Haplomunnidae (Crustacea: Isopoda) reviewed, with a description of an intact specimen of *Thylakogaster* Wilson & Hessler, 1974

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Abstract

The distribution and ecology of the isopod family Haplomunnidae Wilson, 1976 are reviewed with new records given for *Thylakogaster* Wilson & Hessler, 1974, Mid-Atlantic Ridge and east Pacific Ocean, and for *Munella* Bonnier, 1896, Mid-Atlantic Ridge and the eastern Atlantic near the African coast. The specimens of these two genera, collected from Lucky Strike (Mid-Atlantic Ridge), are the first record of the family from hydrothermal vent habitats. The systematics of the Haplomunnidae is updated and the synonymy of *Aryballurops* Gamô, 1983 with *Haplomunna* Richardson, 1908 is proposed. *Thylakogaster lobotourus* Wilson & Hessler, 1974 is redrawn from the first known intact specimen and additional description of the appendages is provided.

Key words: Crustacea, Isopoda, Asellota, Haplomunnidae, *Haplomunna, Thylakogaster, Munella*, Mid-Atlantic Ridge, hydrothermal vents

Introduction

The isopod family Haplomunnidae Wilson, 1976 is a rare but widespread component of deep-sea communities. Unfortunately, long-limbed Haplomunnidae are rarely recovered undamaged, frequently appearing in deep-sea grab or dredge samples as badly damaged, appendage-free carcasses. Recent collections from the Lucky Strike vent field (Mid-Atlantic Ridge) yielded two nearly intact specimens of *Thylakogaster lobotourus* Wilson & Hessler, 1974, an incompletely described species. These specimens verify the original concept of the genus, as well as providing new records of these morphologically unusual deep-sea species. In this paper, we illustrate one intact specimen, provide new records for undescribed species, and review the taxonomy, distributions and ecological settings of the Haplomunnidae.
The Haplomunnidae comprises four genera characterised by their axially compressed, deep body and long-legged ambulatory habit with an epibenthic life style (Wilson 1976). The first records of specimens (*Thylakogaster* Wilson & Hessler, 1974 and *Abyssaranea* Wilson & Hessler, 1974) from this family were mainly from abyssal equatorial and South Atlantic waters. Their similarities to *Munella* Bonnier, 1896, a genus previously known from the continental margins of France (Bay of Biscay) and Italy (Bay of Naples), were recognised at that time (Wilson & Hessler 1974). The family Haplomunnidae Wilson, 1976 was based on the genus *Haplomunna* Richardson, 1908 recorded from abyssal East Pacific waters. Collections from the Japan Trench (Gamô 1983) and from the epifauna of hexactinellid sponge stalks (Beaulieu 2001a, 2001b) have demonstrated that species of this family can be found in environments that span a wide range of available ecosystems in the deep-sea.

Although the Lucky Strike vent field has been the target of several oceanographic expeditions and experimental in situ studies, the sampling effort has been focused mainly in the most active areas of the field (Desbruyères et al. 1994, 2001; Van Dover et al. 1996; Colaço et al. 2002). Of the 473 species listed by Desbruyères & Ségonzac (1997), 159 are Crustacea, with a majority being copepod species (37.1%), followed by conspicuous decapods (28.3%). Other groups appear to have been understudied or overlooked (only two tanaid and eight amphipod species), and the isopod fauna remains almost unknown (six species). During a geological survey carried out in August 2000, a TV-assisted grab was used to take 24 samples mostly from inactive areas of the field. Over 4000 specimens were collected and ascribed to 92 different taxa, including 13 isopod species and 29 other crustacean species (Cunha et al. 2001). The recently collected specimens of Haplomunnidae from the Lucky Strike hydrothermal vent system are the first record of the family from this unusual habitat.

**Abbreviations**

AM, Australian Museum, Sydney; AMORES, Azores Mid-Atlantic Ridge Ecosystem Studies; CENTOB, Centre de tri d’océanographie biologique (Ifremer, Environnement Profond, Brest); DBUA, Departamento de Biologia da Universidade de Aveiro, Aveiro; Ifremer, Institut Français de Recherche pour l’Exploitation de la Mer, Brest; IOC, Intergovernmental Oceanographic Commission; MNHN, Muséum national d’Histoire naturelle, Paris; NOAA, US National Oceanographic and Atmosphere Administration; PRA, Preservational Reserve Area; SIO, Scripps Institution of Oceanography; TTR, Training Through Research Program; UNESCO, United Nations Educational, Scientific and Cultural Organization; USNM, United States National Museum of Natural History; WHOI, Woods Hole Oceanographic Institution; SMBA, Scottish Marine Biological Association; ZMUC, Zoologisk Museum, University of Copenhagen, Denmark.
TABLE 1. Localities of Haplomunnidae. Many samples are too poor a state for description, or have too few individuals, so are indicated by species undefined (sp.) or by a species number. Positions of samples with different beginning and ending latitudes or longitudes are given as midpoint positions. An asterisk (*) indicates the type locality for each species. W&H74 = Wilson & Hessler 1974

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Material and methods

Study site: The Lucky Strike segment is located at the Mid-Atlantic Ridge (MAR) southwest of the Azores (Fouquet et al. 1994). The hydrothermal field, centred at 37°17.5’N, 32°16.5’W, is one of the largest currently known in the MAR and develops around a lava lake at approximately 1700 m in a depression surrounded by three volcanic cones. The lava lake, the first discovered in a slow spreading ridge (Fouquet et al. 1995) is characterised by typical lobated and draped lavas, lava flows and lava pillars. The volcanoes are mostly composed of pillow lavas and volcanic breccia. Many chimneys and other edifices, most of which are inactive or only mildly active, surround the lava lake. Near large chimneys, diffuse venting occurs through unconsolidated sediments. Further information on the geological setting and environmental conditions in the vent field can be found in Costa et al. (1995), Langmuir et al. (1997) and Barriga (1999).

Source of specimens: (Table 1). Specimens from Lucky Strike were collected during geological surveys of the vent field (2000 and 2002) by a joint program of the Geological and Mining Institute of Portugal, Moscow State University and University of Aveiro (TTR-10 and TTR-12, IOC-UNESCO). Michel Ségonzac (EP/CENTOB-Ifremer) provided a sample from Lucky Strike collected during the 1998 PICO expedition (AMORES program, EU MAST III; D. Desbruyères, chief scientist). This latter specimen was collected in colonisation trays (SMAC) deployed by submersible in the vicinity of a black smoker (Tour Eiffel) and recovered after a period of 321 days (D. Desbruyères, personal communication). A series of deep benthic sampling transects in basins of the Atlantic Ocean, conducted by WHOI under the direction of Howard Sanders, Robert Hessler and J. Frederick Grassle, provided most of the original specimens described by Wilson & Hessler (1974). Additional specimens came from the following oceanographic programs: 1984 BALGIM (MNHN; P. Bouchet, chief scientist) from the eastern Atlantic off Africa; South
Tow (SIO; R. Hessler, chief scientist) in the equatorial Pacific; ECHO1 (SIO; Wilson & Hessler 1987; Thistle & Wilson 1996) and PRA (SIO; Wilson 1990; Thistle & Wilson 1996) in the North Pacific between the Clipperton and Clarion Fracture Zones; Station M (SIO; Beaulieu 2001a, 2001b) at abyssal depths off the southern California Borderland of the USA; and the Sigsbee Abyssal Plain in the Gulf of Mexico (Rowe 2003).

Systematics
Suborder Asellota
Family Haplomunnidae Wilson, 1976

Dendrotionidae Wolff, 1962: 64 (part).

Type genus. Haplomunna Richardson, 1908.

Diagnosis (modified from Wilson 1976): Head without eyes, anteriorly rounded, dorsal surface sloping anteriorly, lacking anterior margin. Body with spines, dorsally vaulted, posterior pereonites axially compressed and reduced. Female spermathecal duct emerging anterodorsally near margin of pereonite 5. Anus covered by opercular pleopods. Antennula inserting dorsally on head, sexually dimorphic, with many flagellar articles and aesthetascs in male, and fewer and thinner articles in female. Antenna inserting anterodorsally, basal articles robust, article 3 without scale. Mandible palp (when present) elongate, longer than body of mandible, article 3 elongate with elongate setae only on distal tip. Pereopod I with major subchelate hinge between carpus and propodus; carpus palm (ventral margin) robust, with elongate robust setae. Pereopods II–VI and VII, if present, longer than body. Male pleopod II protopod strongly tapering and narrow distally; exopod lacking setose posterior projection. Pleopod III exopod biarticulate, narrower and longer than endopod, without plumose setae. Uropods emerging at pleotelson ventral margin; uniramous; tiny, not extending beyond terminal margin of pleotelson.

Relationships: The family Haplomunnidae was argued by Wilson (1976) to be the sister group of the Dendrotiidae, and not closely related to Munnidae, Santiidae or Paramunnidae. The primary similarities between the former two families include general body spinosity, vaulted thoracic region, compact anteriorly-sloping emarginate head capsule with antennae and antennulae placed on anterodorsal surface, and elongate pereopods II–VII that exceed the body length. While not fully consistent among species in both families, the ischium and merus of the walking legs are often subequal and shorter than the basis. Notably, the opposite situation occurs among the Munnidae, where the basis is often shorter than the ischium. Although Acanthomunna Beddard, 1884 is somewhat similar in body form to Haplomunna, male dendrotiids have a setose posteriorly-directed appendage on exopod of pleopod II, an apomorphy of the family. Tiny marginal uropods are an apo-
morphism of the Haplomunnidae, although reductions of the uropods are common among other deep-sea isopod taxa. Some, but not all, members of both families share the hetero-
chronic non-expression of the last pereonite. This oddity also occurs among other deep-sea families (e.g., Munnopsidae, Ischnomesidae), so its phylogenetic significance is limited to those clades that reach adulthood without the last pereonite.

Regarding higher-level relationships, Wägele (1989), partially following Wolff (1962), suggested that the asellotan families Munnidae, Santiidae (as Pleurocopidae), Dendrotiidae and Haplomunnidae were related in a group referred to as ‘munnoiden’, or as having a ‘munnoid habitus’. The sister group relationship between the Dendrotiidae and the Haplomunnidae, as discussed above, was not in dispute, but the principal difficulty with Wägele’s (1989) hypothesis lies in the underlying assumption of similarity of body form (Wilson 1996). In Wägele’s (1989: 67) concept, the munnoid habitus includes the following features: an approximately oval body outline, in which the middle pereonites are somewhat broader than the anterior or posterior segments, head broader than long, eyes laterally projecting and often clearly stalked, pereonites 5 to 7 not only narrower but also shorter than the anterior pereonites, pleotelson dorsally convex, and at its origin somewhat narrower, distally rounded and often spindle-like. Other than the stalked eyes, most of these features are seen throughout the Janiroidea, especially among the deep-sea families. Acanthomunna is the only genus with eyes among the Dendrotiidae or the Haplomun-
nidae, but only has rounded lateral projections, somewhat similar to those seen among some Janiridae and clearly unlike the stalked eyes of the presumptive ‘munnoiden’ clade. Although not fully relevant here, the form of the stalked eyes (where present) varies consistently between the eyed families: short, thick and generally with many ocelli among the Munnidae and Santiidae, elongate and often with few ocelli among the Paramunnidae and extremely elongate and thin, with few ocelli in Pleurocope, which belongs to its own sepa-
rate family, Pleurocopidae. The ‘munnoiden’ are unlikely to be a cohesive phylogenetic group because different taxa have different positions for the spermathecal duct and config-
urations of pereopod I (Wilson 1987; personal observation). Additionally, antennae in Paramunnidae, Munnidae and Santiidae, and Pleurocopidae all insert anteroventrally, but with differing positions among the three groups; Haplomunnidae and Dendrotiidae have antennae inserting anterodorsally, often on projections of varying sizes. Other features, such as the above-mentioned comparative lengths of the pereopodal podomeres, also differ considerably among these families. Clarification of the haplomunnid classification will require detailed morphological study and phylogenetic analysis of all families of Janiroi-
dea.

**Distribution:** Although Kussakin (1988), in his useful compendium of the isopods of the Northern Hemisphere, characterised the Haplomunnidae as an equatorial and Southern Hemisphere group and only listed the equatorial Atlantic species *Thylakogaster peterpauli* Wilson & Hessler (1974), recent records (Table 1, Figure 1) indicate that this family is much more widespread than previously suspected, and clearly not limited to equatorial
regions. Species of *Haplomunna* are known from abyssal and hadal waters of the North Pacific, off southern and Baja California (Wilson 1976; Beaulieu 2001a, 2001b) and the Japan Trench (Gamô 1983) from depths of 3880 to 6450 m. *Thylakogaster* has the broadest distribution from depths of 1135 m to 5223 m, including the equatorial Atlantic, Argentine Basin, north of Surinam, Bermuda slope, off Ireland, in the Rockall Trough (Harrison 1988) and in the east Pacific (Thistle & Wilson 1987). New records include the Lucky Strike vent field on the Mid-Atlantic Ridge, and the east Pacific Ocean. *Abyssaranea* has been found at depths from 3459 to 4438 m in the equatorial Atlantic and East Pacific, as well as a new record from a Woods Hole Oceanographic Institution deep-benthic station in the northwestern Atlantic. This latter record is the first non-equatorial record for this genus. *Munella* has most records in the bathyal deep sea (950–2076 m) including the Bay of Biscay, the Bermuda Slope and north of Surinam in the Atlantic. Unconfirmed records of *Munella* in the central Mediterranean are from depths of 100–200 m (Bay of Napoli; Lo Bianco 1903). *Munella* also occurs at abyssal depths in the east Pacific (4797 m, Thistle & Wilson 1996). New records of *Munella* include Lucky Strike vent field on the Mid-Atlantic Ridge (1685 m, TTR-10), the eastern Atlantic near the African coast (1175–1283 m, BALGIM stations), and the Gulf of Mexico (3732 m., Rowe 2003). A new species and new genus of Haplomunnidae collected by Poore et al. (1994) occurs in southeastern Australia at bathyal depths (J. Just, personal communication).

**Habitat and Ecology:** All Haplomunnidae have long-legged ambulatory morphologies, and are unlikely to be burrowers. Because they are primarily epibenthic and exposed to erosion, they are not likely to be found at high energy sites. This family has not been recorded from the HEBBLE (high energy benthic boundary layer experiment) sites (Thistle & Wilson 1987, 1996), and haplomunnid species are a reasonably consistent member of benthic assemblages at quiescent sites. In the Clipperton-Clarion Fracture Zone region of the East Pacific, a region characterised by low abyssal hills, pelagic clay and manganese nodules, *Thylakogaster* has been found at the ECHO 1 site (Thistle & Wilson 1987) and *Munella* at the PRA site (Wilson 1990; Thistle & Wilson 1996). The recorded substrates for haplomunnids range from typical deep-sea sediments to rocky outcrops, manganese nodules and carbonate crusts. Several Atlantic records are from continental margins in muddy sediments (Bonnier 1896), sand and volcanic gravel (Lo Bianco 1903), mixed *Globigerina* and pteropod oozes (Bermuda slope; Wilson & Hessler 1974). We now report them from hydrothermal vents (Lucky Strike) including a high temperature, diffuse venting area. In this case, the *Thylakogaster* specimens were collected on volcanic rocks (hyaloclastic breccia and pillow lavas) in the vicinity of active venting areas and in colonisation trays deployed near black smokers in the SE part of the field, while *Munella* specimens were collected on fragments of inactive chimneys in the NW part of the field. Biogenic structures appear to be favoured, because *Haplomunna* sp. was found highly aggregated on *Hyalonema* sponge stalks (Beaulieu 2001a, 2001b).
Like most deep-sea isopods, the trophic habit of Haplomunnidae species appears to be mostly detritivory. *Haplomunna* sp., found on the basal and middle portions of hexactinellid sponge stalks, may be feeding upon particles accumulating in pockets (Beaulieu 2001a). *Thylakogaster* species have elongate and setose pereopods II–III that may be used to search for food in the sediments or catching suspended particles. These legs on preserved specimens are generally held with the carpus and propodus curving under the mouth field and the first pereopods, like a basket.

**Genus Haplomunna Richardson, 1908**

*Munna* Richardson, 1905: 483 (part).


Type species. *Munna caeca* Richardson, 1905, by monotypy.

Species included: *Haplomunna caeca* (Richardson, 1905); *Haplomunna hubbsi* Wilson & Hessler, 1976; *Haplomunna japonica* (Gamô, 1983).
Diagnosis (modified from Wilson 1976): Head rounded in dorsal view; depth and width less than pereonite 1, with distinct frons-clypeal ridge, antennae on low projection. Body ovate in dorsal view, vaulted in lateral view; surfaces and margins spinose, with two distinctly different sizes of spines: large robust spines, often on raised portions of the cuticle, and small thin spines (‘stiff hairs’ in Richardson 1905), pereonites 5–7 with spines only on lateral edges, dorsal surfaces smooth. Pereonites 1–4 sculptured, dorsal surfaces often with parallel transverse ridges arching across dorsum; lengths subequal. Female coxal developing oostegites external to sternal surface. Pereonites 5–7 dorsomedial axis compressed; lateral portions extending posteriorly beneath elevated pleotelson. Preparatory female with external developing oostegites. Pleotelson longitudinal axis nearly perpendicular to pereonal axis; inflated, width subequal to pereonite 5 width, somewhat bilobed anterodorsally, heart shaped in dorsal view; distal tip smooth, produced ventroposteriorly. Mandible molar process truncate with two distal ridges: distal ridge finely denticulate; proximal ridge with inner row of stout spines, and outer row of long sharp, minutely serrate spines; palp elongate, longer than body of mandible, article 1 longer than articles 2–3, article 3 subequal to article 2, with elongate setae in group at distal tip. Maxillipodal palp with segment 2 distinctly broader, segment 3 only slightly broader than segment 1. Pereopod I strong, subchelate; carpus somewhat elongate; distinct rows of many stiff unequally bifid setae on occlusive margins of both carpus and propodus. Pereopods II–VII similar to each other. All pereopods with two dactylar claws. Opercular pleopods with strong spines. Uropod tiny, uniarticulate, directed ventroposteriorly.

Remarks: We propose a synonymy of Haplomunna Richardson, 1908 and Arybalalurops Gamô, 1983. The species H. japonica differs from the East Pacific species H. caeca and H. hubbsi in having a much more inflated pleotelson, but in all other respects, the three species are similar. Gamô (1983) provides the first description of a male in the Haplomunna clade, details of which we can confirm from specimens of an undescribed species provided by S. Beaulieu (SIO). In particular, the tip of the male pleopod I is rounded and not laterally produced (i.e., not saggitate) as in Thylakogaster, thus having a form more like that of Abyssaranea or Munella. An elongate mandibular palp, another similarity with the latter two genera, and the less modified form of pereopods II–VII clearly separates Haplomunna from Thylakogaster. Nevertheless, Thylakogaster and Haplomunna are similar in several respects, the most conspicuous being the reflexed and inflated pleotelson.

Genus Thylakogaster Wilson & Hessler, 1974


Type species. Thylakogaster peterpauli Wilson & Hessler, 1974, by original designation.

**Diagnosis** (modified from Wilson & Hessler 1974): Head laterally angular or curved in dorsal view; with transverse ridge and frons-clypeal furrow; depth subequal or greater than pereonite 1. Body with many thin-walled spines or spinules, including cuticle of dorsolateral sides of head, lateral and posterior sides of pleon, and external surfaces of pleopods 1 and 2; spines also on coxae, lateral margins of pereonites 1 and 2; dorsum of pleon devoid of such spines. Female developing oostegites on coxae internal to sternal surface. Pleotelson strongly inflated, hollow, expanded dorsally and laterally into somewhat bilobed form, reflected anteriorly, lying above pereonites. Mandible without palp; molar process tapering distally into tuft of thin, curved spines. Maxilliped epipodite triangular, small, width less than basis width, length less than half basis length. Pereopods II and III elongate, distinctly longer than head–pereon length; carpus and propodus curving medially, strongly opposing each other, combined lengths exceeding two-thirds total pereopod length, with large curved setae; dactylus short, covered with fine cuticular hairs, with single claw. Pereopods IV–VII longer than pereopods II and III, more slender and straight, with smaller setae and with long, slender claw and second vestigial claw on dactylus. First pleopod copulatory male posterior margin sagittate. Uropods uniarticulate, positioned ventroposteriorly close to tip of pleon.

**Thylakogaster lobotourus** Wilson & Hessler, 1974 (Figs. 2–3)

*Thylakogaster lobotourus* Wilson & Hessler, 1974: 56–58, fig. 4.

**Type material.**— NW Atlantic: Bermuda Slope, southeast of northern tip of the Bermuda Islands, 32°19’N, 64°32’W, 1135–1153 m, stn WHOI 118a, holotype 1 copulatory male (USNM 141471), paratypes 1 immature female (USNM 141472) and 2 copulatory males (ZMUC).

**Material examined.**— Mid-Atlantic Ridge: Lucky Strike, 37°17.36’N, 32°16.49’W, 1695 m, Submersible *Nautilus*, colonisation tray, stn PICO SMAC C6, 6.VII.1998, D. Desbruyères, 1 female (illustrated herein) head–pereon length 1.46 mm (CENTOB). Same locality, 37°17.44’N, 32°16.60’W, 1685 m, RV *Prof. Logachev*, TV-assisted grab, stn TTR-10 AT-265-Gr, 10.VIII.2000, M.R. Cunha, 1 manca IV–V head–pereon length 1.24 mm (DBUA). Same locality, 37°17.30’N, 32°16.56’W, 1709 m, RV *Prof. Logachev*, TV-assisted grab, stn TTR-12 AT-436-Gr, 29.VIII.2002, M.R. Cunha, 1 female head–pereon length 3.07 mm, and 1 anterior fragment. NW Atlantic: Bermuda Slope, southeast of northern tip of the Bermuda Islands, stn WHOI 118a (type locality), 14 individuals or fragments, most in poor condition (AM P64368); 32°16’N, 64°32’W, 2095–2223 m, stn WHOI 119, 1 individual, pleotelson only (AM P64369).
FIGURE 2. *Thylakogaster lobotourus* Wilson, 1974, female; A, habitus, lateral view (scale bar 1 mm); B, base of antennula and antenna, dorsal view; C, tip of antennula; D, left uropod, lateral view; E, pleopod II, ventral view.
FIGURE 3. *Thylakogaster lobotourus* Wilson, 1974, female; **A**, pereopod I, lateral view; **B** pereopod I, mesial view; **C**, dactylus, pereopod II; **D**, dactylus, pereopod IV; **E**, dactylus, pereopod V; **F**, head, lateral view (scale bars: **A–B**, 0.1 mm; **C–E**, 0.1 mm; **F**, 0.5 mm).
Supplementary description: Female (Figs. 2–3): Head–pereon length 1.46 mm measured laterally. Antennula with 11 articles, article 1 with 2 penicillate setae, article 2 with 1 penicillate seta, article 4 with 1 penicillate seta, all located distally; article 3 length 1.6 article 2 length; article 4 length 0.28 article 2 length (proportions similar to *T. peterpauli* and *T. majusculus*). Antenna length 2.6 head–pereon length; article 5 length 2.5 articles 1–4 length altogether; article 6 length 1.7 article 5 length, both articles bearing numerous long setae; flagellum length 0.30 article 6 length, with 10 articles. Pereopod I basis length 2.3 width; ischium with 5 ventral setae, 2 dorsal setae; merus with 3 ventral setae, 1 dorsal seta, 4 medial setae; carpus length approximately 2 width, slightly longer than basis, with 11–12 setae on ventral margin, with 5–6 short stout setae distal to large central seta, proximal medial surface with 10 setae in two rows; dactylus length approximately 0.85 propodus length. Pereopod II long, length 2 head–pereon length; basis length approximately 3 width; propodus slender and curved, length approximately 15 width; both carpus and propodus with numerous setae arising from short cuticular protuberances, setae largest on occlusive margin on carpus and lateral and medial side of propodus; dactylus length 0.2 propodus length, with 1 claw. Pereopod III shorter than but similar to pereopod II. Pereopods IV–VII less robust and longer than pereopod II, length approximately 1.1 pereopod II length; basis width approximately 0.8 pereopod II width; propodus and carpus approximately two-thirds total pereopod length; propodus slender, length 1.4 carpus length (somewhat longer in pereopod VII); propodus with long robust mediiodistal seta at dactylar insertion.

Remarks: Although the Lucky Strike specimens are distant from the original Bermuda Slope type locality of *T. lobotourus*, we found no differences that require the establishment of a new species. These new specimens suffered some bending and twisting of their thin legs, so the whole body illustration (Fig. 2A) was made by merging several views of the limbs to obtain an approximation of the ‘natural’ condition.

Males and juvenile specimens (mancas or females) of *Thylakogaster* species have usually one or two pairs of setae on the distal margin of pleotelson (between the uropods), and indentations of the margin; mature females lack these setae or indentations. Our observations on *Thylakogaster* specimens held at the Australian Museum show the following patterns: *T. lobotourus* WHOI 118a (AM P.64368), female no setae, male two pairs of setae; *T. lobotourus* Lucky Strike female, one pair of setae and indentations (Fig. 2D); *T. majusculus* WHOI 242a (AM P.64371), juvenile female no setae, male two pairs of setae and indentations; *T. peterpauli* WHOI 155 (AM P.64372), small male several small setae, female no setae, both with abundant cuticular hairs and no indentations; *T. n. sp.1* WHOI 303 (AM P.64373), manca two pairs of setae. The cuticle of *T. peterpauli* has fine spines, especially on the pleotelson, that are missing in *T. lobotourus*.

We have observed several differences between species of *Thylakogaster*:

i) The pereopod I carpus setae distal to large central seta on ventral margin differ: 5 or 6 in *T. lobotourus*, 7 in *T. peterpauli*; 7–9 in *T. majusculus*. 
ii) The antenna of *T. lobotourus* is longer, with a longer flagellum and smaller setae than in *T. peterpauli* (antenna ~3.1 and 2.5 head–pereon length for *T. lobotourus* and *T. peterpauli*, respectively).

iii) The antennula of an adult male is slender with fewer aesthetasc in *T. peterpauli* and more robust in *T. lobotourus* and *T. majusculus*.

iv) Spines on body and pleotelson differ among the species. Relative to each other, number of spines varies as follows: *T. majusculus* > *T. peterpauli* > *T. lobotourus*. The length of the spines shows a different trend: *T. lobotourus* > *T. majusculus* > *T. peterpauli*. The pleotelson in *T. lobotourus* has fewer spines (10–15% less for the same area) but longer spines (1.1 times) than in *T. peterpauli*.

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