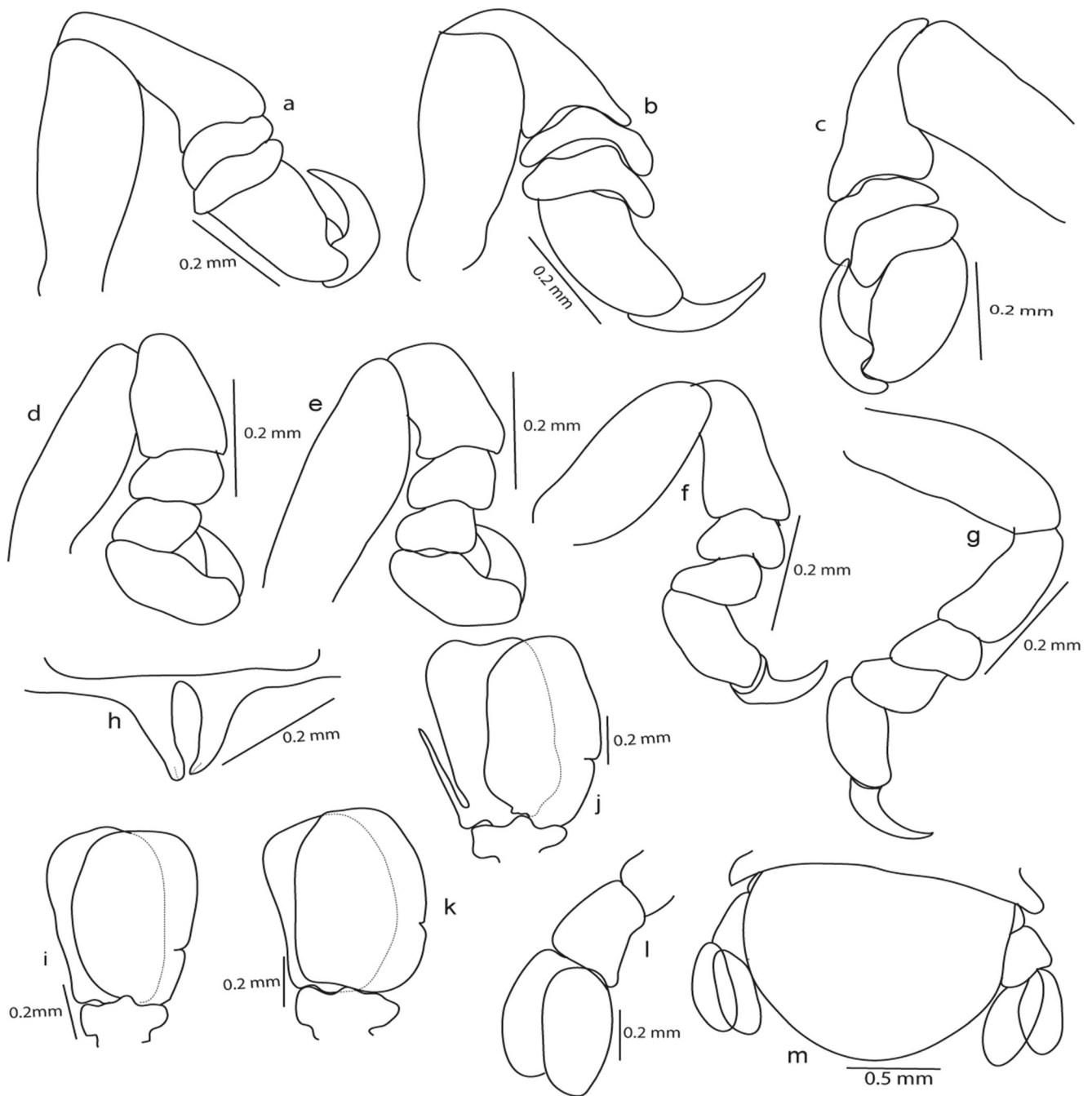


Fig. 29 *Elthusa uranoscopus* sp. nov. from *Uranoscopus guttatus* (Uranoscopidae), paratype male **a–g** Pereopods 1–7; **h** Penes; **i–j** Pleopods 1–2; **k** Pleopod 5; **l** Uropod; **m** Pleotelson and uropods

than pleonite 5, posterior margin broadly rounded, but in *E. emarginata* it is about 1.5 times wider than long and subtriangular. The mandible palp, number of setae on the maxilliped and maxilla of the new species also differs from the *E. emarginata*; in *E. uranoscopus* maxilliped with four RS (vs. five in *E. emarginata*) and maxilla of *E. uranoscopus* with two RS on both mesial and lateral lobe (vs. maxilla with 3 RS on medial and 2 RS on lateral lobes in *E. emarginata*). Similarly, *E. uranoscopus* can also be distinguished from the *E. sigani* by the shape of the coxa: coxae of pereonite 2–5

small and shorter than the corresponding pereonite; coxae 6 and 7, flat, broad and longer than the corresponding pereonite whereas in *E. sigani*, coxae 5–7 narrower than the new species, 6 as long as pereonite. In *E. uranoscopus* pleonites 1, 2 completely and 3 partially overlapped laterally by coxa and posterior margin of pereonite 7, while in *E. sigani*, lateral margin of pleonite 2–5 visible and not overlapped by coxae. The antenna, mandible palp and maxilliped of *E. uranoscopus* are also different from *E. sigani*. The ratio of maximum pleon width to maximum pereon width in *E. uranoscopus* is 0.84

(vs. 0.75–0.79 in *E. sigani*). Differences between *E. uranoscopus* and the other two new species are listed in the Table 1.

Acknowledgments PTA acknowledge the DS Kothari Post-Doctoral Fellowship of University Grants Commission, New Delhi (No.F.4-2/2006 (BSR)/BL/16–17/0401; dated: 28th August 2017) awarded to him. We extend our sincere thanks to Dr. Niel L. Bruce, for his valuable revision/suggestions/discussions on the generic revision of *Elthusa* during the later stage of MS revision. Further, we gratefully acknowledge the effort made by the two anonymous reviewers for their critical reviewing of the manuscript and making valuable suggestions for the improvement of the manuscript.

Funding This research was financed by the University Grants Commission, New Delhi through Post-Doctoral Fellowship to PTA (No.F.4-2/2006 (BSR)/BL/16–17/0401; dated: 28th August 2017).

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The specimen is not under the listed category of experimental animals which need ethics approval.

Sampling and field studies All necessary permits for sampling and observational field studies have been obtained by the authors from the competent authorities.

Data availability Type and voucher specimens were deposited in the collections of Western Ghat Field Research Centre of Zoological Survey of India, Kozhikode (ZSI/WGRC).

Author contribution PTA is the main worker on the topic and prepared the draft of the manuscript. PTA, AKH and AB conceived and designed research. PTA and AB conducted the field work. AKH helped with interpretation of the results. JPT critically reviewed for improving the quality of the manuscript. All authors read and approved the final manuscript.

References

- Aneesh PT, Helna AK, Sudha K, Anilkumar G (2018) *Agarna malayi* Tiwari 1952 (Crustacea: Isopoda: Cymothoidae) parasitising the marine fish, *Tenulosa toli* (Clupeidae) from India: re-description/description, life cycle and pattern of parasitic occurrence. *Zool Stud* 57:25. <https://doi.org/10.6620/ZS.2018.57-25>
- Aneesh PT, Helna AK, Trilles JP, Chandra K (2019a) A taxonomic review of the genus *Joryma* Bowman and Tareen, 1983 (Crustacea: Isopoda: Cymothoidae) parasitizing the marine fishes from Indian waters, with a description of a new species. *Mar Biodivers* 49:1449–1478. <https://doi.org/10.1007/s12526-018-0920-7>
- Aneesh PT, Helna AK, Bijukumar A (2019b) Redescription and neotype designation for the poorly known fish parasitic cymothoid *Joryma brachysoma* (Pillai, 1964) (Crustacea: Isopoda) from India. *Folia Parasitol* 66(014):1–6. <https://doi.org/10.14411/fp.2019.014>
- Avdeev VV (1975) Two representatives of parasitic isopods of the genus *Lironeca* (Cymothoidae) from the region of Australia and New Zealand. *Parasitologia* 3:247–251
- Bleeker P (1857) Recherches sur les Crustacés de l'Inde Archipelagique. II. Sur les Isopodes Cymothoadiens de l'Archipel Indien. *Verhandelingen der Natuurkundige Vereeniging in Nederlandsch-Indië, Batavia (Acta Societatis Scientiarum Indo-Neerlandicae, Batavia)*, 2, 20–40, pls I–II
- Bowman TE, Tareen IU (1983) Cymothoidae from fishes of Kuwait (Arabian Gulf) (Crustacea, Isopoda). *Smith Contr Zool* 382:1–30
- Boyko CB, Bruce NL, Hadfield KA, Merrin KL, Ota Y, Poore GCB, Taiti S, Schotte M, Wilson GDF (Eds) (2008 onwards). World Marine, Freshwater and Terrestrial Isopod Crustaceans database. Accessed at <http://www.marinespecies.org/isopoda> on 2020–04–20. <https://doi.org/10.14284/365>
- Bruce NL (1986) Revision of the isopod crustacean genus *Mothocya* Costa, in Hope, 1851 (Cymothoidae: Flabellifera), parasitic on marine fishes. *J Nat Hist* 20:1089–1192
- Bruce NL (1990) The genera *Catoessa*, *Elthusa*, *Enispa*, *Ichthyoxenus*, *Idusa*, *Livoneca* and *Norilecan*. gen. Isopoda, Cymothoidae, crustacean parasites of marine fishes, with descriptions of eastern Australian species. *Rec Aus Mus* 42:247–300
- Brusca RC (1981) A monograph on the Isopoda Cymothoidae (Crustacea) of the eastern Pacific. *Zool J Linnaean Soc* 73:117–199
- Costa A (1851) Caratteri di alcuni de'generi e specie nuove segnete nel presente catalogo. In *Catalogo dei crostacei Italiani e di molti altri de Mediterraneo, Napoli*. (F. W. Hope). 41–48
- Fricke R, Eschmeyer WN, van der Laan R (2020) Catalog of fishes: genera, species, references (<http://research.calacademy.org/research/ichthyology/catalog/fishcatmain.asp>). Electronic version accessed Jan 2020
- Froese R, Pauly D (2020) Fishbase. Version (02/2015) World Wide Web electronic publication. Available from: <http://www.fishbase.org> (accessed Jan 2020)
- Hadfield KA, Bruce NL, Smit NJ (2016a) *Elthusa nierstraszi* nom. N., the replacement name for *Elthusa parva* (Nierstrasz, 1915), a junior secondary homonym of *Elthusa parva* (Richardson, 1910) (isopoda, Cymothoidae). *ZooKeys* 619:167–170. <https://doi.org/10.3897/zookeys.619.10143>
- Hadfield KA, Bruce NL, Smit NJ (2016b) Redescription of poorly known species of *Ceratothoa* Dana, 1852 (Crustacea, Isopoda, Cymothoidae), based on original type material. *ZooKeys* 592:39–91. <https://doi.org/10.3897/zookeys.592.8098>
- Hadfield KA, Tuttle LJ, Smit NJ (2017) *Elthusa winstoni* sp. nov. (Isopoda, Cymothoidae), a new fish parasitic isopod from Hawaii. *ZooKeys* 661:125–135. <https://doi.org/10.3897/zookeys.661.11251>
- Hale HM (1926) Review of the Australian isopods of the cymothoid group. Part II. *Transactions of the Royal Society of South Australia* 50: 201–234
- Hansen HJ (1897) Reports on the dredging operations off the west coast of Central America to the Galapagos, to the west coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U.S. Fish Commission Steamer Albatross, during 1891, Lieut. Commander Z.L. Tanner, U.S.N., commanding. *Bulletin of the Museum of Comparative Zoology at Harvard College* 3: 95–129. <https://doi.org/10.5962/bhl.part.27494>
- Koelbel C (1879) Über einige neue Cymothoiden. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe* 78:401–416. <https://doi.org/10.5962/bhl.title.60847>
- Kononenko AF (1988) *Lironeca atlantniroi* sp. n (Isopoda, Cymothoidae), a parasitic isopoda from fishes of the North-Atlantic. *Parazitologiya* 22:425–428
- Kumar A, Bruce NL (1997) *Elthusa samariscii* (Shiino, 1951) (Isopoda, Cymothoidae) parasitizing *Samaris cristatus* Gray, 1831, off the Kerala coast, India. *Crustaceana* 70(7):780–787. <https://doi.org/10.1163/156854097X00221>
- Kussakin OG (1979) Marine and brackish isopods (Isopoda) of cold and temperate waters of the northern hemisphere, vol. 1. Suborder Flabellifera. *Opredeliteli po faune SSSR, izdavaemye Zoologicheskim institutom Akademii nauk SSSR* 122: 1–470

- Leach WE (1814) Crustaceology. In: Brewster D (ed) The Edinburgh Encyclopaedia. Baldwin, London, pp 383–437
- Leach WE (1818) Cymothoadées. In: Cuvier F (ed) Dictionnaire des Sciences Naturelles. Strasbourg et Levraut, Paris, pp 338–354
- Menzies RJ, WL Kruczynski (1983) Isopod Crustacea (exclusive of Epicaridea). Memoirs of the Hourglass Cruises 6 (1): 1–126
- Milne Edwards H (1840) Histoire Naturelle des Crustacés III, Comprendent l'anatomie, la physiologie et la classification de ces animaux, vol 3. Librairie encyclopédique de Roret, Paris, p 638. <https://doi.org/10.5962/bhl.title.6234>
- Öktemer A, Trilles JP, Kocabaş E, İnceoğlu H, Alaş A (2018) Redescription of *Elthusa sinuata* (Koelbel, 1879) Comb.Nov. (Isopoda, Cymothoidae) Parasitizing the Red Bandfish in Turkey. Thalassas: An International Journal of Marine Sciences:1–7. <https://doi.org/10.1007/s41208-018-0068-z>
- Penso G (1939) Nuovo parassita e nuova parassitosi del “Gadus potassou”. Corriere della Pesca Anno 12:1
- Pillai NK (1954) A preliminary note on the Tanaidacea and Isopoda of Travancore. Bulletin of the Central Research Institute, University of Travancore (C) 3, no. 1, 1–21
- Richardson H (1904) Contributions to the natural history of the Isopoda. Proceedings of the United States National Museum 27: 1–89. <https://doi.org/10.5479/si.00963801.27-1350.113>
- Richardson H (1909) Isopods collected in the Northwest Pacific by the U.S. bureau of fisheries steamer “Albatross” in 1906. Proceedings of the United States National Museum 37: 75–129. <https://doi.org/10.5479/si.00963801.37-1701.75>
- Richardson H (1910) Marine isopods collected in the Philippines by the U.S. Fisheries Steamer “Albatross” in 1907–1908. Department of Commerce and Labor, Bureau of Fisheries, 736, 1–44
- Rocha-Ramírez A, Chávez-López R, Bruce NL (2005) *Elthusa alvaradoensis* n. sp (Isopoda, Cymothoidae) from the gill chamber of the lizardfish, *Synodus foetens* (Linnaeus, 1766). Crustaceana 78(6):701–707. <https://doi.org/10.1163/156854005774353430>
- Sadowsky V, Moreira PS (1981) Occurrence of *Squalus cubensis* Rivero, 1936, in the Western South Atlantic Ocean, and incidence of its parasitic isopod *Lironeca splendida* sp. n. Stud Neotropical Fauna Environ 16:137–150. <https://doi.org/10.1080/01650528109360588>
- Saito N, Yamauchi T (2016) A new species and new host records of the genus *Elthusa* (Crustacea: Isopoda: Cymothoidae) from Japan. Crustac Res 45:59–67. https://doi.org/10.18353/crustacea.45.0_59
- Schioedte JC, Meinert F (1884) Symbolae ad Monographiam Cymothoarum Isopodum Familiae 4. Cymothoidae. Trib. II. Cymothoinae. Trib. III. Livonecinae. *NaturhistTidsskr* 14(3): 221–454
- Shiino SM (1951) On the cymothoid Isopoda parasitic in Japanese fishes. Bull Japan Soc Sci Fish 16:81–89
- Stebbing TRR (1905) Report on the isopods collected by Professor Herdman at Ceylon, in 1902. In: Herdman WA (ed) Report to the government of Ceylon on the Pearl Oyster Fisheries in the Gulf of Manaar. Vol 4, Supplementary report 23. The Royal Society, London, pp 1–64. <https://doi.org/10.5962/bhl.title.23477>
- Stimpson W (1857) The Crustacea and Echinodermata of the Pacific shores of North America. Boston Soc Nat Hist 6:503–513. <https://doi.org/10.5962/bhl.title.59693>
- Trilles JP (1994). Les Cymothoidae (Crustacea, Isopoda) du Monde. Prodom pour une faune. Stud Mar 21/22 (1–2) (1991): 5–288
- Trilles JP, Justine J-L (2004) Une nouvelle espèce de Cymothoidae et trois Aegidae (Crustacea, Isopoda) récoltés sur des poissons de profondeur au large de la Nouvelle-Calédonie. Zoosystema 26(2): 211–233
- Trilles JP, Justine J-L (2006) *Elthusa arnoglossi* sp. nov. (Crustacea: Isopoda: Cymothoidae), a branchial parasite of flatfishes (Bothidae) from the Chesterfield Islands, New Caledonia. Zootaxa 1338:57–68. <https://doi.org/10.11646/zootaxa.1338.1.4>
- Trilles JP, Justine J-L (2010) *Elthusa epinepheli* sp. nov. (Crustacea, Isopoda, Cymothoidae) a branchial parasite of the grouper *Epinephelus howlandi* (Serranidae, Epinephelinae) from off New Caledonia. Acta Parasitol 55(2):177–187. <https://doi.org/10.2478/s11686-010-0020-8>
- Trilles JP, Randall JE (2011) Redescription of *Elthusa emarginata* (Bleeker, 1857) (Crustacea, isopoda, Cymothoidae), type species of the genus *Elthusa* Schioedte and Meinert. Mar Biol Res 7(5): 453–465. <https://doi.org/10.1080/17451000.2010.528770>
- van der Wal S, Smit NJ, Hadfield KA (2019) Review of the fish parasitic genus *Elthusa* Schioedte and Meinert, 1884 (Crustacea, Isopoda, Cymothoidae) from South Africa, including the description of three new species. ZooKeys 841:1–37. <https://doi.org/10.3897/zookeys.841.32364>
- Wägele J-W (1989) Evolution und phylogenetisches system der Isopoda. Stand der Forschung und neue Erkenntnisse Zoologica 140:1–262
- Williams EH Jr, Bunkley-Williams L (1994) *Ryukyua globosa* n. gen., n. sp., and *R. circularis* n. comb., parasitic in the opercular chambers of Pacific and Indian Ocean clupeid fishes. J Aquat Anim Health 6: 151–161

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.