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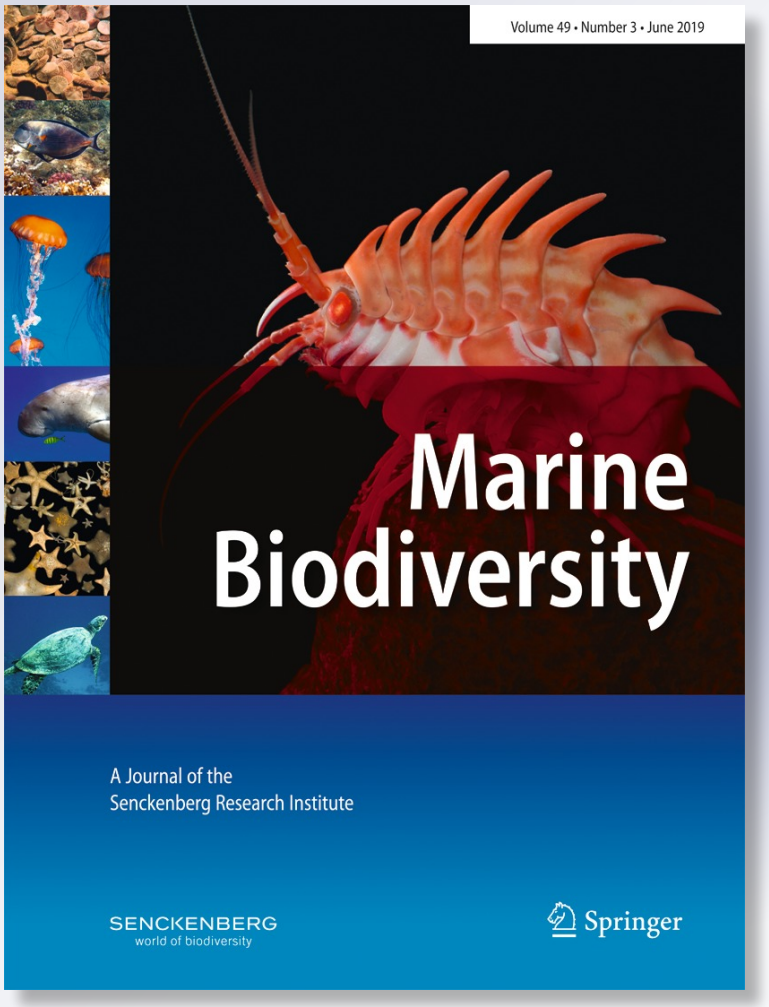

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ORIGINAL PAPER

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

Panakkool Thamban Aneesh[1,2] · Ameri Kottarathil Helna[3] · Jean-Paul Trilles[4] · Kailash Chandra[1]

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Abstract

The genus *Joryma* is here revised, with a description of a new species collected from the host *Escualosa thoracata* (Clupeidae) off the Malabar Coast of the Arabian Sea. *Joryma malabaricus* sp. nov. is described from female, male, transitional, pre-manca, and manca stages and the female stage is distinguished from other *Joryma* species by the following female characteristics: cephalon conspicuous dorsally and extending beyond pereonite 1 expansion, pereonite 1 anterolateral expansion unilateral and not bilobed, laterally overlapped pleonites 1 and 2, triangular pleotelson, uropod rami unequal in length; exopod slightly longer than endopod, mandibular palp not segmented in female (three segments in male), four recurved spines in maxilliped palp. A neotype was designated and redescribed for *J. engraulidis*, with an additional description from fresh material. *Joryma sawayah* and *Joryma hilsae* are redescribed from the female stage and described from the male stage respectively. The type material of *Joryma tartoor* and *Joryma brachysoma* is lost and after their original description, both species have not been reported. A key to the species of *Joryma* is also presented.

Keywords Branchial fish parasites · Neotype · New species · *Joryma malabaricus* sp. nov. · Arabian Sea · India

Introduction

The Cymothoidae Leach, 1814 are protandric hermaphrodite parasites, feeding on the blood of freshwater, marine, and estuarine fishes (Brusca 1981; Trilles et al. 2011, 2012, 2013; Aneesh et al. 2013, 2017). The adverse effects of their parasitism generate considerable interest among parasitologists and fish pathologists. Cymothoids are known to prefer various parts of the host fish, occurring on the skin, fins, buccal or branchial cavities, or burrowing into the flesh of the host fish (Smit et al. 2014). Species from the genera *Anilocra* Leach, 1818, *Creniola* Bruce, 1987, *Pleopodias* Richardson, 1910, and *Nerocila* Leach, 1818 are usually attached on the body surface; the species of *Cymothoa* Fabricius, 1793, *Ceratothoa* Dana, 1852, *Cinusa* Schiödte and Meinert, 1884, *Glossobius* Schiödte and Meinert, 1883, *Lobothorax* Bleeker, 1857, and *Smenispa* Özdikem, 2009 are known to be found in the buccal cavity, whereas species of the genera *Agarna* Schiödte and Meinert, 1884, *Joryma* Bowman and Tareen, 1983, *Norileca* Bruce, 1990, and *Mothocya* Costa in Hope, 1851 prefer the branchial cavities; the species of *Ichthyoxenus* Herklots, 1870 and *Riggia* Szidat, 1948 are

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usually burrowed into the host flesh (Trilles 1975, 1979, 1994; Schiödte and Meinert 1883, 1884; Bowman and Tareen 1983; Bruce 1986, 1987a, b; Tsai and Dai 1999; Thatcher et al. 2002; Hadfield et al. 2013, 2014; Trilles et al. 2012, 2013; Martin et al. 2015a, b, 2016; Aneesh et al. 2015b, 2016, 2017; Bruce et al. 2016; Hadfield and Smit 2017).

The branchial cymothoid genus, *Joryma* was established by Bowman and Tareen in 1983, which included at the time *Joryma sawayah* Bowman and Tareen 1983 (type species) and the new combinations of *Agarna engraulidis* Barnard, 1936, *Agarna tartoor* Pillai, 1954, *Agarna brachysoma* Pillai, 1964. The last addition to the genus is the species *Joryma hilsae* Rameshkumar, Ravichandran and Trilles, 2011 bringing the current total number of *Joryma* species to five.

Barnard (1936) minimally described *Joryma engraulidis* from Orissa Coast, India as *Agarna engraulidis*. Subsequently, Pillai (1954, 1964) described another two species of *Joryma*; *J. brachysoma* and *J. tartoor* under the genus *Agarna.* The type species, *J. sawayah*, was described from the female stage by Bowman and Tareen in 1983. Later, Rameshkumar et al. (2011) described a new species *Joryma hilsae* Rameshkumar et al. 2011 based on the ovigerous female. Further, the type materials of *Joryma engraulidis*, *J. brachysoma*, and *J. tartoor* were not available and the subsequent reports of *Joryma brachysoma* and *J. tartoor* are either misidentifications or unconfirmed records and in fact, both species have not been reported after their original description.

The present study was initially set out to describe a new species collected from the Malabar Coast of the Arabian Sea (*Joryma malabaricus* sp. nov.), but most species within the genus had little to no morphological descriptions for all stages, since attention is given to female cymothoids for identification. Species description based on all the different life stages, including manca, pre-manca, juvenile, male, and female, should be completed where possible to aid precise identification, irrespective of the stages of infestation.

Thirty years since the erection of the genus, it is deemed necessary to provide the following: (1) a key to the *Joryma* species; (2) a description of *J. malabaricus* sp. nov. based on different life stages; (3) designate a neotype for *J. engraulidis* and provide a species redescription based on the neotype and non-type material; (4) redescribe *J. sawayah* Bowman and Tareen, 1983 and *Joryma hilsae* Rameshkumar, Ravichandran and Trilles, 2011 from female and male specimens; and (5) briefly illustrate the issues of *Joryma tartoor* (Pillai, 1954) and *Jorymabrachysoma* (Pillai, 1964).

Materials and methods

Fresh specimens of *Joryma* spp. were collected from the host fish from Ayyikkara (Lat. 11° 51′ N, Long. 75° 22′ E), one of the major fish landing centers of the Malabar Coast of the Arabian Sea, India; and Marina Beach fish landing center, Chennai (Lat. 13° 50′ N, Long. 80° 28′ E). The live cymothoids were fixed in 5% formaldehyde for 2 h and thoroughly rinsed of formaldehyde with distilled water. The fixed parasites were then dehydrated through upgraded ethanol series (30, 50, 70, 80, 90, and 100%), preserved in 75% ethanol and subjected to taxonomical identification at species level according to appropriate taxonomical keys (Bowman and Tareen 1983; Rameshkumar et al. 2011). Methodology for dissection and mounting of appendages were according to Aneesh et al. (2017). The specimens were microphotographed by using a multi-focusing stereo-microscope Leica-M205A and image capturing software (Leica Application Suite). Drawings of the mouthparts and appendages were performed using a camera lucida attached to the microscope. Fish taxonomy and host nomenclature were performed according to Fish Base (Froese and Pauly 2017) and Catalog of Fishes (Eschmeyer 2017). The identification and characterization of cymothoid stages were well explained in the following references (Aneesh 2014; Helna 2016; Aneesh et al. 2017). The types and voucher specimens are deposited in the National Zoological Collections of Zoological Survey of India (NZC-ZSI).

Results

Taxonomy

Suborder Cymothoida Wägele, 1989.

Superfamily Cymothooidea Leach, 1814.

Family Cymothoidae Leach, 1814.

Genus ***Joryma*** Bowman and Tareen, 1983.

Joryma Bowman and Tareen, 1983—Bowman and Tareen 1983: 21; Rameshkumar et al. 2011:88; Aneesh et al. 2015a: 1–10.

Agama Schiödte and Meinert, 1884: 328–329; Barnard 1936: 169; Pillai 1964: 211.

Type species: Joryma sawayah Bowman and Tareen, 1983.

Generic diagnosis

Female—Body asymmetrical, hunched to one side, cephalon immersed in pereonite 1, eyes present. Pereonite 1 produced into lobe along one or both lateral margins of the head. Coxae of pereonites 2 and 3 medially inflated, much larger than remaining coxae and resembling the dorsolateral bosses ("ovarian bosses") of epicarideans. Antennule well separated at bases. Antenna with 8–10 articles. Mandible palp enlarged, very stout, unsegmented/distinctly or incompletely segmented. Maxilliped with 3–7 recurved spines. Maxilla with scales on both lobes. Brood pouch is formed by 4 pairs of overlapping oostegites arising from the bases of pereopods 2, 3, 4, and

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6; 2nd oostegites small, 6th largest, 3rd and 4th medium and posteriorly covered by a pocket formed from sternite. Pleon nearly as wide as pereon; pereonite 1 partly or completely covered by pereonite 7. Uropod rami equal or unequal; not reaching the posterior margin of pleotelson.

Male—Smaller than female, body symmetrical, 2–3 times longer than wide. Cephalon not immersed in the pereonite 1. Eyes very prominent and larger than that of the female. Mandible palp thick, 3-segmented or separation between the segments 1 and 2 incomplete, basal segment broader, apical segment short and rounded. Pereonite 1 anterio-lateral corners not produced; coxae 2 and 3 clearly visible dorsally, 4–7 posterior part is visible. All pleonites visible dorsally, not immersed in the pereonite 7. Pereopods, gradually increasing in size from 1 to 7; ischium of pereopods 5–7 slightly longer than others. Penes visible on sternite 7. Pleopods slightly visible in dorsal view. Appendix masculine of pleopod 2straight, slightly shorter than endopodite and tapering gradually to narrow apex. Pleotelson slightly longer than wide, shorter than pleonite 5, posterior margin broadly triangular.

Manca—Body elongated and transparent, 4.2–4.3 times longer than wide, eyes black, ovate, and very prominent. All pleonites visible and subequal in length and width, 4.3 times wider than long. Pleotelson slightly longer than wide and the apical margin with 40–44 plumose setae. Antennule, all articles with few spinules and distal articles with few elongate setae and terminal with aesthetascs. Antenna slightly longer than antennule, all the articles with spinules and terminal article with aesthetascs. Article three of the mandible palp with few marginal setae and one large apical recurved seta. Maxillule, maxilla, and maxilliped similar to those of the male stage. Six pereopods; dactyli of all the pereopod without a tooth. Pleopods not distinctly visible in dorsal view. Pleopod 1 with many plumose setae on both endopodite and exopodite. Pleopods 2–5, apical margin of exopodite with many plumose setae. Uropod rami exopodite with 8–10 plumose setae and apical margin with one small and one larger slightly recurved spine; endopodite with 16–20 plumose setae. Uropods and pleotelson with many dark chromatophores.

Composition: *Joryma engraulidis* Barnard, 1936, *Joryma tartoor* Pillai, 1954, *Joryma brachysoma* Pillai, 1954 and *Joryma sawayah* Bowman and Tareen, 1983 (type species).

Key to the species of *Joryma*

1. Pleonites not overlapped, pleotelson rounded, mandibular palp 3 segmented, uropods rami equal or unequal 2

   —Pleonites overlapped, pleotelson triangular or round-triangular, rami unequal, mandibular palp; 3-segmented or unsegmented 3

2. Uropod rami equal, body 2–2.3 times longer than wide, cephalon reaching the margin of pereonite 1 expansion, pereonite 1 anterolateral expansion bilateral and slightly bilobed . . . . . ***J. hilsae***

   Uropod rami unequal, body 1.4–1.6 times longer than wide, cephalon reaching beyond pereonite 1 expansion, pereonite 1 anterolateral expansion unilateral and not bilobed . . . . . ***J. engraulidis***

3. Cephalon not reaching the margin of pereonite 1 expansion, pereonite 1 anterolateral expansion bilateral and distinctly or slightly bilobed 4

   —Cephalon covered dorsally by pereonite 1 expansion or conspicuous dorsally, pereonite 1 anterolateral expansion unilateral or bilateral, pleotelson triangular 5

4. Pereonite 1 anterolateral expansion distinctly bilobed, pleonite 1, 2 and 3 overlapped laterally, pleotelson triangular, mandibular palp not segmented . . . . . ***J. sawayah***

   —Pereonite 1 anterolateral expansion slightly bilobed, pleonite 1entirly overlapped and not visible in dorsal view, pleotelson round-triangular, mandibular palp distinctly 3-segmented . . . . . ***J. brachysoma***

5. Cephalon covered dorsally by pereonite 1 expansion, pleotelson weak to actually triangular, pereonite 1 anterolateral expansion bilateral and slightly bilobed, pleonite 1 and 2 overlapped laterally by pereonite 7, mandibular palp segmentation is incomplete in female . . . ***J. tartoor***

   —Cephalon conspicuous dorsally, extending beyond pereonite 1 expansion, pereonite 1 anterolateral expansion unilateral and not bilobed, pleonite 1 and 2 overlapped laterally by pereonite 7, mandibular palp not segmented in female . . . . . ***J. malabaricus* sp. nov.**

Joryma malabaricus Aneesh, Helna, and Trilles **sp. nov.**

The new species name is registered in ZooBank under urn: urn:lsid:zoobank.org:act:71E8B331-E91C-48F5-818B-8EAFBAD212DF.

Material examined: 23 females (17 ovigerous and 6 non-ovigerous); 6 transitional stage; 18 males; 18 manca-larvae.

Type material: *Holotype* (Fig. 1a–d) female (10.3 mm TL; 5.4 mm W), from the right branchial cavity of *Escualosa thoracata* (Valenciennes, 1847), from Malabar Coast, Arabian Sea, India (Lat. 11° 51′ N, Long. 75° 22′ E), 26 February 2017, coll. Aneesh and Helna (Reg. No C-7138/2).

Paratypes: same information as the Holotype with the following measurements and registration details: 1 male (Fig. 1h–j) (6.7 mm TL; 2.3 mm W), (Reg. No C-7139/2); 1 female

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(10 mm TL; 4.9 mm W) (Reg. No C-7140/2); 1 female (10 mm TL; 4.9 mm W) (Reg. No C-7141/2); 1 female (9.5 mm TL; 5 mm W) (Reg. No C-7142/2); 2 transitional stages (8.5 mm TL; 4 mm W and 8 mm TL; 3.9 mm W) (Reg. No C-7143/2); 12 Pre-manca larva (2 mm TL) (Reg. No C-7144/2); 1 female (10 mm TL; 4.9 mm W) (Reg. No C-7145/2).

Type host: *Escualosa thoracata* (Valenciennes, 1847) (Clupeidae).

Type locality: Malabar Coast, Arabian Sea, India (Lat. 11° 51′ N, Long. 75° 22′ E).

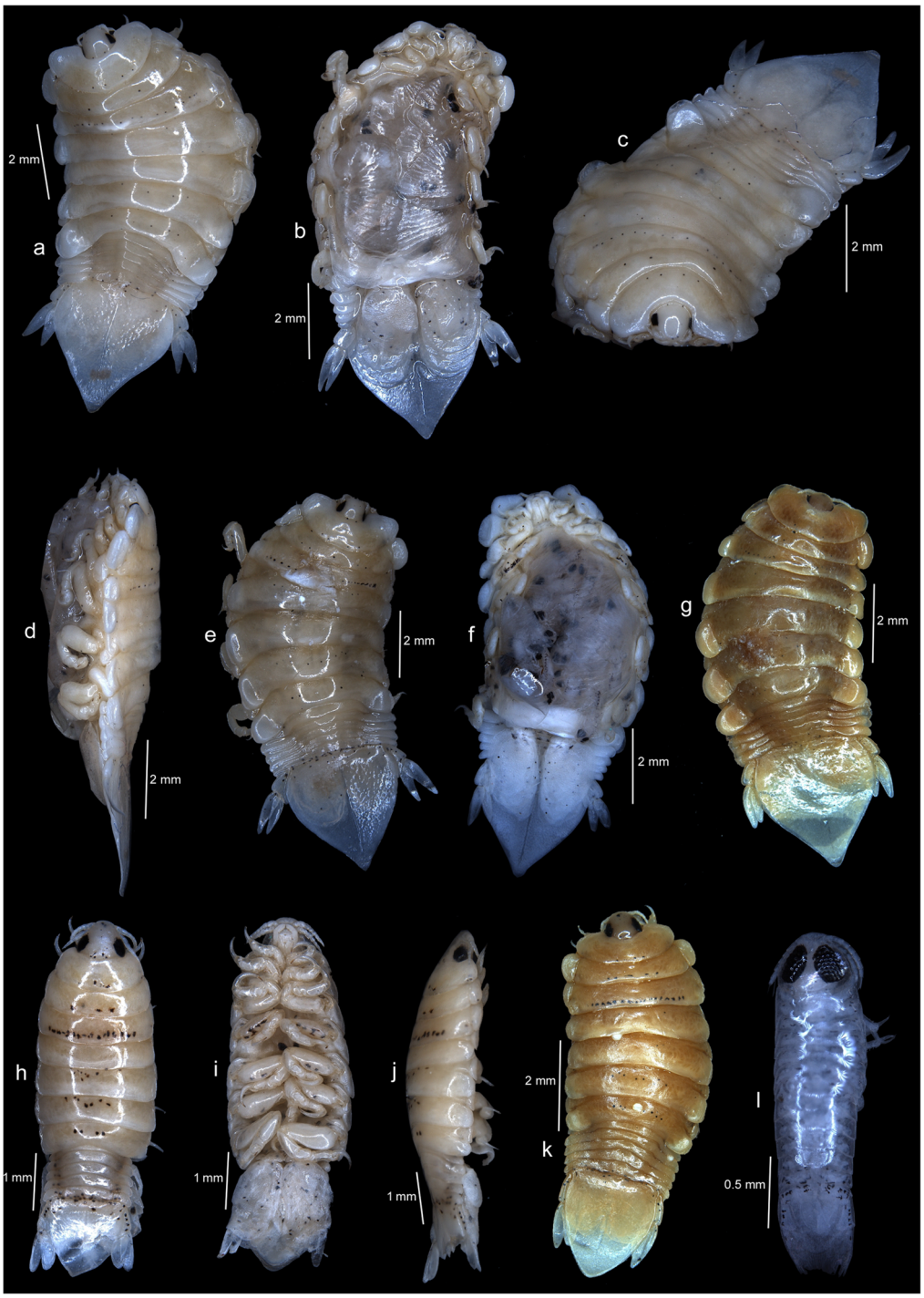

Fig. 1 *Joryma malabaricus* sp. nov., from *Escualosa thoracata* (Valenciennes, 1847). **a**–**d** Ovigerous female holotype (10.3 mm) Reg. no. C-7138/2. **a** Dorsal view, **b** ventral view, **c** dorso-frontal view, **d** lateral view. **e**, **f** Ovigerous female paratype (10 mm) Reg. no. C-7140/2, **e** dorsal view, **f** ventral view, **g** dorsal view of non-ovigerous female. **h**–**j** Male paratype (6.7 mm) Reg. no. C-7139/2, **h** dorsal view, **i** ventral view, **j** lateral view, **k** dorsal view of transitional stage—paratype (8 mm) Reg. no. C-7143/2; **l** dorsal view of manca

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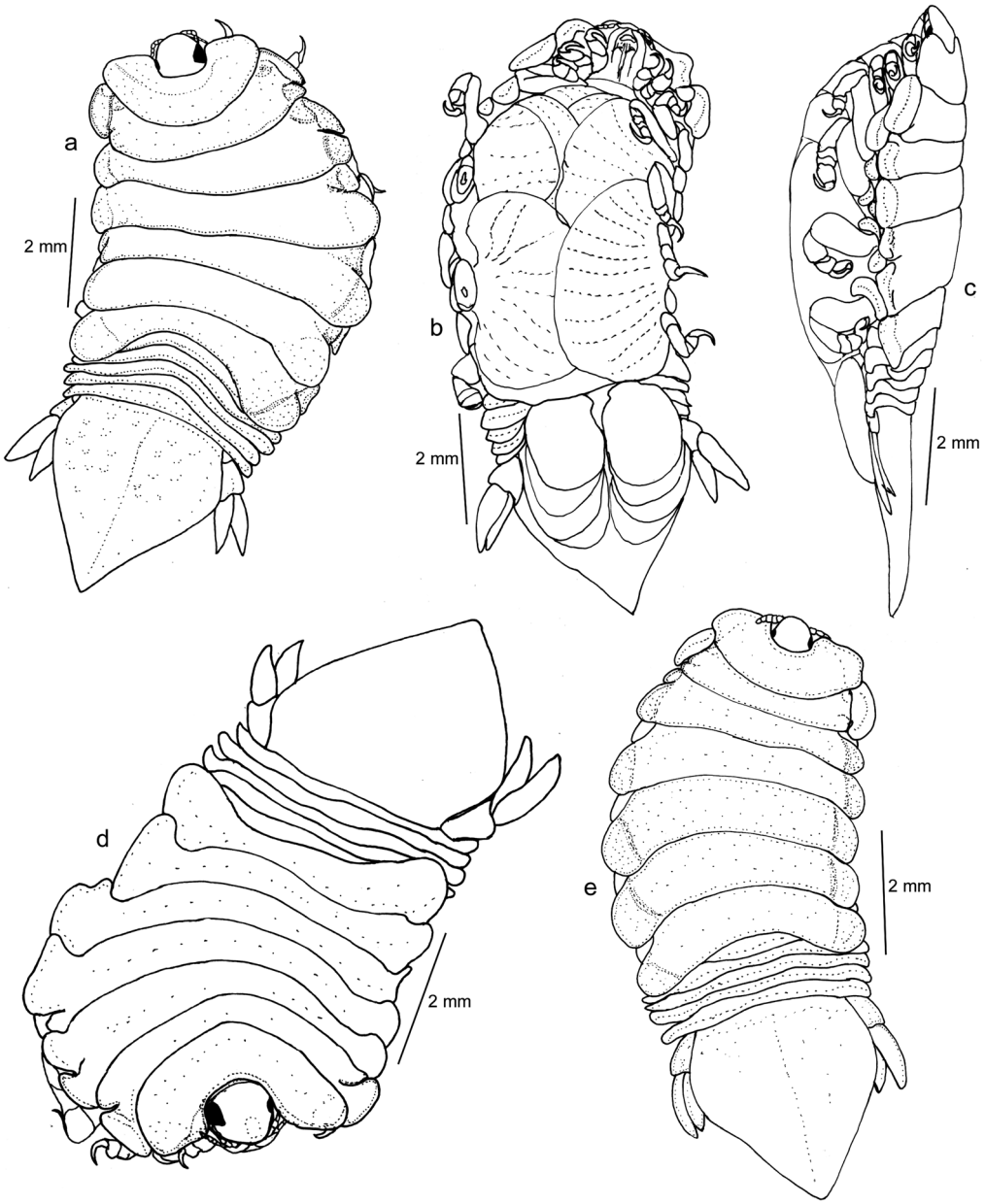

Fig. 2 *Joryma malabaricus* sp. nov., from *Escualosa thoracata* (Valenciennes, 1847). **a**–**d** Ovigerous female holotype (10.3 mm) Reg. no. C-7138/2, **a** dorsal view, **b** ventral view, **c** lateral view, **d** dorso-frontal view, and **e** dorsal view of non-ovigerous female

Description

Female

Figures 1a–g, 2, 3, and 4: Body asymmetrical, and hunched 1.8–2 times longer than wide, widest at pereonite 4. Cephalon symmetrical, slightly longer than wide, anterior margin rounded, dorsally conspicuous, and extending beyond pereonite 1 expansion and deeply immersed in pereonite 1. Eyes distinct, 0.45 times the length of the cephalon, visible dorsally. Pereonite 1 anterolateral expansion unilateral and not bilobed, not reaching the anterior margin of head. Pereonite 1 longest, pereonite 4 slightly shorter than 1. Pereonite 2 shortest, pereonite 7 slightly longer than 2. Pereonites 3 and 5 subequal in length, pereonite 6 slightly smaller than 4. Coxa 2 clearly visible dorsally, enlarged, produced anteriorly into lobe underlying process of pereonite1. Coxae 3, 6, 7 posterior part is visible. Coxae 4 and 5 not visible dorsally, smaller than others and overlapped laterally by preceding pereonites. Coxae 3–7 occupying anterior halves of pereonite margins; anterior halves of coxae 3, 6 and 7, overlapped laterally by preceding pereonites. Postero-lateral regions of pereonites slightly developed, especially pereonites 3–7. Pleonites 1 and 2 overlapped laterally by pereonite 7. Pleonite 5 slightly longer than others, pleonites 1–4

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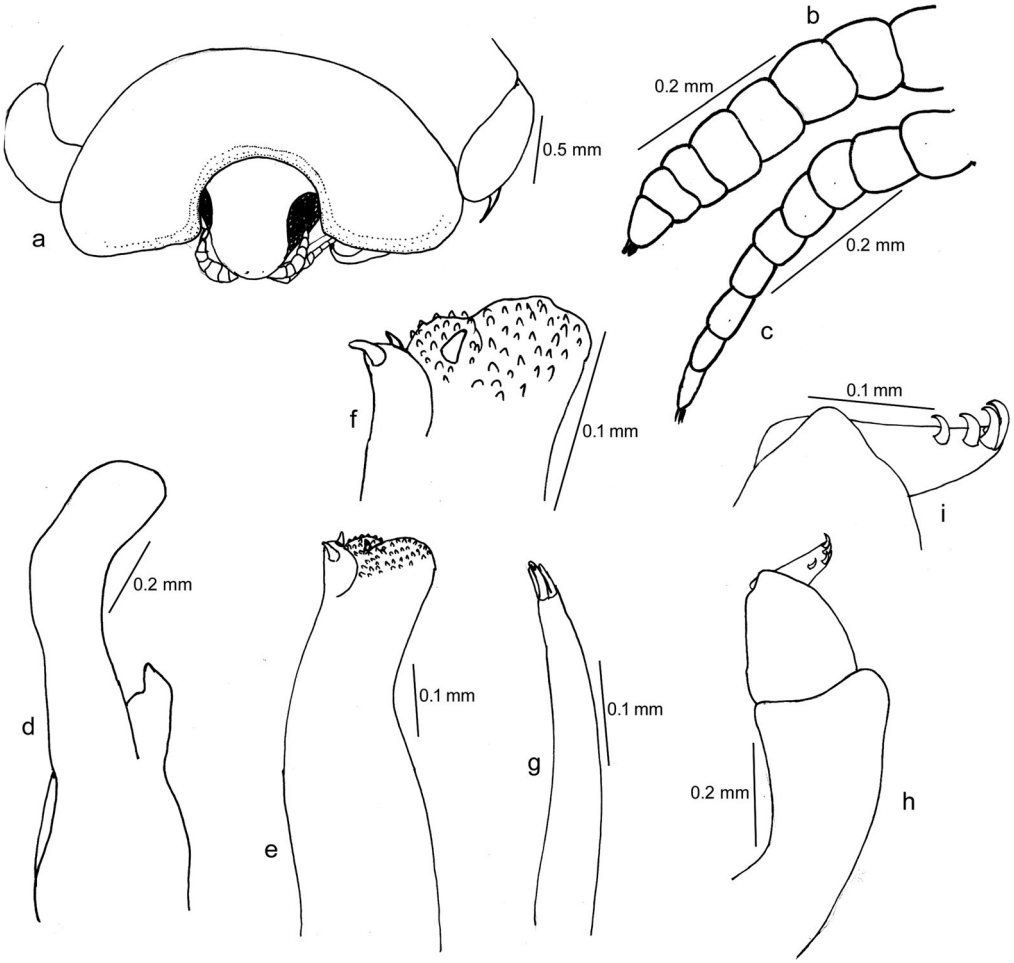

Fig. 3 *Joryma malabaricus* sp. nov., from *Escualosa thoracata* (Valenciennes, 1847) **Ovigerous female holotype**. **a** Cephalon, **b** antennae, **c** antennule, **d** mandible, **e** maxilla, **f** maxilla apex, **g** maxillule, **h** maxilliped, and **i** maxilliped apex

subequal, all pleonites subequal in width, lateral margin of pleonites curving posteriorly. Pleotelson 1.1 times longer than wide, shorter than pleonite 5, posterior margin triangular, distinct caudo-medial lobe.

Antennule stouter and shorter than the antenna, well separated at the base, reaching anterior 1/3 portion of the eye, composed of eight articles; article 8 with few terminal setae. Antenna with 9 articles, longer than antennule, extending slightly beyond the anterior border of pereonite 1, article 9 with few terminal setae. Mandible palp thick, without segmentation. Maxillule with four slightly recurved apical spines. Maxilla, bilobed, inner and outer lobes with minute scales, inner median lobe with 1 and outer lateral lobe with two small, slightly recurved spines. Maxilliped without oostegial lobe; anapical segment with 2 large terminal recurved spines and two small recurved spines on lateral margin.

Pereopods 1–3 subequal in length; pereopods 4–7 subequal in length; longer than pereopod 3. Pereopods 4 and 5 basis longer than others, ischium gradually increasing the length from pereopod 1–7. Dactyli of pereopods 1–3 reach up to merus, 4–7, shorter than propodus. Pleopod 2 without appendix masculine. Pleopod peduncles expanded laterally into rounded lobes. Pleopods 3–5 exopod with sub-triangular proximo-lateral lobes. Uropods shorter than pleotelson; rami pyriform longer than peduncle, exopod longer than endopod.

Brood pouch with 4 pairs of overlapping oostegites, arising from bases of pereopods 2, 3, 4, and 6; 2nd oostegite small, 6th largest, 4th and 3rd medium. Posteriorly covered by a pocket formed from sternite, sternal pocket dorsally visible. Eggs or larvae per brood pouch range from 84 to 220 according to the size of the female.

Male

Figures 1 h–j, 5 and 6: Smaller than female, body symmetrical, 2.9–3 times longer than wide, widest at pereonite 5. Cephalon sub-triangular, round anterior border, 2.9–3 times longer than wide, not immersed in pereonite 1. Eyes very prominent and 3–3.2 times larger than the female. Pereonite 1 anterio-lateral margins not produced; pereonite 1 longest, 7 shortest, 2–6 subequal. Pereonites gradually increasing in width from 1 to 5, 5 widest, 6 and 7 subequal in width and

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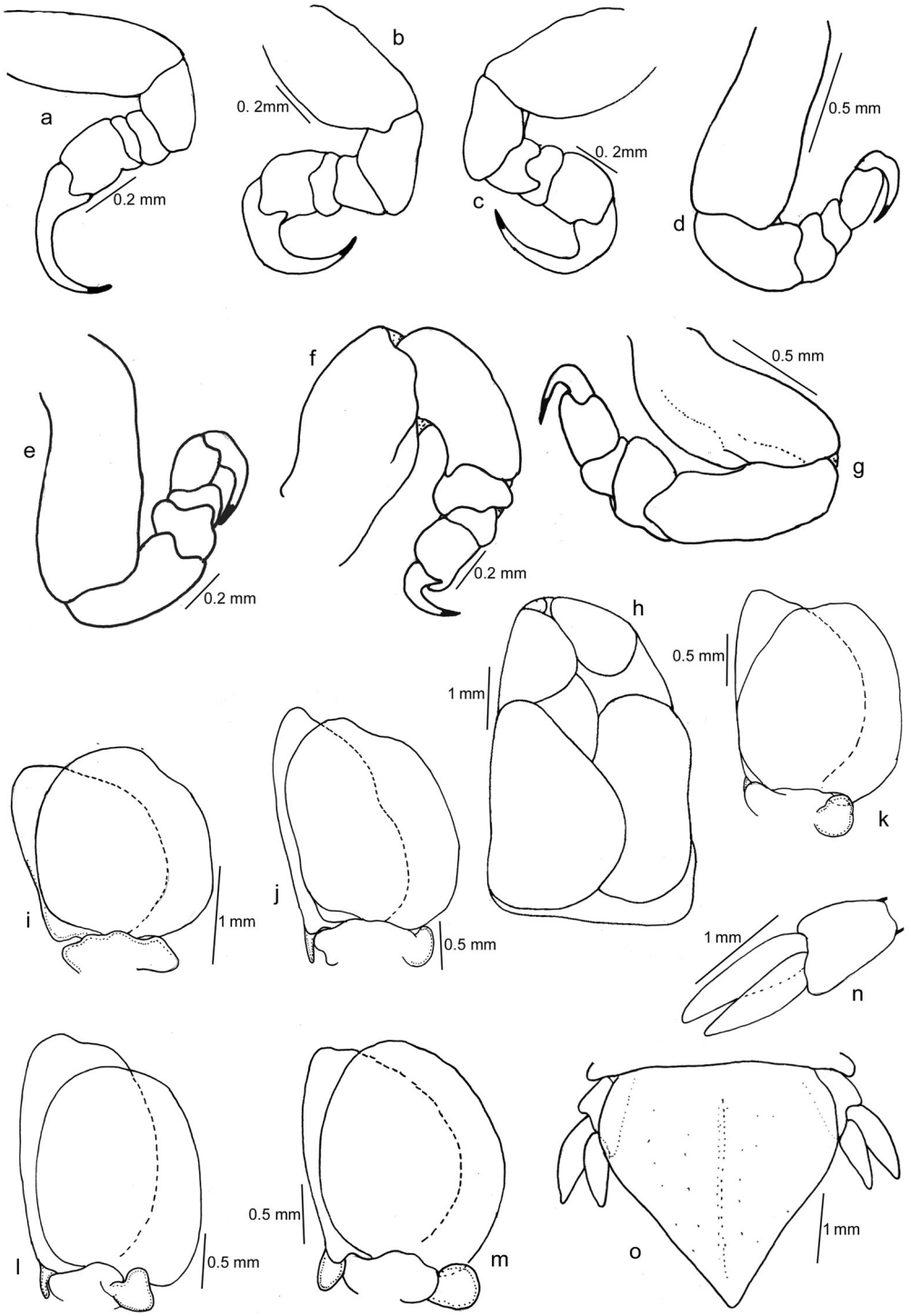

Fig. 4 *Joryma malabaricus* sp. nov., from *Escualosa thoracata* (Valenciennes, 1847) Ovigerous female holotype. **a**–**g** Pereopod 1–7, **h** brood pouch, **i**–**m** pleopod 1–5, **n** uropod, and **o** view of pleotelson and uropod

slightly narrower than 5. Coxae 2 and 3 clearly visible dorsally, coxae 4–7 posterior part visible. Pleonite 1 overlapped laterally by pereonite 7. Pleonites subequal in length and width, lateral margins slightly directed posteriorly. Pleotelson slightly longer than wide, shorter than pleonite 5, posterior margin broadly triangular.

Antennule composed of 8 articles, reaching up to the anterior margin of pereonite 1; article 8 with few terminal setae. Antenna with 9 articles and longer than antennule, reaching beyond the anterior margin of pereonite 1. Article 9 with few terminal setae. Mandible palp thick, the separation between the segments 1 and 2 apparently incomplete, basal segment

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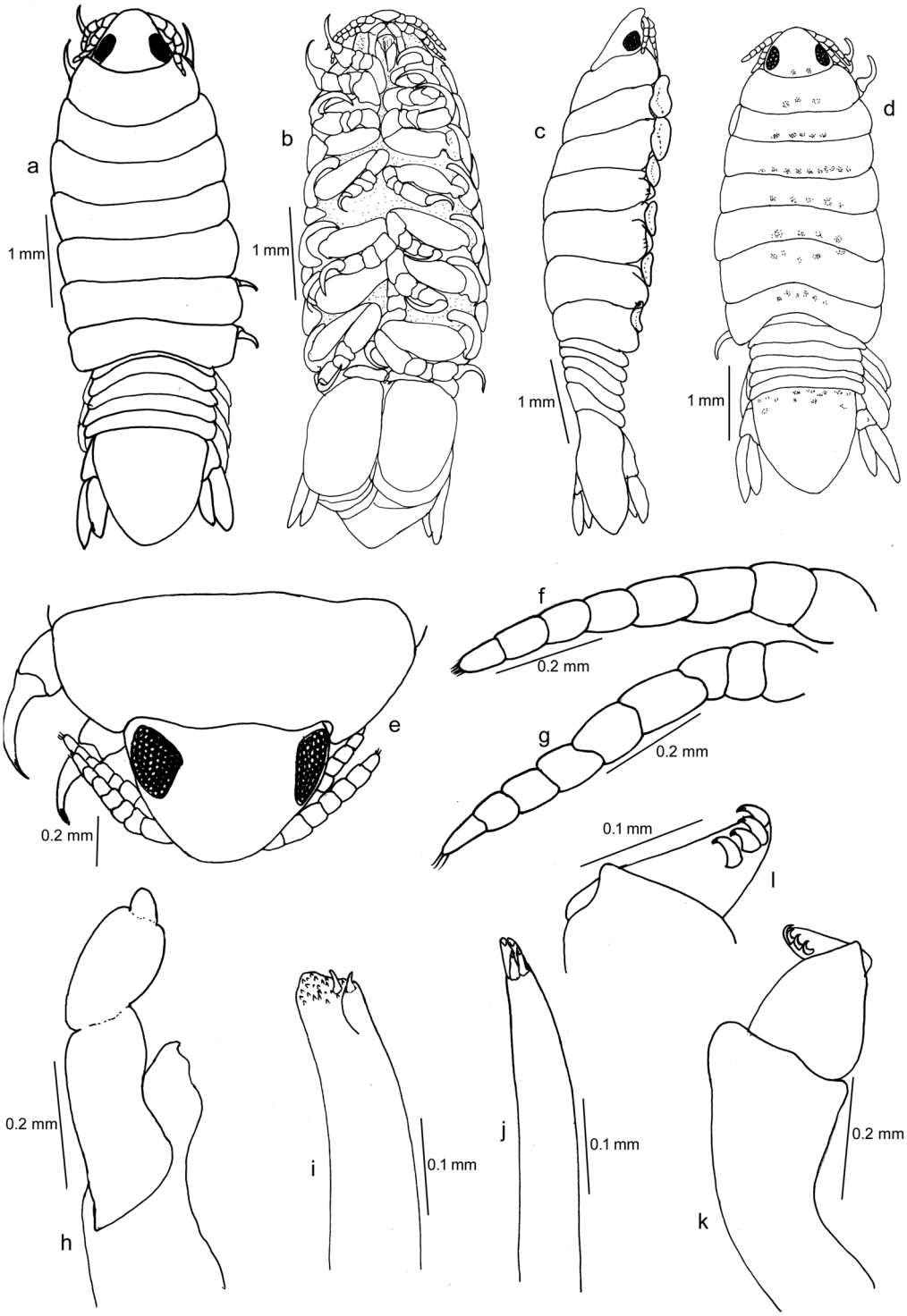

Fig. 5 *Joryma malabaricus* sp. nov., from *Escualosa thoracata* (Valenciennes, 1847). **a**–**c** Male paratype (6.7 mm) Reg. no. C-7139/2, **a** dorsal view, **b** ventral view, **c** lateral view, **d** dorsal view of non-type male, **e** cephalon, **f** antennule, **g** antenna, **h** mandible, **i** maxilla, **j** maxillule, **k** maxilliped, and **l** maxilliped apex

border, apical segment short and rounded. Maxillule with 4 recurved apical spines. Bilobed maxilla, inner and outer lobes with minute scales and each lobe with one spine. Maxilliped similar to that of female, the apical segment with 2 terminal recurved spines and 2 small recurved spines on lateral margin.

Pereopods, gradually increasing in size from 1 to 7. Penes, visible on sternite 7. Pleopods slightly visible in dorsal view. Appendix masculine of pleopod 2 straight, slightly shorter than endopodite and tapering gradually to narrow apex. Rami lamellar, endopod slightly smaller

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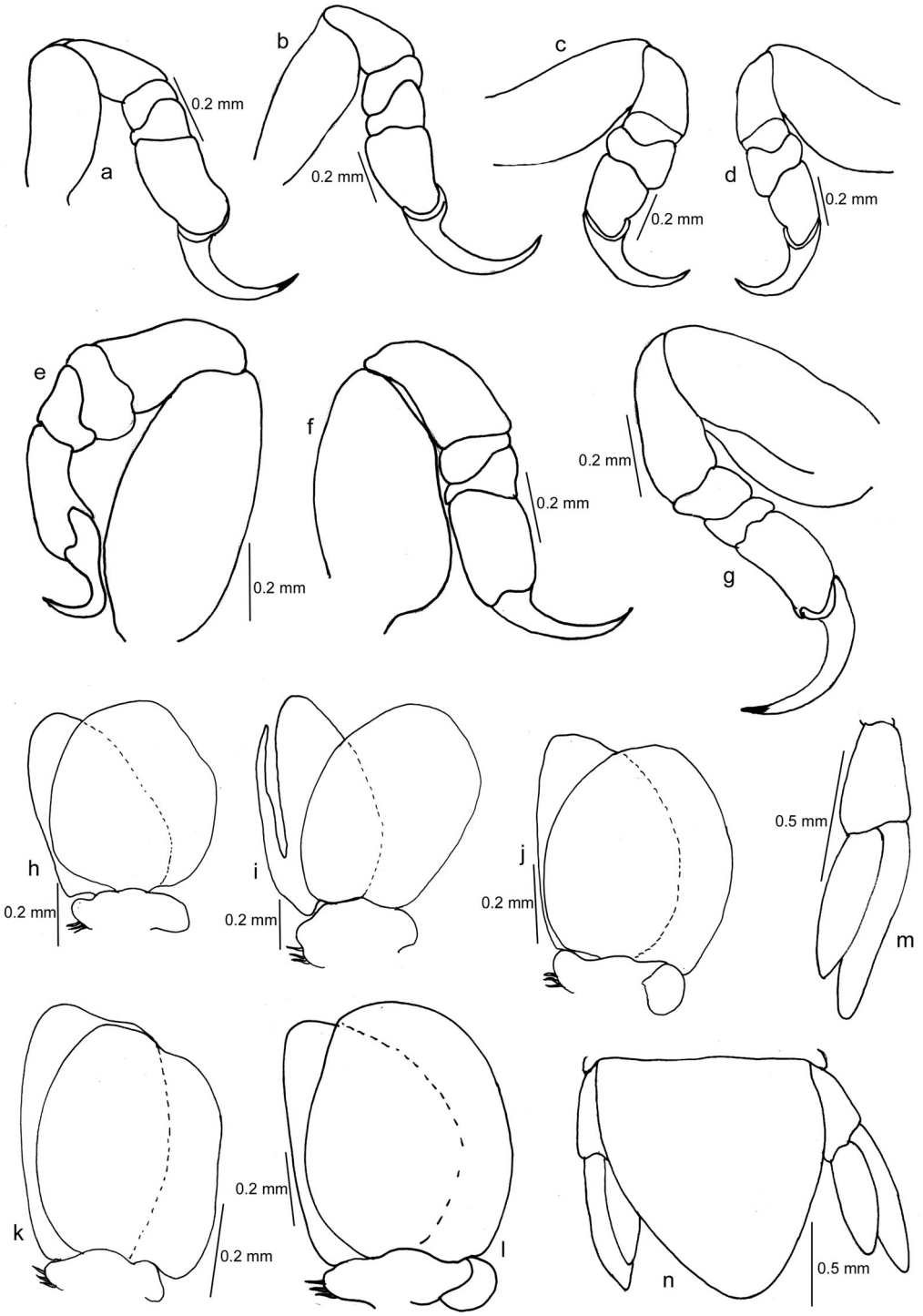

Fig. 6 *Joryma malabaricus* sp. nov., from *Escualosa thoracata* (Valenciennes, 1847), male (**a**–**g**). Pereopod 1–7; **h**–**l** pleopod 1–5, **m** uropod rami, and **n** pleotelson and uropod

than exopod; peduncles of pleopods expanded laterally into rounded lobes with few small setae. Uropods slightly shorter than pleotelson; rami unequal in length, curved and apically rounded, exopod longer than endopod.

Transitional stage

Figures 1k and 7: Body 2.3–2.4 times longer than wide; slightly hunched toward one side, Cephalon sub-triangular

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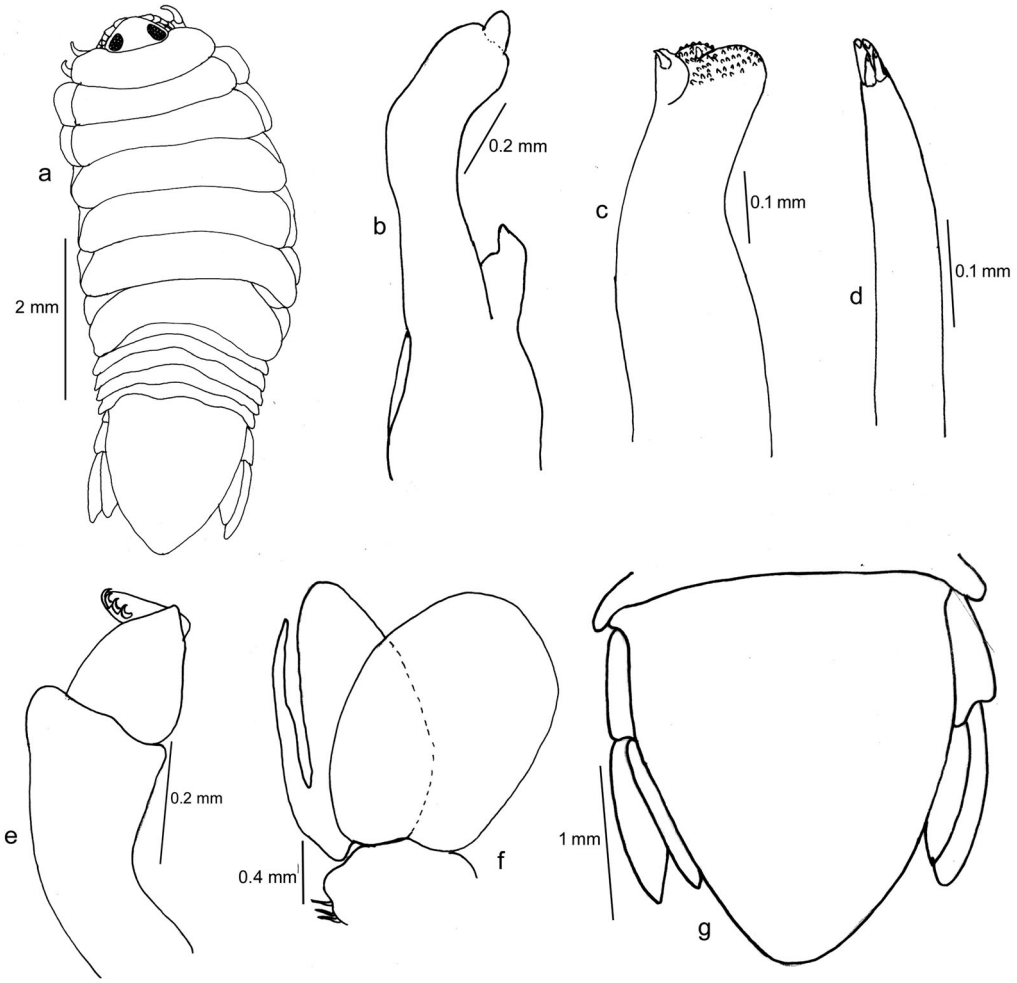

Fig. 7 *Joryma malabaricus* sp. nov., from *Escualosa thoracata* (Valenciennes, 1847). Transitional stage paratype (8 mm) Reg. no. C-7143/2, **a** dorsal view, **b** mandible, **c** maxilla, **d** maxillule, **e** maxilliped, **f** pleopod 2, and **g** view of pleotelson and uropod

with round anterior border, conspicuous dorsally slightly immersed in pereonite 1 and anterior part extending beyond pereonite 1 expansion. Eyes distinct, dorsally visible. Pereonites, pleonites, antennules, antenna, and mandible palp are similar to those of the ovigerous female and maxilla, maxilliped similar to those of the male. Pereonite 1 anterolateral expansion not much developed. Coxae similar to that of the female. Postero-lateral parts of pereonites slightly inflated, especially pereonite 6 and 7. Penes not prominent. Pleotelson 1.2 times longer than wide, wider than pleonite 5 and uropods longer than female, reaches up to 0.75 lengths of pleotelson. Rami unequal, endopod longer than exopod. Pereopods and pleopods similar to those of male and female

Manca

Figures 1l and 8: Body elongated and transparent, 4.2–4.3 times longer than wide, eyes black, ovate and very prominent. Cephalon 1.2–1.3 times wider than long and transparent with few chromatophores scattered over the dorsal surface. Pereonites 1 and 7 relatively long; pereonite 2 shortest, 3–6 subequal in length; longer than pereonite 2; pereonite 5 widest. All pleonites visible and subequal in length and width; 4.3 times wider than long. Pleotelson slightly longer than wide and the apical margin with 40–44 plumose setae

Antennule with 8 articles extends slightly beyond the anterior margin of pereonite 1; all articles with few spinules; articles 5–7 with 2 elongate setae; article 8 with 3 elongate setae and 4 terminal aesthetascs. Antenna slightly longer than antennule, with 9 articles, all the articles with spinules and article 9 with few terminal aesthetascs. Article 3 of the mandible palp with three marginal setae and one large apical recurved seta. Maxillule, maxilla, and maxilliped similar to those of the male stage.

Six pereopods; pereopods 2–4 each with one spine on merus. Dactyli of all pereopods without a tooth. Propodus of pereopod 1 with one, of pereopods 2–5 with two spines on distal margin; carpi of pereopods 3–6 with one spine. Pleopods not distinctly visible in dorsal view. Pleopod 1

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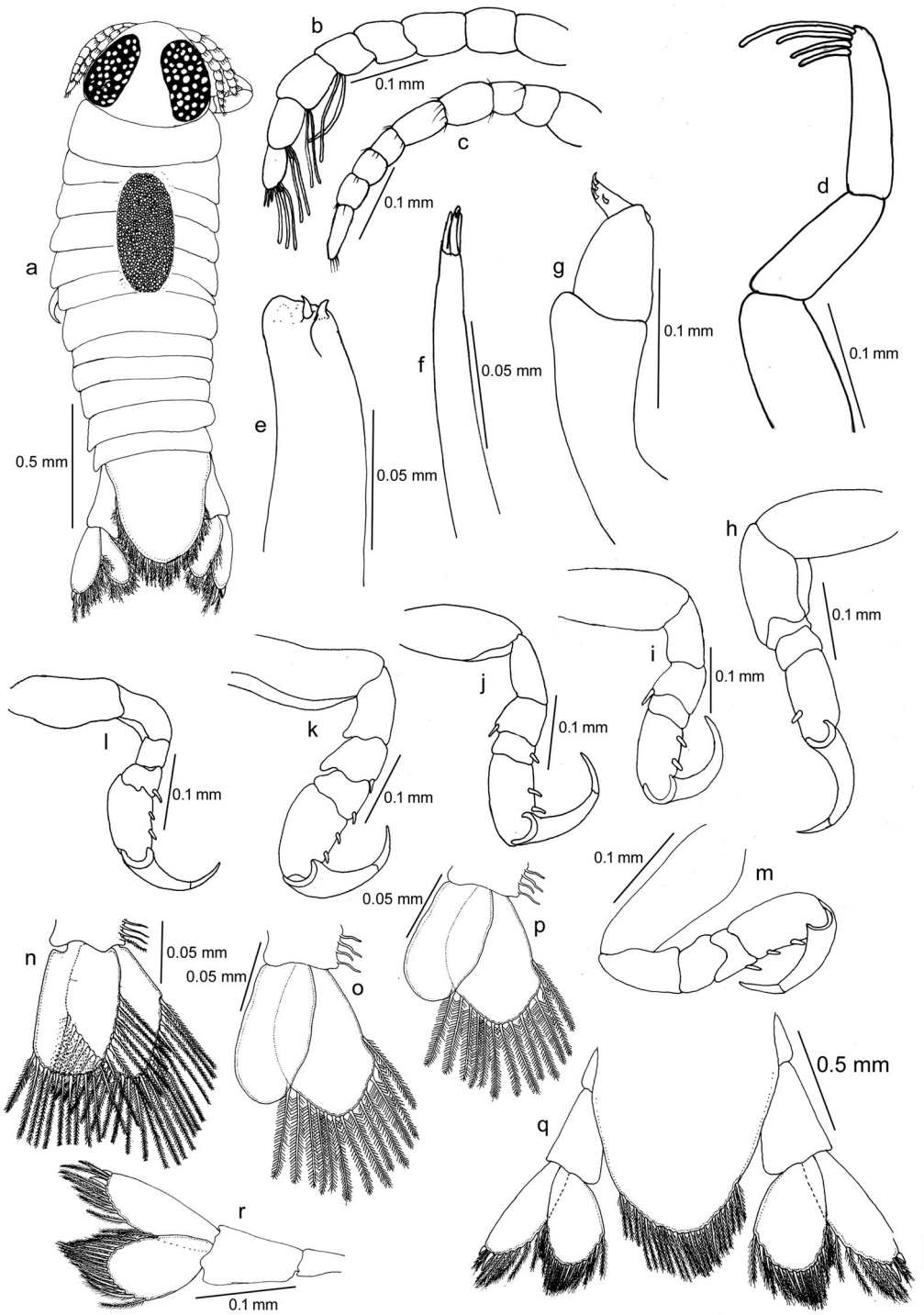

Fig. 8 *Joryma malabaricus* sp. nov., from *Escualosa thoracata* (Valenciennes, 1847), manca larva. **a** Dorsal view, **b** antennule, **c** antenna, **d** mandible palp, **e** maxillule, **f** maxilla, **g** maxilliped, **h**–**m** pereopods 1–7, **n**–**o** pleopod 1–2, **p** pleopod 5, **q** view of pleotelson and uropod, and **r** uropod with rami

with 18–20 plumose setae on endopodite and 20–22 plumose setae on exopodite. Pleopods 2–5, apical margin of exopodite with 20–22 plumose setae. Uropod rami endopod broader than exopod, extending strongly beyond the distal margin of pleotelson, curved and apically rounded. Exopodite with 8–10 plumose setae and apical margin with one small and one larger slightly recurved spine; endopodite with 16–20 plumose setae. Uropods and pleotelson with many dark chromatophores.

Body size: female (9–13 mm); male (4.5–7 mm); transitional stage (8–10 mm); manca (2–2.2 mm).

Color: ovigerous female–body pale tan with yellow/golden yellow/orange coloration in the thoracic region (depending on the color of the ovary) in the live state; male and transitional

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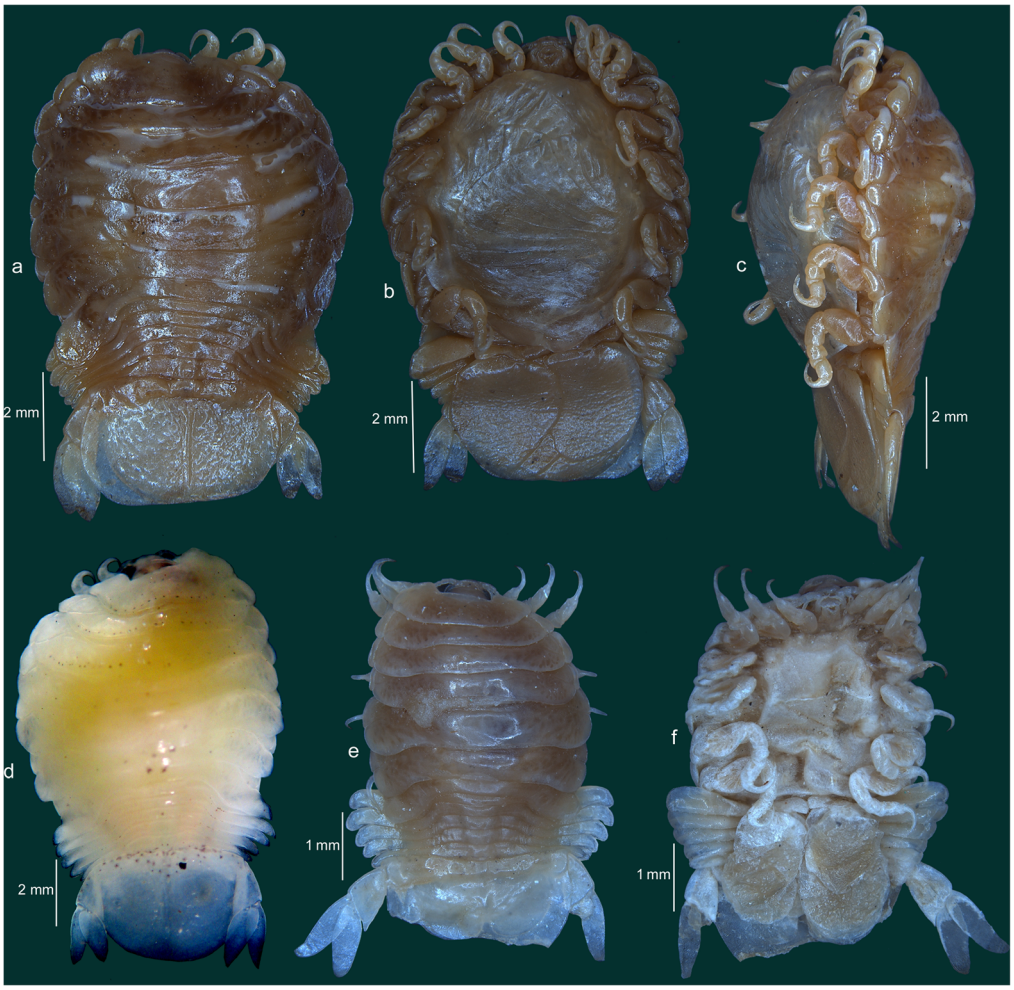

Fig. 9 ***Joryma engraulidis*** (Barnard, 1936) from *Thryssa setirostris* (Broussonet, 1782) female (**a**–**c**)**.** Ovigerous female neotype, Reg. no. C-7136/2; **a** Dorsal view, **b** ventral view, **c** lateral view, **d** ovigerous female viewed in a fresh state; **e**–**f** non-ovigerous female, **e** dorsal view and **f** ventral view

stage–body pale tan; manca–clear with scattered chromatophores.

Distribution: Currently only known from the type locality, Malabar Coast of the Arabian Sea, India.

Host: Only known from the type host *Escualosa thoracata* (Clupeidae).

Etymology: The species name is derived from the name of the type locality, the Malabar Coast.

Joryma engraulidis (Barnard, 1936).

Agarna engraulidis Barnard, 1936.

Livoneca engraulidis Pillai, 1964.

Joryma engraulidis—Bowman and Tareen 1983; Aneesh et al. 2015a: 1–10.

Unconfirmed reports: *Joryma engraulidis*—Veerappan and Selvamathi 2009.

Material examined: 16 females (15 ovigerous and 1non-ovigerous).

Type material and locality: **Neotype**—here designated, females (ovigerous) (10.5 mm), Marina Beach fish landing center, Chennai, India (13° 05′ 00″ N, 80° 28′ 24″ E, Bay of Bengal) (Reg. No C-7136/2) from *Thryssa setirostris*, coll. Aneesh.

Non-type—from *Thryssa setirostris* (Broussonet, 1782) coll. Aneesh and Helna, 1 female (non-ovigerous) (8 mm) and 1 female (ovigerous) (11 mm), Ayyikkara fish landing center (11° 51′ 33″ N, 75° 22′ 30 E″, Malabar Coast, India) (Reg. No C-7137/2).

Description

Female

Figures 9, 10, 11, and 12: Body strongly convex dorsally and asymmetrical, slightly longer than wide (1.4–1.6 times longer than wide), widest at pereonite 5. Cephalon symmetrical, subtriangular, 1.5–1.7 times wider than long, conspicuous dorsally, reaching beyond pereonite 1 expansion and deeply immersed in pereonite 1. Eyes small, black, distinct, sub-dorsal, and in the posterio-lateral of cephalon. Pereonite 1 without coxa, only coxae of pereonites 2–3 visible in dorsal view;

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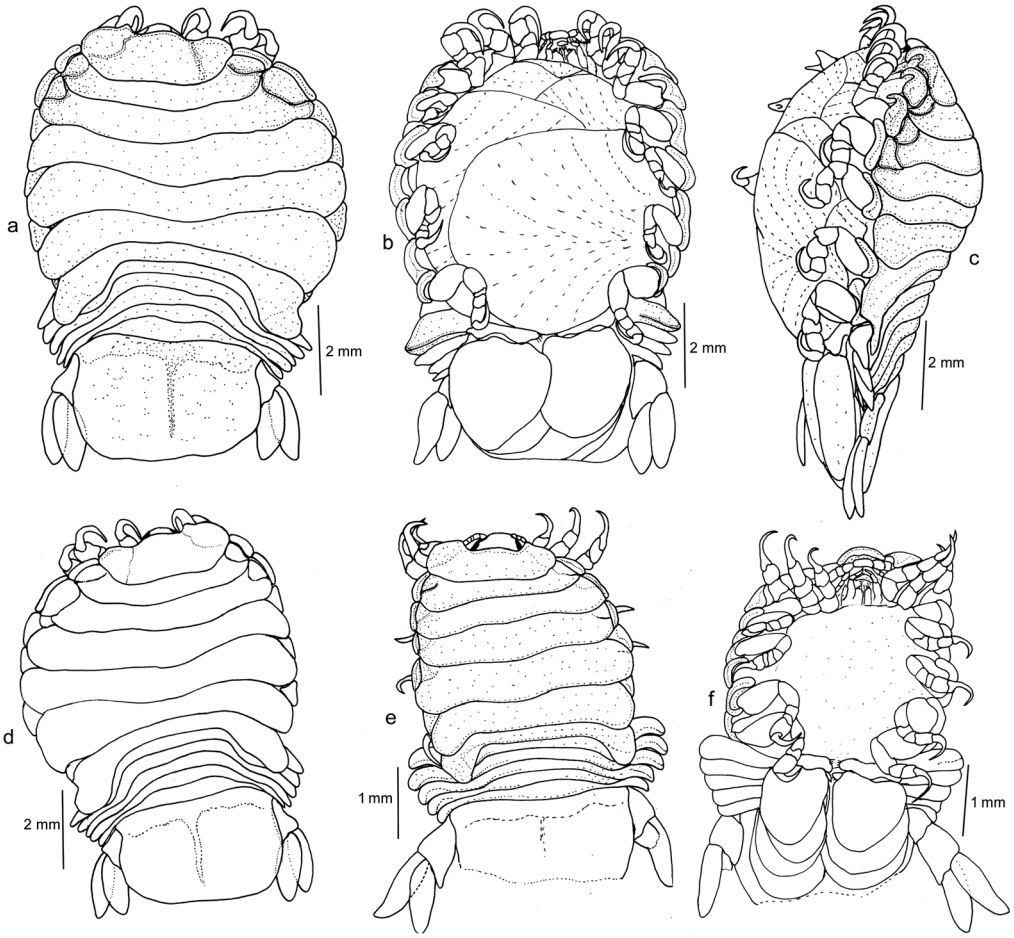

Fig. 10 ***Joryma engraulidis*** (Barnard, 1936) from *Thryssa setirostris* (Broussonet, 1782) female (**a**–**c**)**.** Ovigerous female neotype**,** Reg. no. C-7136/2. **a** Dorsal, **b** ventral, **c** lateral, **d** ovigerous female; **e**–**f** non-ovigerous female, **e** dorsal and **f** ventral

coxae of pereonites 4–7 concealed under the lateral margins of the corresponding segments, shallow, and much shorter than the segments. All pereonites, asymmetrical. Pereonite 1 anterolateral expansion unilateral and not bilobed. Pereonite 1 with either right or left lateral margin strongly and opposite less, gibbose; depends on the branchial cavity they prefer. Pereonite 1 longest, pereonite 4 slightly shorter than 1, pereonites 4 and 5 subequal. Pereonites 2, 3, and 6 subequal and shorter than 5. Pereonite 4–7 decreasing in length progressively, pereonite 7 shortest. Pereonites 2–7 with anterio-lateral margin clearly demarcated; pereonites 2–4, conspicuous, pereonites 5–7 decreasing in size and less conspicuous. Pereonites increase in width from 1 to 5, slightly toward one side; pereonite 5 widest and gradually decrease in width from 6 to 7. Pleon as wide as pereon, all pleonites clearly visible dorsally. Pleonites decreasing progressively in width posteriorly from 1 to 5. Lateral angles of pleonite 1 projecting beyond the lateral corners of pereonite 7. Lateral angles of pleonite 5 almost hidden between the peduncles of uropods and pleonite 4. Pleotelson 1.5–1.6 times wider than long, shorter than pleonite 5, posterior margin broadly rounded, themedio-longitudinal ridge is weakly developed

Antennule stouter than the antenna, composed of 7 articles. Antenna with 8–9 articles, slightly longer and slender than antennule. Mandible palp 3 segmented and basal segment border, apical segment shot and conical. Maxillule with 4 unequal slightly recurved apical spines; outer pair longer than inner. Bilobed maxilla with 2 spines on both inner median lobe and outer lateral lobe. Maxilliped without oostegial lobe; article 3 with 3 large terminal recurved spines.

Pereopods short, pereopods 1–7 without spines, pereopod 7 longest; dactyli of pereopods 1–3 much larger than that of other pereonites. Pleopods not visible in dorsal view; pleopod 2 without appendix masculine. Exopodite of pleopod 2–5 without proximo-lateral lobes. Peduncle of all pleopods with 3–4 setae. Uropod rami short and unequal flattened extend almost up to the distal margin of pleotelson; exopod narrow, ovate; endopod slightly broader and longer than that of exopod, apex tunicate.

Brood pouch with 4 pairs of overlapping oostegites arising from the bases of pereopods 2, 3, 4, and 6; 2nd oostegite small, 4th and 6th large and 3rd medium. Posteriorly covered by a pocket formed from sternite. The number of eggs or larvae per brood pouch ranges from 136 to 340 according to the size of the female.

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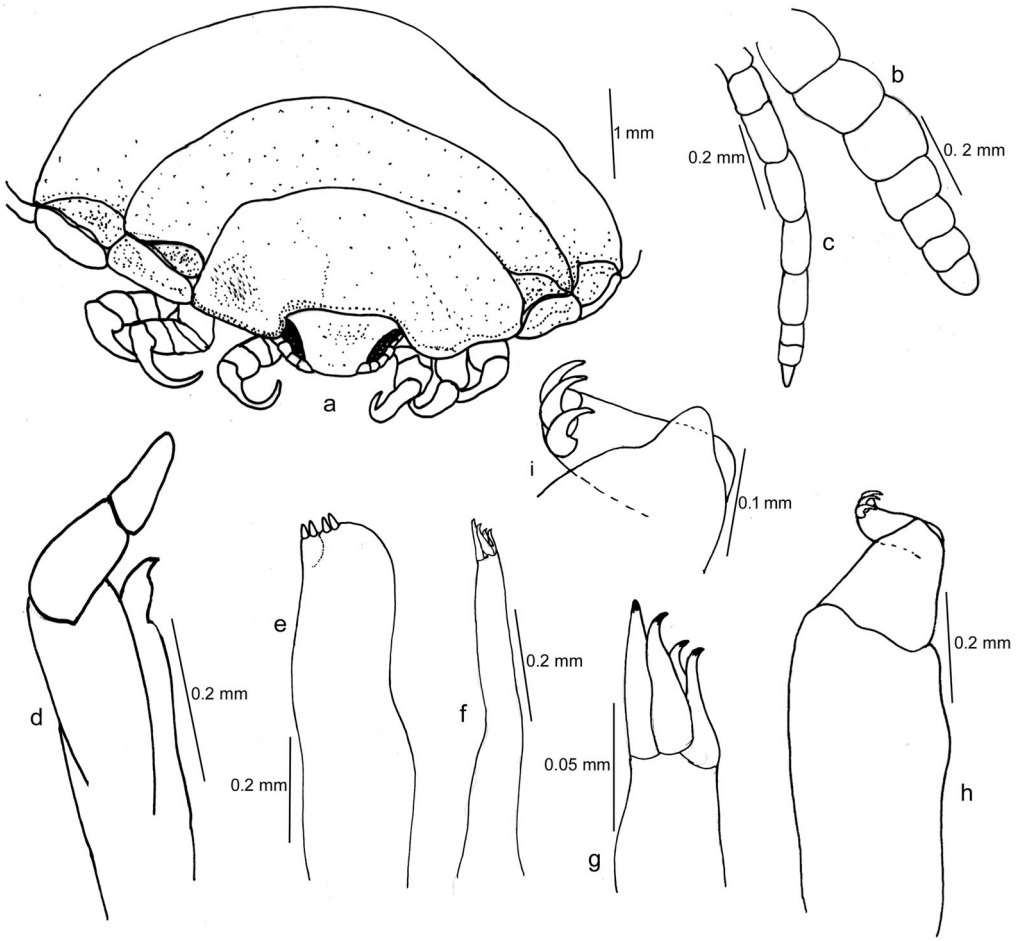

Fig. 11 ***Joryma engraulidis*** (Barnard, 1936) from *Thryssa setirostris* (Broussonet, 1782) ovigerous female neotype, Reg. no. C-7136/2. **a** Cephalon, **b** antennule, **c** antenna, **d** mandible, **e** maxilla, **f** maxillule, **g** maxillule apex, **h** maxilliped, and **i** distal segment of maxilliped palp

Body size: ovigerous females 9–14 mm; non-ovigerous female 8 mm.

Color: female, in living condition, white color.

Distribution: Only known from Indian waters; Off Devi River, Orissa Coast, India (Barnard 1936), Marina Beach, Chennai, Bay of Bengal (present study) and Malabar Coast, Arabian Sea (Aneesh et al. 2015a).

Hosts: Only known from the type host *Engraulis setirostris* [= *Thryssa setirostris*] (Barnard 1936; Aneesh et al. 2015a, present study).

Neotype designation for *Joryma engraulidis* (Barnard, 1936): *Joryma engraulidis* was described by Barnard (1936) as *Agarna engraulidis*. The original description provided a brief description of the female (dorsal and lateral view, mandible palp) and needed to be updated according to the modern standards. Fortunately, the type locality (off Devi River, Orissa Coast, India) and the type host (*Engraulis setirostris* (Broussonet, 1782) (= *Thryssa setirostris* (Broussonet, 1782)) were clearly mentioned, but no mention of the deposition of the type material. Present museum inquiries failed to reveal any material that could be definitely identified, or indeed even potentially considered as the type material for *Joryma engraulidis***.** As there are no museum records of Barnard's (1936) material, it seems that, inevitably, the types were either not deposited or have been subsequently lost.

There are very few subsequent records of this species; Pillai (1964) had transferred Barnard's *Agarna engraulidis* to the genus *Livoneca* Leach, 1818 but was later transferred to the genus *Joryma* (Bowman and Tareen 1983). Recently, Aneesh et al. (2015a) reported *J. engraulidis* from the Malabar Coast of India without providing any description. The report by Veerappan and Selvamathi (2009) is not confirmed since they failed to provide any relevant data for their clime. The identification of this species to date is based only on Barnard's original description and this species needs a precise redescription.

The new material of *Joryma engraulidis* described here was collected from the same host fish *Thryssa setirostris* as in the original description. The present specimens were collected from two different localities in India: Marina

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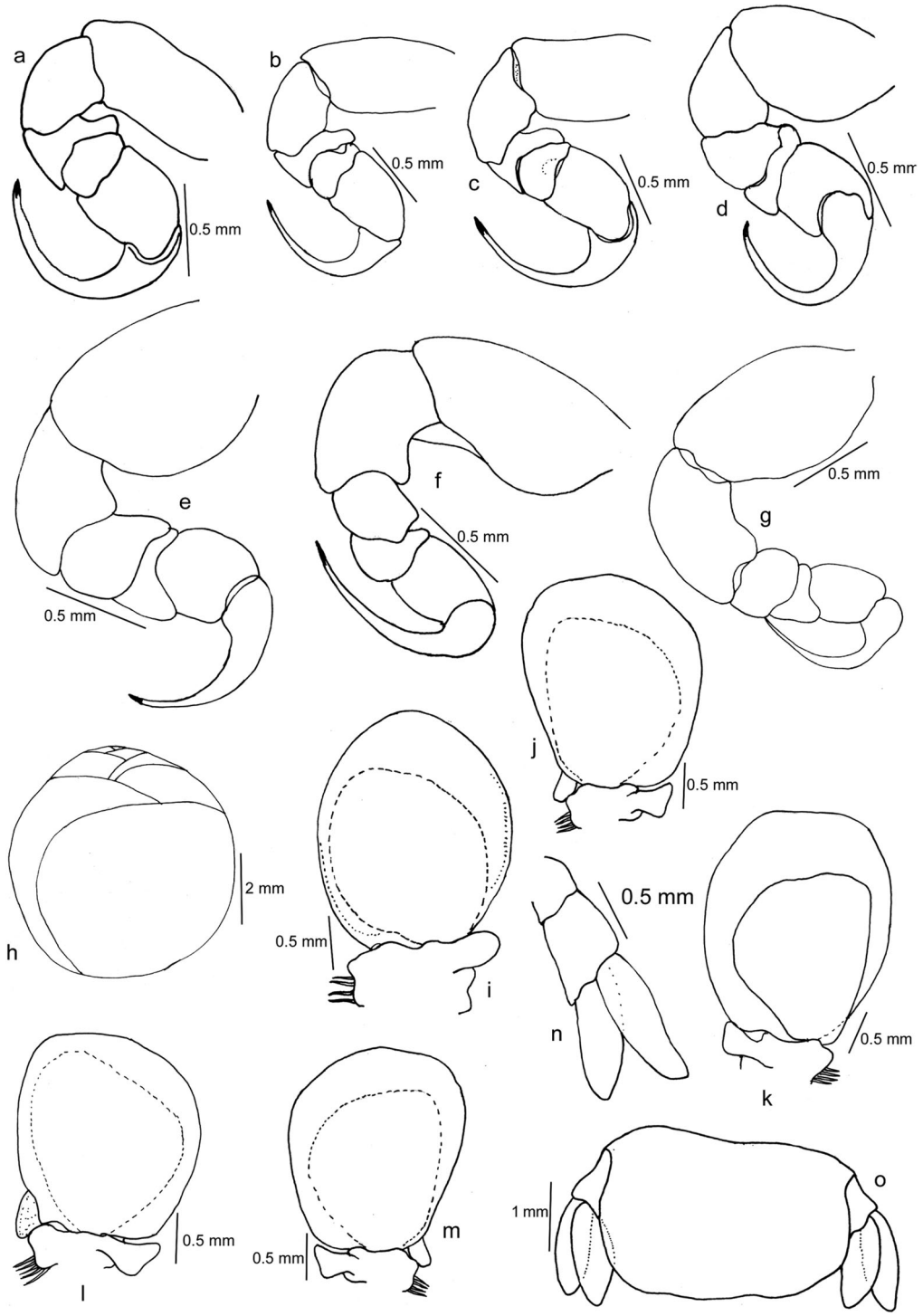

Fig. 12 ***Joryma engraulidis*** (Barnard, 1936) from *Thryssa setirostris* (Broussonet, 1782), ovigerous female neotype, Reg. no. C-7136/2. **a**–**g** Pereopods 1–7, **h** brood, **i**–**m** pleopods 1–5, **n** uropod, and **o** pleotelson and uropods

Beach, Chennai, India, Lat. 13° 50′ N, Long. 80° 28′ E, the Bay of Bengal and Ayyikkara fish landing Centers, 11° 51′ 33″ N, 75° 22′ 30″ E, Malabar Coast, India. The Marina Beach, Chennai, is around 900 km away from the locality of Barnard's specimen (Off Devi River, Orissa Coast, India). We consider the new type locality resulting from the neotype designation to be similar to the original type locality "as nearly as practicable from the original type locality" (Anon 1999, ICZN, Art. 75.3.6).

All the present Indian material agrees well with the description and figures given by Barnard (1936)—pleonites not overlapped, pleotelson broadly rounded, mandibular

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palp 3 segmented, uropods rami unequal, body asymmetrical and strongly convex dorsally, 1.4–1.6 times longer than wide, cephalon conspicuous dorsally and reaching beyond pereonite 1 expansion, pereonite 1 anterolateral expansion unilateral and not bilobed. The present material is slightly smaller (10.5 mm) than the size of the material given by Barnard (1936; females 12 mm).We are confident that the present material from Marina Beach, Chennai, India (Lat. 13° 50′ N, Long. 80° 28′ E, Bay of Bengal) and Barnard's material from Orissa Coast is the same species, and we have taken the decision to designate a neotype in order to conserve Barnard's (1936) name and concept of this species and the future use of this name.

Joryma hilsae Rameshkumar, Ravichandran and Trilles, 2011

Joryma hilsae—Rameshkumar, Ravichandran and Trilles 2011; Satyanarayan 2012: 153–155, Figs. 1 and 3; Aneesh et al. 2015a: 1–10.

Type material and locality: Rameshkumar et al. (2011) described this species from Muttam, South-western Coast of India based on *holotype* female (MNHN 6289) collected from the clupeid host, *Sardinella* sp. and three *paratypes:* one non-ovigerous female (AUCR C19) from *Stolephorus commersonnii* Lacepède, 1803 and two non-ovigerous female (AUCR C 20) from clupeid host, *Hilsa kelee* (Cuvier, 1829) from the same locality**.**

Material examined: 26 females (19 ovigerous and 7 non-ovigerous), 13 males.

Non-type—All from host *Pellona ditchela* Valenciennes, 1847 Valenciennes (Pristigasteridae) from Ayyikkara fish landing center (110 51′ 33″ N, 750 22′ 30 E″, Malabar Coast, Arabian Sea, India) coll. Aneesh and Helna. Five females ovigerous (18 mm,19 mm, 21 mm, 22 mm, 23 mm TL) and two males (8 mm and 9 mm TL) (Reg. No. C-7147/2).

Description

Female

Figure 13a–g, 14 and 15: asymmetrical body, 2–2.3 times longer than wide, widest at pereonite 5. One side of the body almost straight and another side strongly twisted. Cephalon symmetrical, as long as wide, conspicuous dorsally, reaching the margin of pereonite 1 expansion. Anterior margin rounded, accommodated in the anterolateral expansion of pereonite 1. Eyes small, moderately developed, partly covered by pereonite 1. Coxae 2 and 3 dorsally visible, coxae 4–7 posterior part is visible. Coxa 2 and 3 enlarged, produced anteriorly into lobe underlying process of pereonite 1 and 2 respectively; coxa 3 shorter than the lateral margin of pereonite 3. Coxae 4–7 occupying anterior halves of pereonite margins; anterior halves of pereonites coxae 4–7 overlapped laterally by preceding pereonites. Pereonite 1 produced on each side into slightly bilobed processes, reaching the anterior margin of Cephalon; pereonites 1 and 4 longest, 2 and 7 shortest, 3, 5, and 6 subequal in length. Postero-lateral margins of pereonites 2–7 inflated especially at the hunched side of pereon. All pleonites visible, not immersed in pereonite 7. Pleonite 1 slightly shorter than others, pleonites 2–4 subequal, pleonite 5 longest, lateral margin of pleonites in the hunched side curving posteriorly. Pleotelson 1.1–1.3 times wider than long, shorter than pleonite 5, posterior margin broadly rounded with the caudo-medial lobe.

Antennule stouter than the antenna, well separated at the base, composed of 8 articles; article 8 with 2–3 terminal setae. Antenna with 9 articles, slightly shorter and more slender than antennule. Mandible palp 3-segmented, the separation between the segments 1 and 2 apparently incomplete, basal segment border, apical segment short and rounded. Maxillule with 4 unequal slightly recurved apical spines; outer pair much shorter than inner. Bilobed maxilla, inner and outer lobes with minute scales and with 2 slightly recurved spines on the inner median lobe and two spines on the outer lateral lobe. Maxilliped without oostegial lobe; article 3 with 3 large terminal recurved spines and one small recurved spine on lateral margin.

Pereopods short, without spines, gradually increasing the size from pereopod 1 to 7; dactyli of pereopods 1–7 reduced, basis and ischium of pereopods 4–7 much dilated. Pleopods not visible in dorsal view; pleopod 2 without appendix masculine. Rami of pleopods 1–5 lamellar, endopod smaller than exopod; protopod without coupling hooks and laterally expanded into rounded lobes. The proximo-medial lobe increasing in size from endopod 1 to 5. Uropods much shorter than pleotelson, reaching the middle of the lateral margin of pleotelson; rami equal in length, curved and apically rounded.

Brood pouch with 4 pairs of overlapping oostegites arising from the bases of pereopods 2, 3, 4, and 6; 2nd oostegites small, 4th and 6th large and 3rd medium. Posteriorly covered by a pocket formed from sternite, sterna pockets are dorsally overlapped by oostegites of 6th pereopod. The number of eggs or larvae per brood pouch ranges from 180 to 390 according to the size of the female.

Male

Figures 13h, i, 14, 15, 16, and 17: Relatively (2.5–2.7 times) smaller than ovigerous female. Body symmetrical, 2.5–2.7 times longer than wide, widest at pereonite 5. Cephalon as long as wide, triangular with round anterior border, not immersed in pereonite 1. Eyes prominent, 2.7–2.9 times larger than the female. Pereonite 1 anterio-lateral corners slightly produced; pereonite 1 longest, 7 shortest, pereonites 2–6

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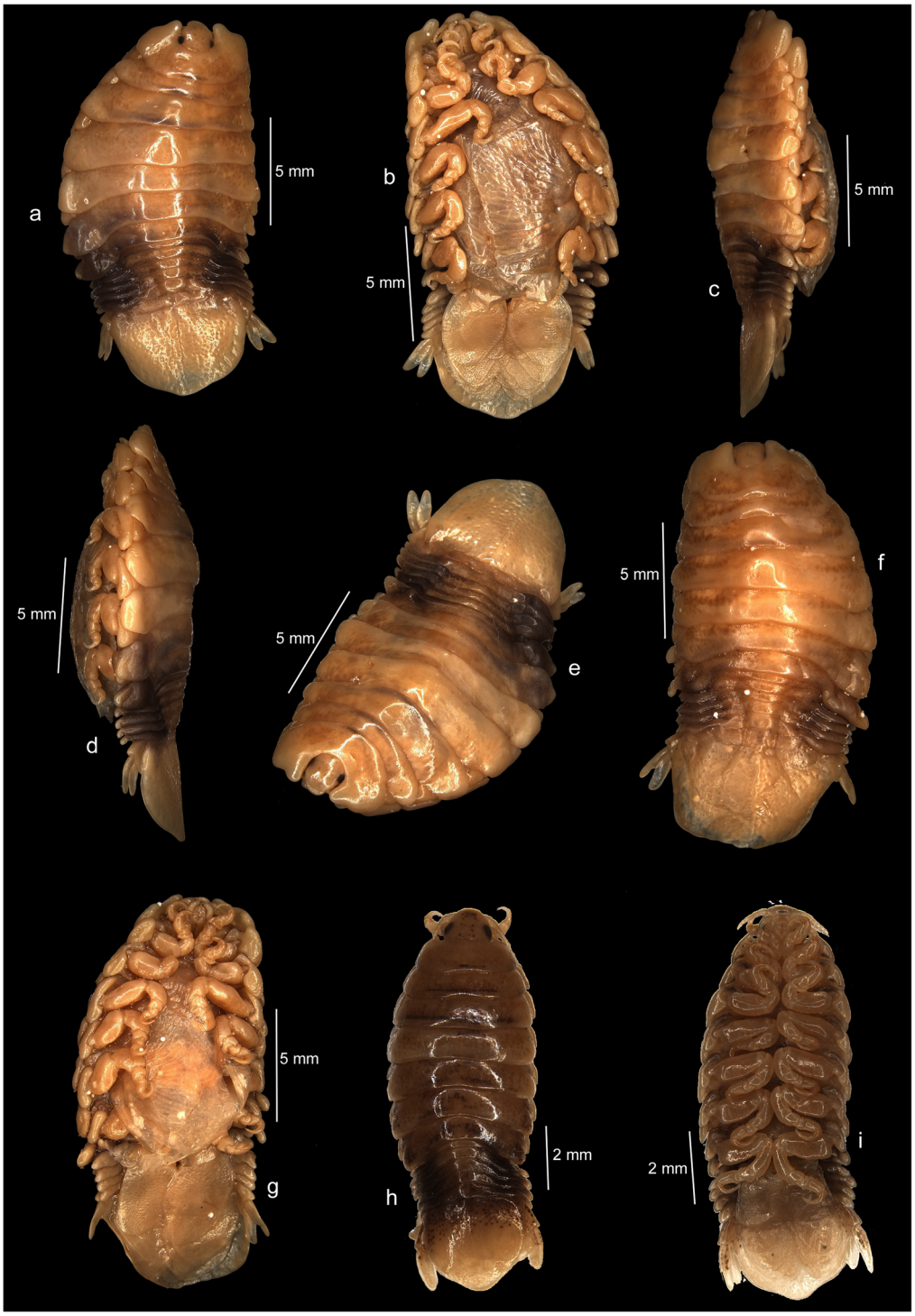

Fig. 13 ***Joryma hilsae*** Rameshkumar, Ravichandran and Trilles, 2011 from *Pellona ditchela* Valenciennes, 1847 (Pristigasteridae). **a**–**g** Ovigerous female, **a** dorsal, **b** ventral, **c**, **d** lateral, **e** dorso-frontal, **f** dorsal, **g** ventral; **h**, **i** male, **h** dorsal; **i** ventral

subequal. Pereonites gradually increasing in width from 1 to 5, pereonite 5 widest, gradually reducing in width posteriorly. Coxae 2 and 3 clearly visible dorsally, in coxae 4–7 posterior part is visible. Coxa 3 much enlarged and inflated, coxae 4–7 occupying anterior halves of pereonite margins; anterior halves of pereonites 4–7 overlapped laterally by preceding pereonites. All pleonites visible, not immersed in pereonite 7. Pleonite 1 slightly shorter than others, pleonites 2–4 subequal, pleonite 5 longest, lateral margin of pleonites in both sides slightly curving posteriorly. Pleotelson 1.2–1.3

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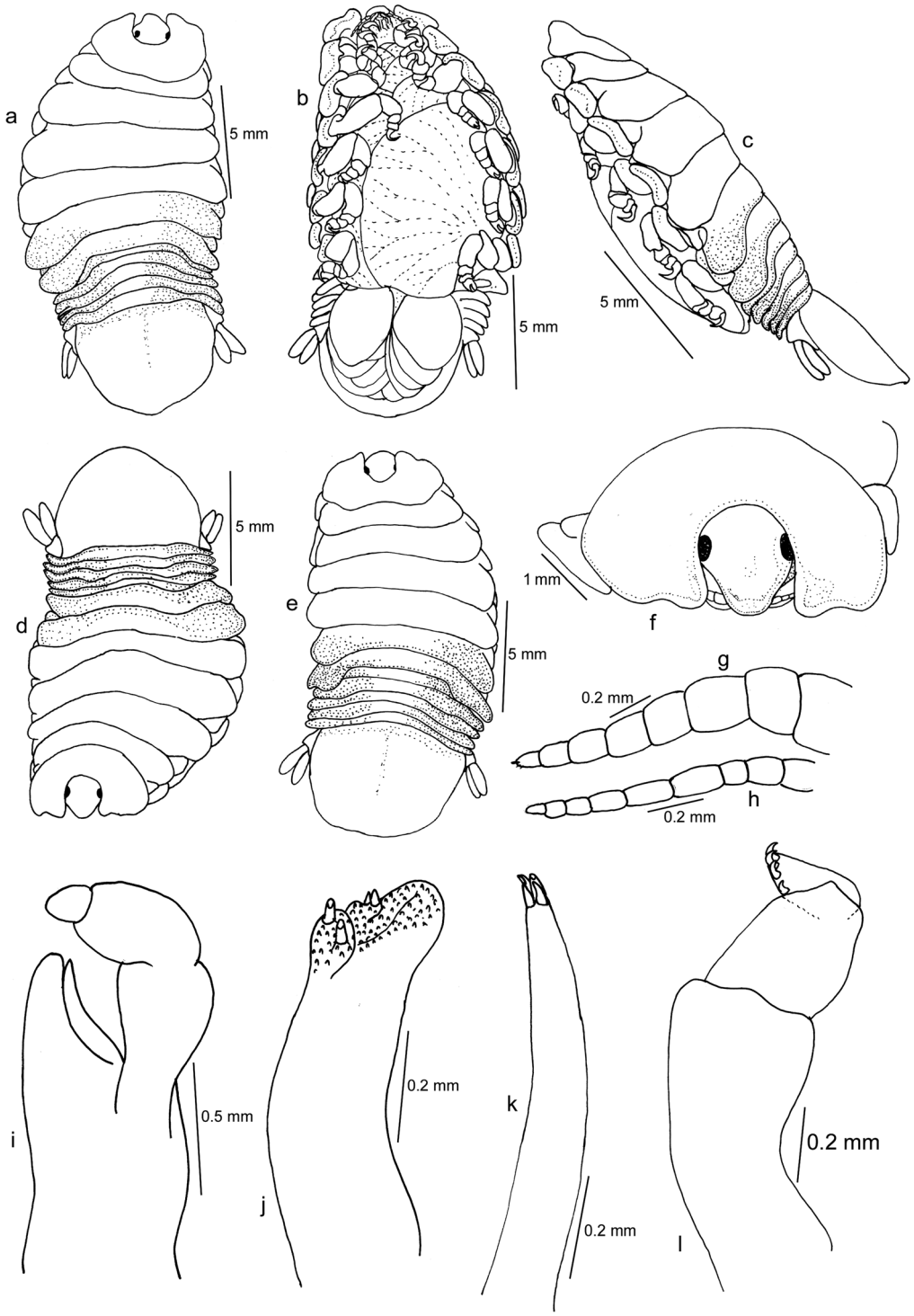

Fig. 14 ***Joryma hilsae*** Rameshkumar, Ravichandran and Trilles, 2011 from *Pellona ditchela* Valenciennes, 1847 (Pristigasteridae), ovigerous female. **a** Dorsal, **b** ventral, **c** lateral, **d** dorso-frontal, **e** dorsal, **f** cephalon, **g** antennule, **h** antenna, **i** mandible, **j** maxillule, **k** maxilla, and **l** maxilliped

times wider than long, shorter than pleonite 5, posterior margin broadly rounded.

Antennule stouter than the antenna, well separated at the base, composed of 8 articles; articles gradually decreasing in width from article 1 to 8, article 8 with few terminal setae. Antenna with 9 articles, slightly shorter and more slender than antennule, article 4 longer than others. Mandible palp 3-segmented, apical segment short. Maxillule with 4 unequal and slightly recurved apical spines; outer pair much shorter than inner. Maxilla bilobed, inner and outer lobes with minute

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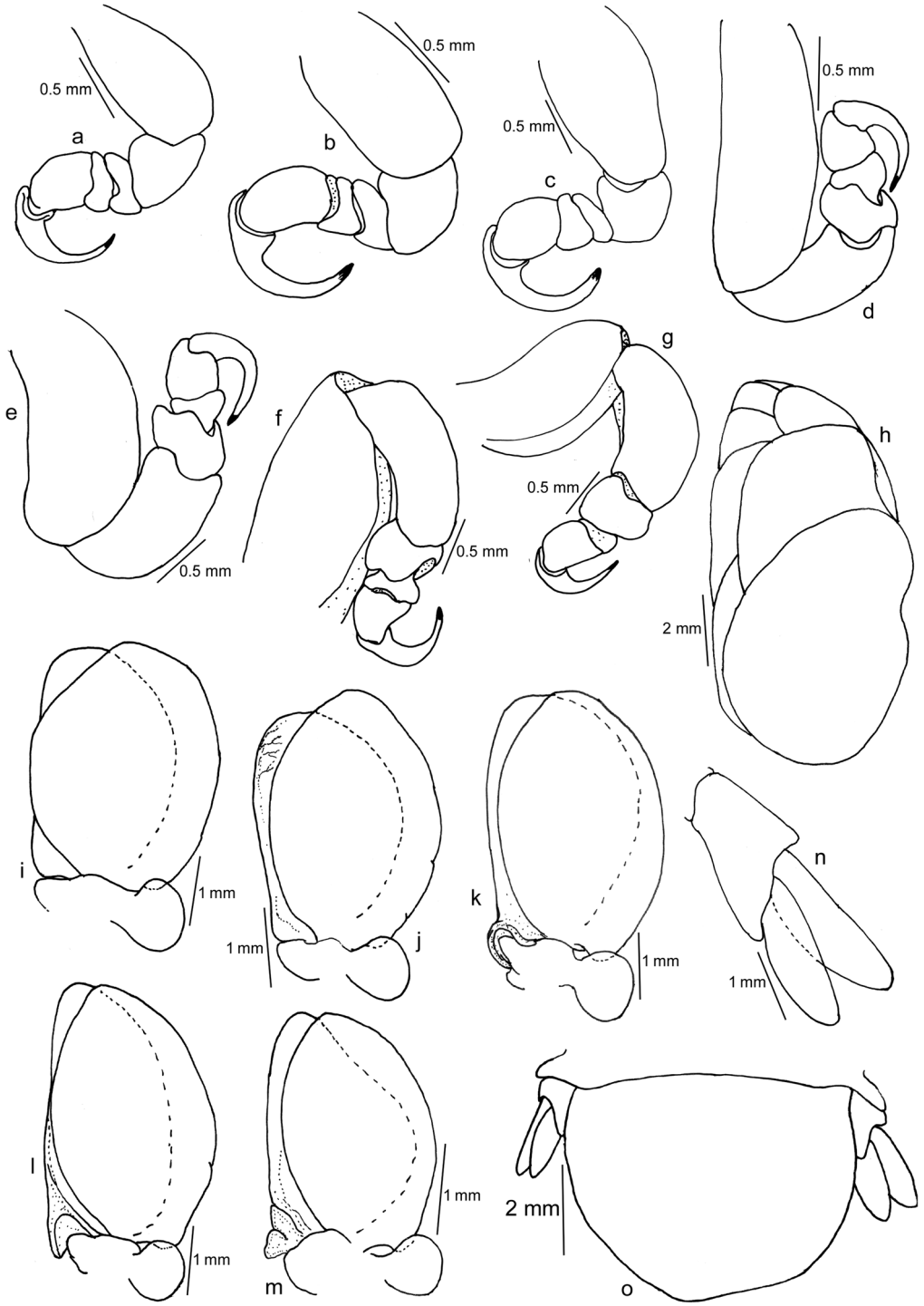

Fig. 15 ***Joryma hilsae*** Rameshkumar, Ravichandran and Trilles, 2011 from *Pellona ditchela* Valenciennes, 1847 (Pristigasteridae) female. **a**–**g** Pereopods 1–7, **h** brood, **i**–**m** pleopods 1–5, **n** uropod with rami, and **o** pleotelson and uropods

scales, inner median lobe with 1 and outer lateral lobe with two slightly recurved spines. Maxilliped without oostegial lobe; article 3 with 3 large terminal recurved spines and one small recurved spine on lateral margin.

Pereopods gradually increasing in size from 1 to 7; dactyli of pereopods 1 to 3 not reduced, basis and ischium of pereopods 4 to 7 much dilated. Penes hardly visible on sternite 7. Pleopods not distinctly visible in dorsal view. Pleopod 2 with appendix masculine, much shorter than endopodite. Rami of all pleopods lamellar, endopod slightly smaller than exopod; protopod without coupling hooks and laterally expanded into rounded lobes. The proximo-medial lobe

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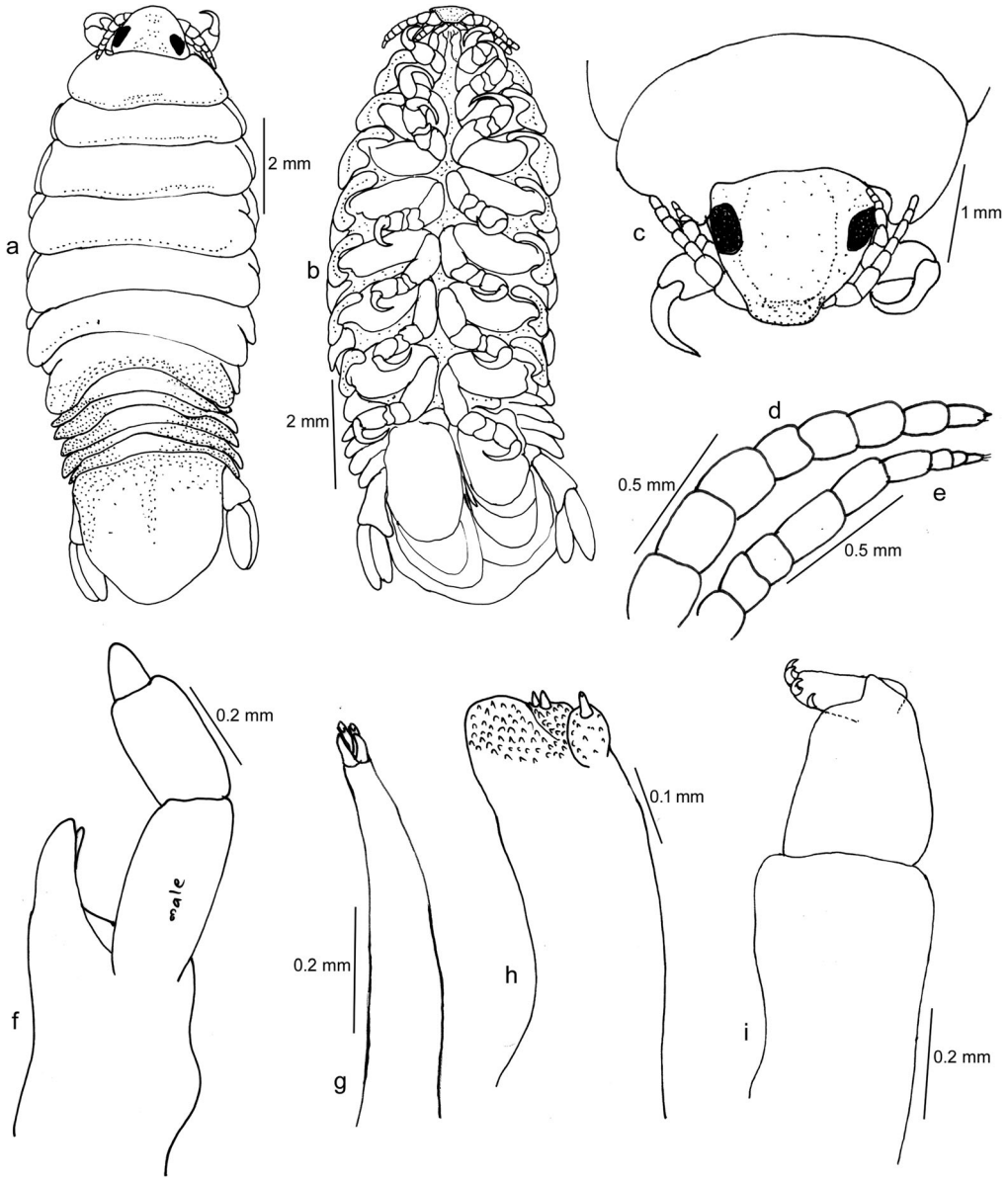

Fig. 16 ***Joryma hilsae*** Rameshkumar, Ravichandran and Trilles, 2011 from *Pellona ditchela* Valenciennes, 1847 (Pristigasteridae), male. **a** Dorsal view, **b** ventral view, **c** cephalon, **d** antennule, **e** antenna, **f** mandible, **g** maxillule, **h** maxilla, and **i** maxilliped

increasing in size from endopod 1 to 5. Peduncle of all pleopods with few reduced setae. Uropods slightly shorter than pleotelson, nearly reaching the distal margin of pleotelson; rami equal in length, curved, and apically rounded.

Body size: ovigerous female (14–23 mm), male (7–12 mm).

Color: Both male and female, body pale tan with large dark stripes on lateral parts of pereonites 6 and 7 and pleonites 1–5.

Distribution: Known from the type locality, Muttam, South-western Coasts of India (Rameshkumar et al. 2011), from Malabar Coast, Arabian Sea (Aneesh et al. 2015a; present study), Bay of Bengal, Marina Beach fish landing center, Chennai, India (present study).

Hosts: From *Sardinella* sp. (Clupeidae), *Stolephorus commersonnii* (Engraulidae) and *Hilsa kelee* (Cuvier, 1829) (Clupeidae) (Rameshkumar et al. 2011). *Pellona ditchela* (Pristigasteridae) (Aneesh et al. 2015a; present study).

Joryma sawayah Bowman and Tareen, 1983.
(Figs. 18, 19, 20, 21, and 22)

Joryma sawayah—Bowman and Tareen 1983; Satyanarayan 2012: 153–155, Figs. 2 and 4; Rameshkumar et al. 2013: 42–46, Fig. 1. D; Aneesh et al. 2015a:1–10; Rameshkumar et al. 2016: 940–944, Fig. 1d.

Type and type locality: Bowman and Tareen (1983) described this species from Doha, Kuwait, based on *holotype* female (20.8 mm) USNM 191058 collected from the pristigasterid host, *Ilisha indica* (Swainson, 1839) (= *Ilisha melastoma* (Bloch and Schneider, 1801)) , and

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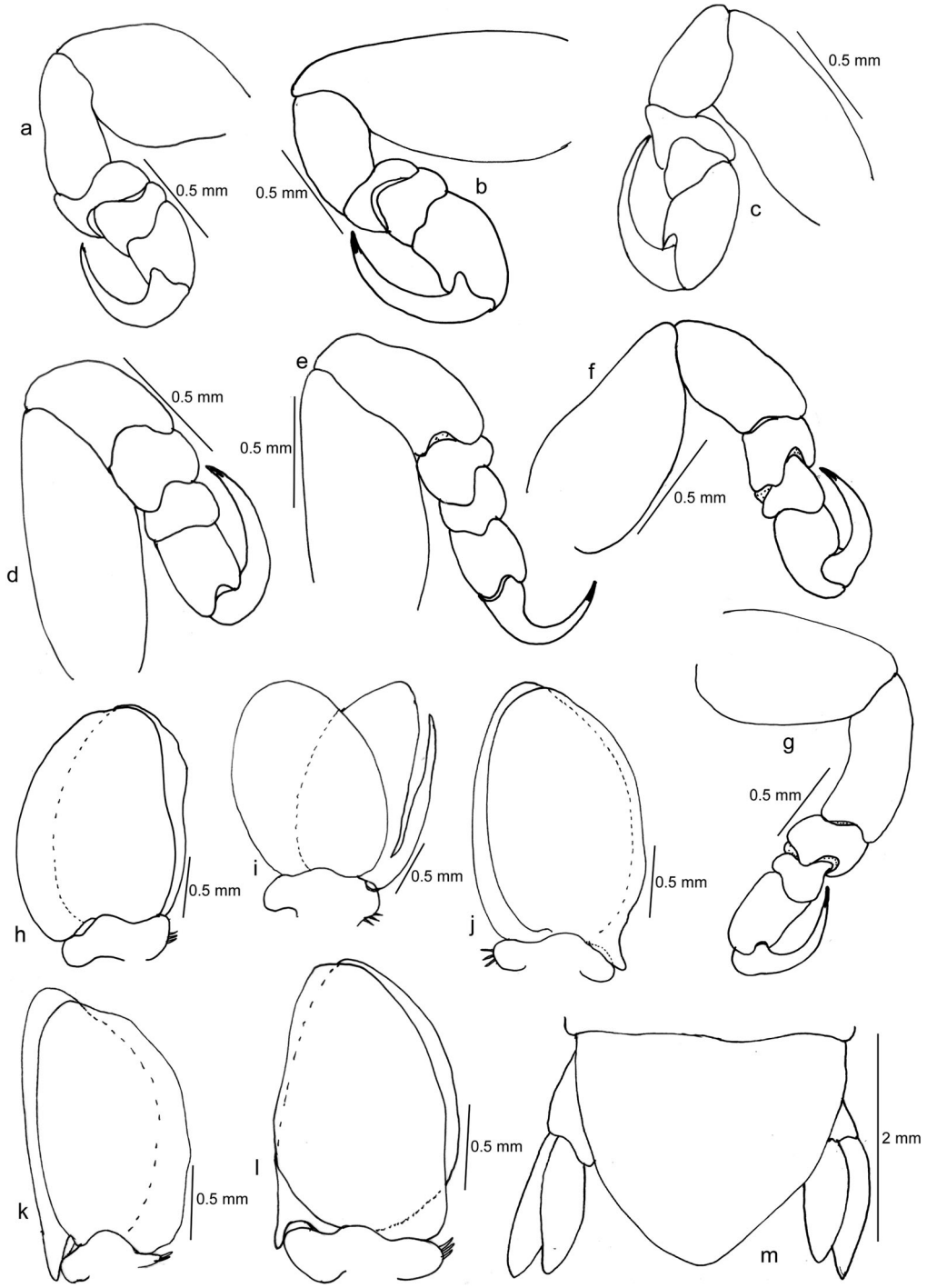

Fig. 17 ***Joryma hilsae*** Rameshkumar, Ravichandran and Trilles, 2011 from *Pellona ditchela* Valenciennes, 1847 (Pristigasteridae), male. **a**–**g** Pereopods 1–7, **h**–**l** pleopods 1–5, and **m** pleotelson and uropods

one *paratype* female from same locality and several other specimens from South of Faylaka (3 paratypes USNM 191060) and from North of platform (paratypes USNM 191061, 191057).

Material examined: 17 females (12 ovigerous and 5 non-ovigerous), 8 males.

Non-type—all from *Ilisha melastoma* (Bloch and Schneider, 1801) (Pristigasteridae) coll. PT Aneesh and AK Helna, from Ayyikkara fish landing center (11° 51′ 33″ N, 75° 22′ 30 E″, Malabar Coast, Arabian Sea, India. One female ovigerous (23 mm) and one male (10 mm) (Reg. No. C-7148/2).

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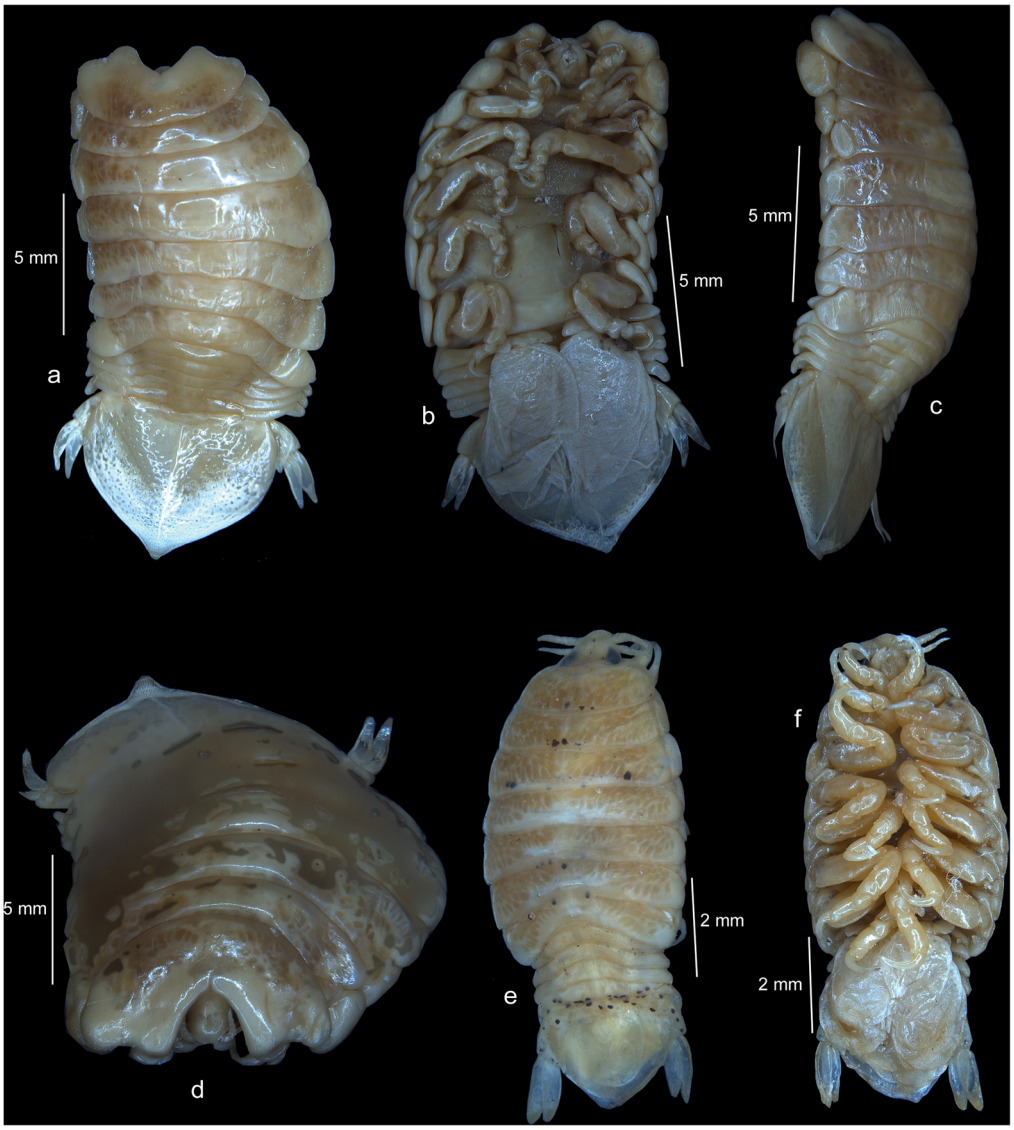

Fig. 18 *Joryma sawayah* Bowman and Tareen, 1983 from *Ilisha melastoma* (Bloch and Schneider, 1801) (Pristigasteridae) **(a–d),** female. **a** Dorsal, **b** ventral, **c** lateral, **d** dorso-frontal; **e**, **f** male, **e** dorsal and **f** ventral

Description

Female

Figure 18a–d, 19, 20: body asymmetrical, twisted to one side. Twisting of the female body is either toward left or right according to their occupation in the right and left branchial cavity respectively. Cephalon symmetrical, pyriform, slightly longer than wide, exposed dorsally, not reaching the margin of pereonite 1 expansion; anterior margin of the cephalon, rounded, accommodated in the anterolateral expansion of pereonite 1. Eyes moderately developed, but covered by pereonite 1 and not visible dorsally. Pereonite 1 produced on each side into inflated bilobed process reaching well beyond the anterior margin of head; anterior-median margin with a narrow furrow. Pereonite 4 longest, pereonite 1 slightly shorter than 4. Pereonite 2 shortest, pereonites 3, 5–7 subequal in length. Coxa 2 clearly and coax 3 moderately visible dorsally, coxae 4–7 posterior part is visible. Coxa 2 much enlarged and inflated, produced anteriorly into lobe underlying process of pereonite1. Coxa 3 inflated, shorter than the lateral margin of pereonite 3. Coxae 4–7 occupying anterior halves of pereonite margins; anterior halves of coxae 4–7 overlapped laterally by preceding pereonites, giving the impression that coxa belongs to preceding pereonites.Postero-lateral parts of pereonites 3–7slightly inflated. All pleonites visible dorsally not immersed in pereonite 7. Pleonites 1 and 2 entirely, and pleonite 3 partially overlapped laterally by pereonite 7. Pleonite 1 and 5 slightly longer than others, pleonites 2–4 subequal, all pleonites subequal in width, lateral margin of

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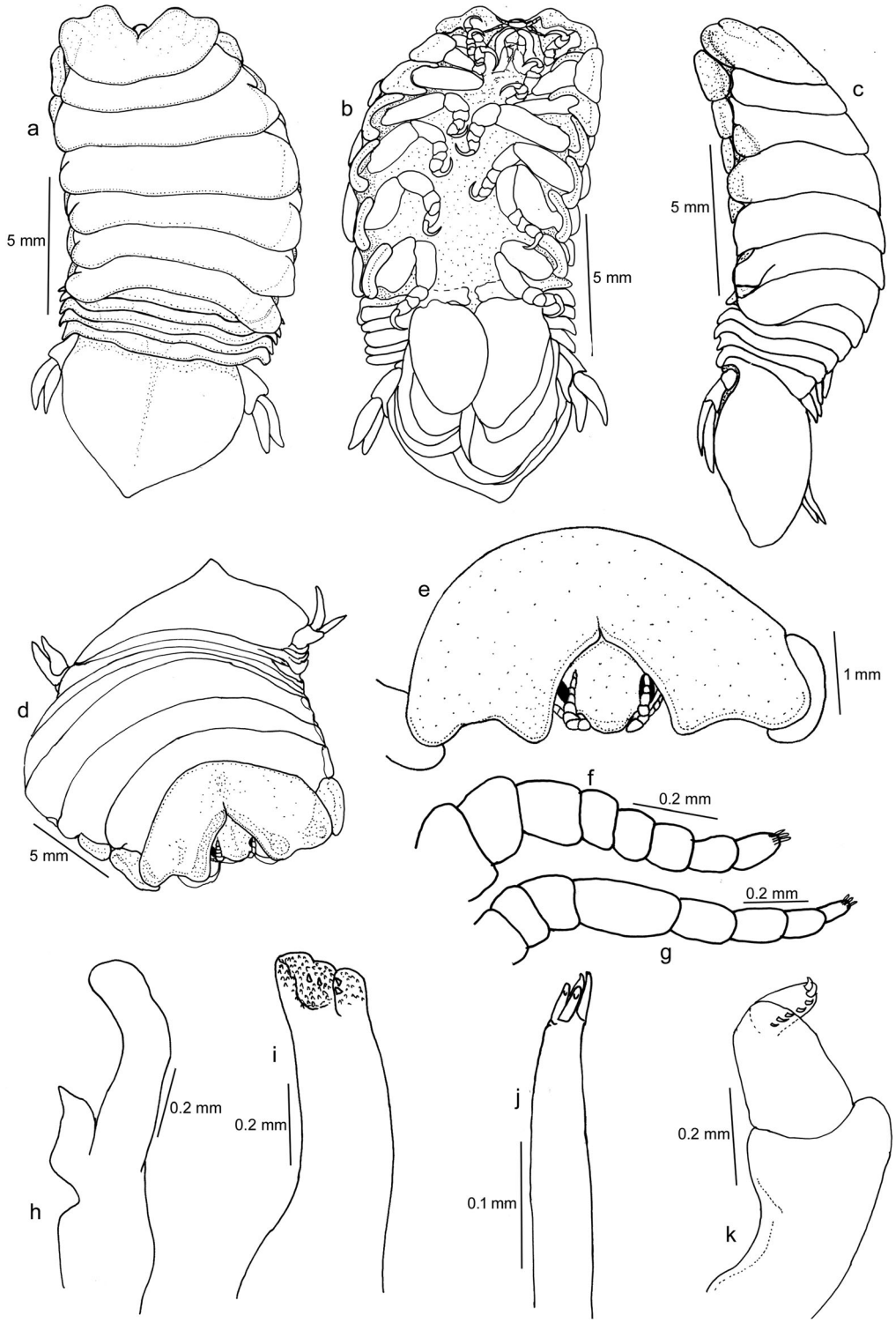

Fig. 19 *Joryma sawayah* Bowman and Tareen, 1983 from *Ilisha melastoma* (Bloch and Schneider, 1801) (Pristigasteridae) female**. a** Dorsal, **b** ventral, **c** lateral, **d** dorso-frontal, **e** cephalon, **f** antennule, **g** antenna, **h** mandible, **i** maxillule, **j** maxilla, and **k** maxilliped

pleonites curving posteriorly. Pleotelson 1.1–1.2 times wider than long, shorter than pleonite 5, posterior margin subtriangular distinct caudo-medial lobe.

Antennule stouter than the antenna, well separated at the base, reaching mid of eye, composed of 8 articles; article 8 with few terminal setae. Articles gradually decreasing in width. Antenna with 8 articles, slightly longer than antennule, article 4 longest; article 8 with few terminal setae. Mandible palp thick, no segmentation evident in palps. Maxillule with 4 strong slightly recurved apical spines. Bilobed maxilla, inner and outer lobes with

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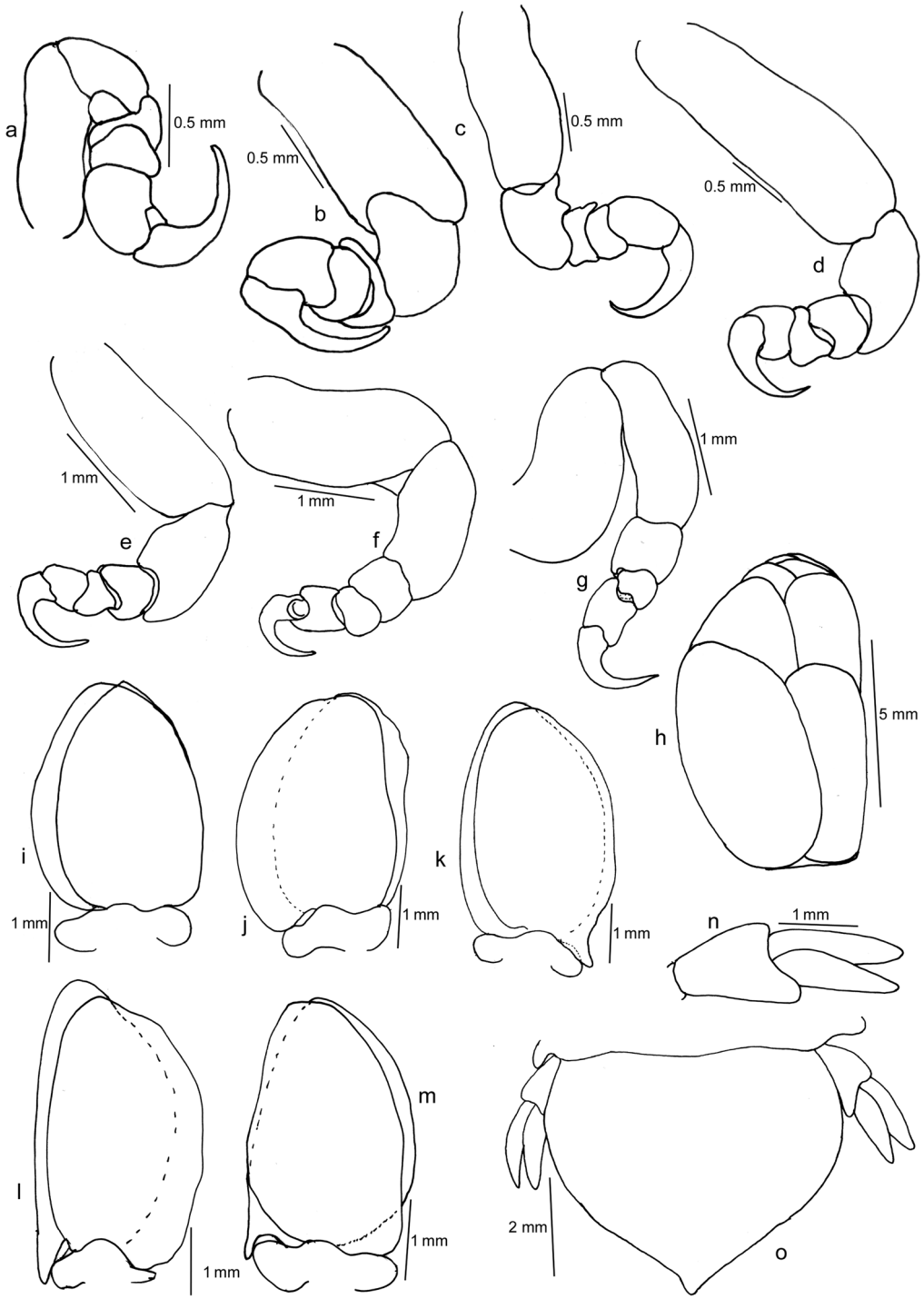

Fig. 20 *Joryma sawayah* Bowman and Tareen, 1983 from *Ilisha melastoma* (Bloch and Schneider, 1801) (Pristigasteridae) female. **a**–**g** Pereopods 1–7, **h** brood, **i**–**m** pleopods 1–5, **n** uropod with rami, and **o** pleotelson and uropods

minute scales and each with 2 slightly recurved spines on the inner median lobe and outer lateral lobe. Maxilliped without oostegial lobe; an apical segment with 2 large terminal recurved spines and five small recurved spines on lateral margin.

Pereopods 1–3 subequal; pereopods 4–7 subequal, longer than pereopods 1–3. The basis of pereopods 1–3 subequal, pereopod 4 longest, gradually decreasing in length from pereopod 5 to 7; the basis of pereopod 4 in one side slightly longer than another side. Pereopod ischium 1–7gradually increasing in length. Pleopod 2 without appendix masculine. Peduncles of pleopods expanded laterally into rounded lobes. Exopods of pleopods 3–5 with triangular proximo-lateral lobes. Uropods much shorter than pleotelson; rami pyriform, longer than peduncle, exopod longer than endopod.

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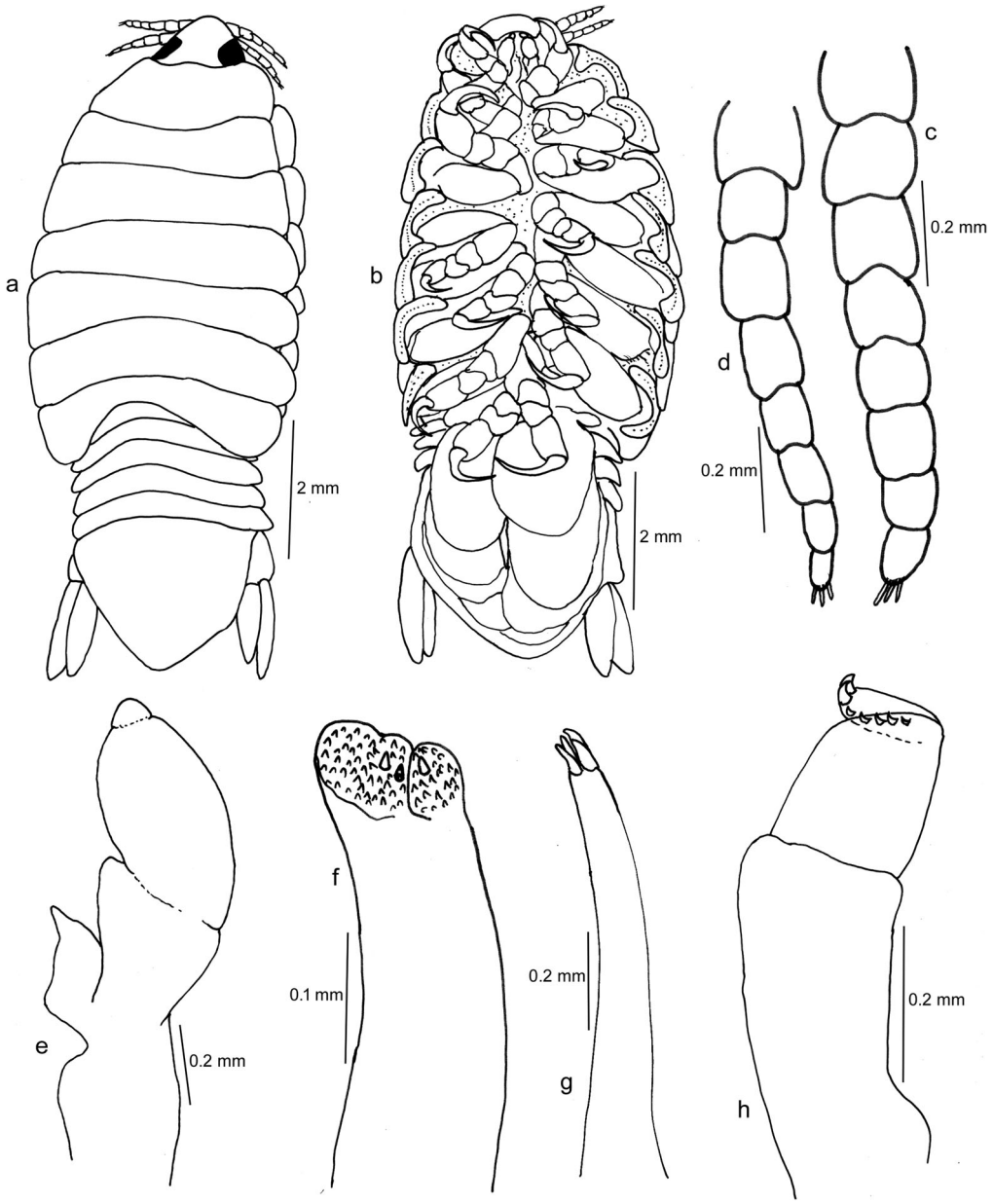

Fig. 21 *Joryma sawayah* Bowman and Tareen, 1983 from *Ilisha melastoma* (Bloch and Schneider, 1801) (Pristigasteridae) male. **a** Dorsal view, **b** ventral view, **c** antennule, **d** antenna, **e** mandible, **f** maxillule, **g** maxilla, and **h** maxilliped

Brood pouch with 4 pairs of overlapping oostegites and posteriorly covered by sternal pockets. Last two pairs of oostegites are much larger. The sternal pockets are dorsally overlapped by oostegites of pereopod 6. The number of eggs or larvae per brood pouch ranges from 190 to 380 according to the size of the female.

Male

Figure 18e, f, 21 and 22: smaller than female, body symmetrical and 2.3–2.4 times longer than wide, widest at pereonite 5. Cephalon triangular with round anterior border, wider than long, not immersed in pereonite 1. Eyes prominent and larger than in the female. Pereonite 1 anterio-lateral corners not produced; pereonite 1 longest, pereonite 7 shortest, pereonite 2 smaller than 3, pereonites 3–6 subequal. Pereonites gradually increasing in width from 1 to 5, pereonite 5 widest, gradually decreasing in width toward posterior pereonites. Coxae 2 and 3 clearly visible dorsally, in coxae 4–7 posterior part is visible. All pleonites visible dorsally, not immersed in pereonite 7. Pleonite 1 entirely, pleonite 2 partially overlapped laterally by pereonite 7. All pleonites subequal in length and width, lateral margins of pleonites directed posteriorly. Pleotelson

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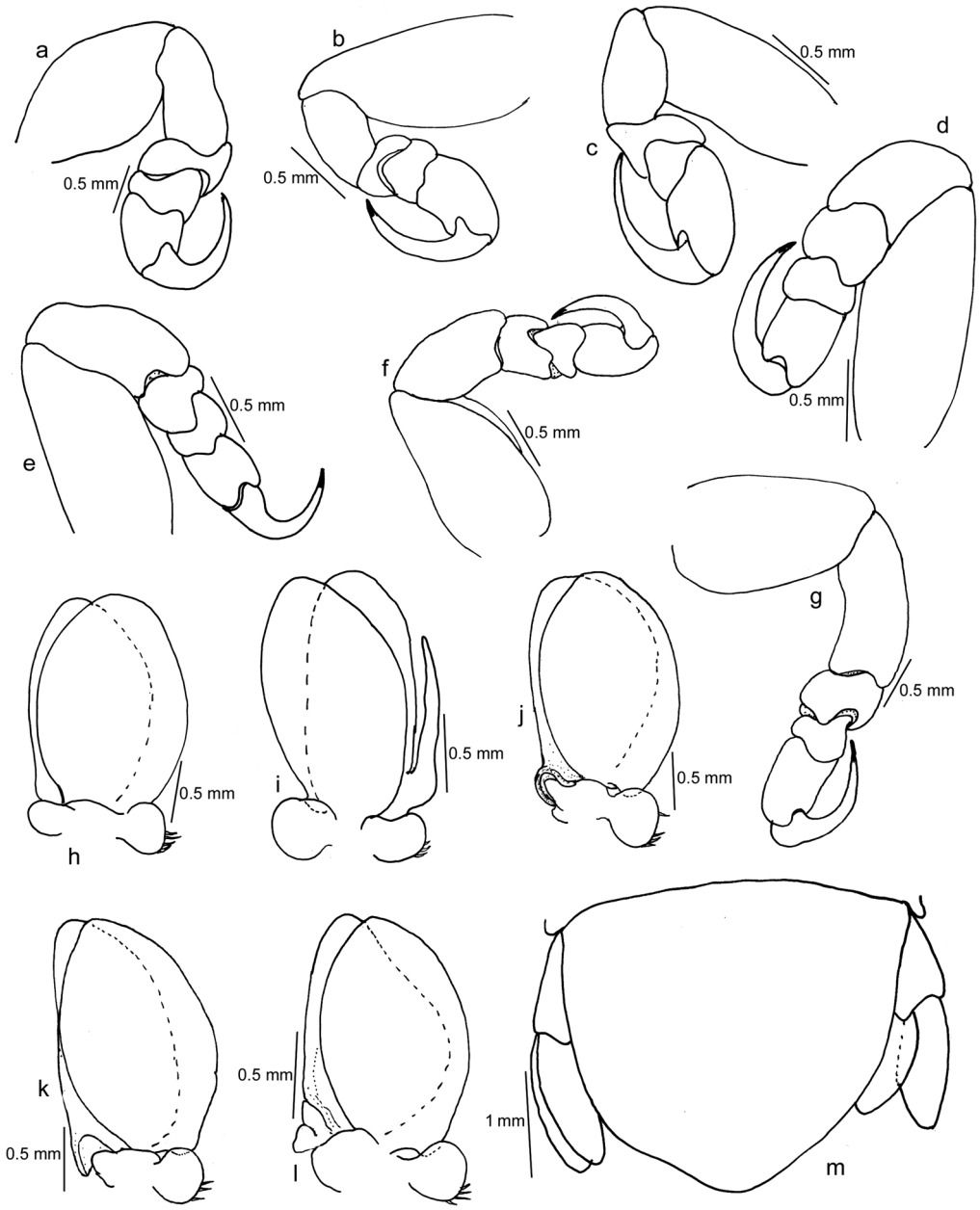

Fig. 22 *Joryma sawayah* Bowman and Tareen, 1983 from *Ilisha melastoma* (Bloch and Schneider, 1801) (Pristigasteridae) male. **a**–**g** Pereopods 1–7, **h**–**l** pleopods 1–5, and **m** pleotelson and uropods

slightly wider than long, shorter than pleonite 5, posterior margin broadly triangular.

Antennule stouter than the antenna, well separated at the base, reaching beyond the middle of pereonite 1, composed of 8 articles; article 8 with few terminal setae. Antenna with 8 articles, article 8 with few terminal setae. Mandible palp very thick, the separation between the segments 1 and 2 apparently incomplete, basal segment border, apical segment short and rounded. Maxillule with 4 strong slightly recurved apical spines. Bilobed maxilla, inner and outer lobes with minute scales, inner median lobe with 1 and outer lateral lobe with two small spines. Maxilliped similar to female, the apical segment with 2 large terminal recurved spines and five small recurved spines on lateral margin.

Pereopods gradually increasing in size from 1 to 7. Penes visible on sternite 7. Pleopods not distinctly visible in dorsal view. Pleopod 2 with appendix masculine, shorter than endopodite, straight, tapering gradually to narrowly rounded apex. Rami of all pleopods lamellar, endopod slightly smaller than exopod; peduncles of pleopods expanded laterally into rounded lobes with few reduced setae. Exopods of pleopods 3–5 with triangular proximo-lateral lobes. Uropods slightly longer than pleotelson, reaching slightly beyond the distal

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margin of pleotelson; rami unequal in length, curved and apically rounded, exopod longer than endopod.

Body size: Ovigerous females (16–24 mm), male (8–13 mm).

Color: Female and male tan in a fresh state.

Distribution: From Kuwait (Bowman and Tareen (1983), Chennai Coast (Satyanarayan 2012), Muttom (Rameshkumar et al. 2013), Nagapattinam Coast (Rameshkumar et al. 2016), from Malabar Coast, Arabian Sea, India (Aneesh et al. 2015a).

Hosts: Bowman and Tareen, (1983) collected this species from *Ilisha indica* (= *Ilisha melastoma*) and *Terapon puta* Cuvier, 1829 (= *Terapon puta*) (Terapontidae). *Pellona ditchela* (Satyanarayan 2012). It was previously collected from the type host *Ilisha melastoma* from India (Rameshkumar et al. 2013; Aneesh et al. 2015a).

Joryma brachysoma (Pillai, 1964)

Agarna brachysoma Pillai, 1964

Joryma brachysoma—Bowman and Tareen 1983.

Catoessa gruneri—Anandkumar et al. 2017: 55–60, Fig. 2f.

Norileca indica—Ravichandran et al. 2009: 8–84, Figs. 1 and 2.

Catoessa boscii—Ravichandran, Rameshkumar and Balasubramanian, 2010: 97–98, Fig. 1.

Unconfirmed report: *Joryma brachysoma*—Veerappan and Selvamathi 2009.

Type and type locality: Pillai (1964) collected several specimens from the gill chamber of *Pellona brachysoma* Bleeker, 1852 (= *Sardinella brachysoma* Bleeker, 1852) from Trivandrum, Kerala Coast, Arabian Sea. The author reported that the holotype female is deposited in the Indian Museum but unfortunately, Pillai (1964) did not mention the registration particulars of the holotype. Inquiries at the Indian museum failed to disclose any material that could be definitely identified, or undeniably even potentially considered as the type material for *J. brachysoma*. As there are no museum records, it seems that the types were either not deposited or they are lost/destroyed.

Distribution: Collected from Trivandrum, Kerala Coast, Arabian Sea (Pillai, 1964).

Hosts: *Pellona brachysoma* Bleeker (= *Sardinella brachysoma*) Pillai (1964).

Remarks: Pillai (1964) described *Agarna brachysoma* according to several specimens collected from Trivandrum, Kerala Coast, Arabian Sea, from the type host. Later, Bowman and Tareen (1983) placed this species under the genus *Joryma.* The subsequent reports of *Joryma brachysoma* are either misidentification or unconfirmed records; Anandkumar et al.'s (2017) figure of *Joryma brachysoma* (Pillai 1964) from the host *Netuma bilineata* (Valenciennes, 1840) is a misidentification and refers to *Catoessa gruneri* Bowman and Tareen, 1983 based on the morphology. Similarly, Ravichandran et al.'s (2009) figure of *Joryma brachysoma* (Pillai, 1964) from the host *Rastrelliger kanagurta* (Cuvier, 1816) from Southwest Coast of India is also a misidentification and refers to *Norileca indica* (H. Milne Edwards, 1840). Ravichandran et al.'s (2010) figure of "*Joryma brachysoma*" in the buccal cavity of *Rastrelliger kanagurta* (Cuvier) refers to *Catoessaboscii* (Bleeker, 1857). Further, the report of Veerappan and Selvamathi (2009) is not confirmed, in view of the fact that, they failed to provide any relevant data for their claim. In fact, this species was not reported since its original description by Pillai (1964).

Joryma tartoor (Pillai, 1954).

Agarna tartoor Pillai, 1954: 16—Pillai 1964: 211–223.

Joryma tartoor—Bowman and Tareen 1983

Norileca indica—Ravichandran et al. 2010: 97–98, Fig. 3.

Type and type locality: Pillai (1954) collected specimens from the gill chamber of *Opisthopterus tardoore* (Cuvier, 1829) from Trivandrum, Kerala Coast, Arabian Sea. The author reported that the holotype female is deposited in the Indian Museum but Pillai (1964) and the detail of the accession number is not available in the original description. The present museum inquiries, at the Indian museum, failed to recover any material for *J. tartoor* and it seems that the types were either not submitted or it was lost.

Distribution: Trivandrum, Kerala Coast, Arabian Sea (Pillai, 1954, 1964).

Hosts: *Opisthopterus tardoore* (Cuvier, 1829) .

Remarks: Pillai (1954) described this species as *Agarna tartoor*, based on several specimens collected from Trivandrum, Kerala Coast, Arabian Sea, from the type host. Subsequently, Pillai (1964) provided a description of the female, male, and manca larva. Later, Bowman and Tareen (1983) transferred this species to the genus *Joryma.* After its original description and subsequent redescription by Pillai (1964), there have been no other confirmed reports of this species from anywhere. According to Pillai (1954, 1964), the holotype female is deposited in the Indian Museum, though unfortunately, the type is not present in the Indian Museum. It seems that, inevitably, the types were either not submitted or got lost. The records of *Joryma tartoor* by Ravichandran et al. (2010) was a misidentification. Ravichandran et al's figure (Fig. 3) of *Joryma tartoor* in dorsal and ventral view is a misidentification and it refers to ventral view (female and male) and dorsal view (female and male) of *Norileca indica* (H. Milne Edwards, 1840).

Discussion

Joryma can be recognized by the expanded anterior coxa 1 and the morphology of the mandibular palp; the brood pouch in *Joryma* is formed by four pairs of overlapping oostegites

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arising from the bases of pereopods 2, 3, 4, and 6; 2nd oostegite small, 6th largest, 4th and 3rd medium, and posteriorly covered by a pocket formed from sternite. The male stages of *Joryma* can be distinguished by the symmetrical body; cephalon not immersed in pereonite 1, mandible palp 3-segmented or separation between the segments 1 and 2 incomplete, the size of pereopods gradually increasing from 1 to 7, penis visible on sternite 7, appendix masculine of pleopod 2, straight, and slightly shorter than endopodite.

Other similar branchial cymothoid genera differ from *Joryma* in the following characteristics: *Agarna* Schiödte and Meinert, 1884: the posterior pereon is much-elevated mid-dorsally, and pereonites 4–7 are greatly expanded laterally; antennae 1 are narrowly separated at their bases, and the mandibular palp is not enlarged (Bowman and Tareen 1983); *Catoessa* Schiödte and Meinert, 1884: pleon narrow, not immersed into pereon; all pleonites visible, pleonite 1 narrower than pleonite 2, pereopods 1–7 without carina on basis and dilated merus, or with slender carina on basis 6–7 (Trilles et al. 2012); *Ryukyua* Williams and Bunkley-Williams, 1994: body nearly as wide as long, coxa shorter than respective pereonites, distal article of mandibular palp very short compared to other articles and apex rounded, pleon narrower and deeply immersed in pereon (Williams and Bunkley-Williams 1994); *Elthusa* Schiödte and Meinert, 1884*:* body weakly vaulted, coxae equal size on both sides, maxilliped palp article 3 slender and with few setae; pereopods with relatively short dactylus, pleonite 1 as wide as or slightly narrower than pleonite 2; cephalon posterior margin not trilobed; pleon wide; antennule shorter than antenna, bases not in contact (varying from close together to wide apart); all pleopods simple and lamellar (Bruce 1990; Hadfield et al. 2017); *Mothocya* Costa in Hope, 1851: body asymmetrical, antennule longer than the antenna, maxilliped with oostegite lobe in ovigerous female, males are smaller and not twisted, with appendix masculine on pleopod 2 (Bruce 1986); *Norileca* Bruce, 1990: coxae of about equal size on both sides, brood pouch with posterior pocket, at least endopod of pleopod 5 with prominent lobes, pleonites 1 and 2 without ventro-lateral processes; uropods not extending beyond posterior of pleotelson (Bruce 1990).

Species of *Joryma* are restricted mainly to clupeiform hosts, with the exception of *Joryma sawayah* Bowman and Tareen, 1983 known from the perciform fish *Terapon puta* (Terapontidae). *Joryma* species show different levels of host specificity towards clupeiform fishes. Four species of *Joryma*, including the new species, are only known from the type host; *Joryma engraulidis* (Barnard, 1936) from *Thryssa setirostris* (Engraulidae), *Joryma brachysoma* (Pillai, 1964) from *Sardinella brachysoma* (Clupeidae), *Joryma tartoor* (Pillai, 1954) from *Opisthopterus tardoore* (Pristigasteridae), and *Joryma malabaricus* sp. nov. from *Escualosa thoracata* (Clupeidae). The remaining two species of *Joryma* show oligoxenous host specificity; *Joryma sawayah* Bowman and Tareen, 1983 is known from two hosts, *Ilisha melastoma* (Pristigasteridae) and *Terapon puta* (Terapontidae), and *Joryma hilsae* Rameshkumar, Ravichandran and Trilles, 2011 recorded from four host fishes including two clupeid fishes *Sardinella* sp. and *Hilsa kelee*, one engraulid fish *Stolephorus commersonnii* and a pristigasterid fish *Pellona ditchela*.

All five species of *Joryma* are described from India, with the exception of *J. sawayah* from Kuwait. *Joryma* spp. show unique site-specific parasitization; large ovigerous females are attached to the inner wall of the operculum, close to the postero-dorsal corner of the gill chamber with the body upside down; juvenile males are attached to the opposite gill chamber more or less in the same position.

***Joryma malabaricus* sp. nov.**: The new species is easily distinguished from other known species of *Joryma* by several morphological characteristics: the cephalon is conspicuous dorsally and extending beyond the pereonite 1 expansion; pereonite 1 anterolateral expansion unilateral, not bilobed; pleonites 1 and 2 laterally overlapped; pleotelson triangular; uropod rami unequal, exopod slightly longer than endopod; mandibular palp not segmented in female (in male incomplete three segment), maxilliped palp with four recurved spines. Hunching of the female body is either toward left or right according to their occupation in the branchial cavity; if the parasite is located in the right branchial cavity; its body bends toward the left and vice versa.

Joryma engraulidis (Barnard, 1936): The *J. engraulidis* can be easily distinguished from other known species within the genus by the following characteristics, body 1.4–1.6 times longer than wide, cephalon conspicuous dorsally and reaching beyond pereonite 1 expansion, pereonite 1 anterolateral expansion unilateral and not bilobed, pleonites not overlapped, pleotelson broadly rounded, uropod rami unequal, mandibular palp 3-segmented. The type material of *J. engraulidis* was either not submitted or it was lost/destroyed and we have designated a neotype for *J. engraulidis* by fulfilling all the ICZN criteria.

Joryma hilsae Rameshkumar, Ravichandran, and Trilles, 2011: Rameshkumar et al. (2011) described this species based on the ovigerous female; the present study provided a detailed description of the male. The characteristics of female of this species are as follows: body 2–2.3 times longer than wide, cephalon conspicuous dorsally and reaching the margin of pereonite 1 expansion, pereonite 1 anterolateral expansion bilateral and slightly bilobed, pleonites not overlapped, pleotelson broadly rounded, uropods rami equal mandibular palp 3-segmented, antenna with 9 articles, maxilliped with 4 recurved spines. Akin to that of other *Joryma* species, the body twisting of the female is either toward left or right according to their occupation of the branchial cavity respectively.

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Joryma sawayah Bowman and Tareen, 1983: The type species for the genus was first described by Bowman and Tareen (1983) and was subsequently reported from India by Rameshkumar et al. (2013, 2016) and Aneesh et al. (2015a). In the present study, we have redescribed the species while incorporating details from the male and female stages. *Joryma sawayah* is readily identifiable from the cephalon exposed dorsally and not reaching the margin of pereonite 1 expansion, pereonite 1 anterolateral expansion bilateral and distinctly bilobed, pleonite 1, 2 and 3 overlapped laterally, pleotelson triangular, uropods rami unequal, mandibular palp not segmented.

Joryma brachysoma (Pillai, 1964): Based on Pillai's (1964) description, the species can be easily distinguished from other species of *Joryma*by with the following characteristics: cephalon exposed dorsally; not reaching the margin of pereonite 1 expansion, pereonite 1 anterolateral expansion bilateral and slightly bilobed. Pleonite 1 entirely overlapped and not visible in dorsal view. Pleonites overlapped pleotelson round-triangular, uropods rami unequal, mandibular palp distinctly 3-segmented. Until now the identification of this species is based only on Pillai's original description and it needs an accurate redescription.

Joryma tartoor (Pillai, 1954): As for *J. brachysoma*, the identification of *Joryma tartoor* is also based on the original description by Pillai (1954) and subsequent description by Pillai in 1964 and this species needs an accurate redescription. The species (*J. tartoor*) can be easily distinguished from other species of *Joryma* by the following characteristics: Cephalon covered dorsally by pereonite 1 expansion, pleotelson acutely triangular, pereonite 1 anterolateral expansion bilateral and slightly bilobed, pleonite 1 and 2 overlapped laterally, pleotelson acutely triangular, uropods rami unequal, mandibular palp incompletely 3 segmented. Antenna with 9 or 10 articles, maxilliped with 4 recurved spines.

In the present study, we could not collect or examine any specimen of *Joryma tartoor*. There is a need for a neotype designation for both *Joryma brachysoma* and *Joryma tartoor*, in order to conserve the name and species identity. In the present study, even though we have examined the type host of both species, we could not get any specimens for these species.

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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.

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