**Heterophryxus pacificus**, a new species of dajid isopod from the central North Pacific

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**Abstract.**— A new species of the euphausiid-ectoparasitic isopod in the genus *Heterophryxus* Sars, 1885 is described based on an immature female specimen collected from the central North Pacific. The new species, *Heterophryxus pacificus*, can be distinguished from the immature females of *H. appendiculatus* Sars, 1885 and *H. elongatus* Schultz, 1977 in having (1) a wider and thicker body, (2) a cephalon without an anterior hollow, and (3) complex-shaped pereomeres 2 to 4. A diagnosis of the genus *Heterophryxus* is provided.

**Key words:** Isopoda, Dajidae, Heterophryxus, new species, North Pacific, diagnosis

**Introduction**

*Heterophryxus* Sars, 1885 is an isopod genus ectoparasitic on euphausiids and is comprised of three species; *H. appendiculatus* Sars, 1885, *H. elongatus* Schultz, 1977, and *H. australis* Schultz, 1977. *Heterophryxus appendiculatus* was originally described based on material from off Cape Verde Islands in the central Atlantic Ocean (Sars, 1885). This species has a wide zoogeographic distribution in the tropical-temperate belt worldwide (Gómez-Gutiérrez & Castellanos-Osorio, 2010). *Heterophryxus appendiculatus* is recorded from the Caribbean Sea (Gómez-Gutiérrez & Castellanos-Osorio, 2010), the Atlantic Ocean (Sars, 1885; Giard & Bonnier, 1889; Tattersall, 1913), the Mediterranean Sea (Lo Bianco, 1902; Drago & Albertelli, 1975), the Indian Ocean (Sebastian, 1970), and the Pacific Ocean (Shimomura & Ohtsuka, 2008; Gómez-Gutiérrez & Castellanos-Osorio, 2010; Fig. 1). On the other hand, *H. elongatus* and *H. australis* are known only from the Southern Ocean (Schultz, 1977; Fig. 1).

Recently, we had an opportunity to examine the zooplankton samples collected through the R/V Kaiyo Maru 2013 cruise in the North Pacific Ocean (Fisheries Agency, 2015) and found an unusual crustacean specimen in the samples. Closer examination revealed that it was an undescribed species of *Heterophryxus* and herein we describe it as a new species.

**Material and Methods**

Zooplankton samples were collected by vertical towing (0–150 m) using a modified NORPAC net (mesh size: 0.335 mm). Samples were fixed in 5% formalin solution. In the laboratory, specimens were sorted, observed and illustrated using a Nikon Eclipse E600 light microscope with Nikon Y-IDT drawing tube. Body length was measured from the anterior margin of cephalon to the posterior margin of pleon. The type material is deposited in the Osaka Museum of Natural History, Japan (OMNH). The zooplankton sample excluding the type material is also deposited in the Zooplankton Sample Collection of Fisheries Research Agency (registration number: ZP-FRA1299-49).
Taxonomic Account

Family Dajidae Sars, 1883
Genus Heterophryxus Sars, 1885

Diagnosis (based on the previously known species and the present new species)

Mature female: body oval in dorsal view, flattened dorsoventrally, anterior margin semi-quadrangle; cephalon and pereomeres fused together, but mid-dorsal surface of pereon 5 or 6-segmented; cephalon without eyes and antenna 1, but bearing reduced antenna 2 ventrally; pereomeres 1–4 each with pair of short pereopods and pair of oostegites on ventral surface, pereomeres 5–6 covered with pair of broad lamellae ventrally, posterior end of pereomere 6 with pair of large backward pereopods 5; pleon small, attached to posterior margin of pereomere 6, anterior border undefined, pleopods and uropods absent. Pereopods 1–4 similar in shape, propodus ovate, dactylus smallest, with minute claw; pereopod 5 well developed, bifurcate, basis–merus fused, carpus with long outward projection, propodus strongly curved inward, dactylus microscopic.

Immature female: body relatively slender, flattened dorsoventrally; cephalon rounded on anterolateral corners, coalesced pereomere 1, without eyes, but bearing reduced antennae 1–2 ventrally; pereomeres 2–4 clearly defined, borders of other pereomeres obscure, posterior margin of pereon rounded, ventral surfaces of pereomeres 1–4 each with pair of short pereopods, posterolateral corner of pereon bearing pair of large backward pereopods 5; pleon small or indistinct, pleopods absent, uropods vestigial. Shapes of pereopods almost same as mature female.

Male: body small, slender, little flattened dorsoventrally, curved ventrally; cephalon roundish trapezoidal, coalesced pereomere 1, without eyes, but bearing reduced antenna 1 and short antenna 2 ventrally; pereon composed of seven segments, borders of pereomeres 2–7 distinct, ventral surfaces of pereomeres 1–7 each bearing pair of ordinary pereopods; pleon relatively large, unsegmented, posterior margin rounded, pleopods and uropods absent. Pereopods 1–7 similar in shape, propodus ovate, dactylus curved inward, with minute claw.

Remarks

The original and subsequent descriptions of Heterophryxus are limited to Sars (1885) and Schultz (1977). These papers simply stated that Heterophryxus was characterized by the possession of pair of pereopods 5 with a unique clamping or clasping structure. A more comprehensive diagnosis for the genus is provided here to stabilize the name. The number of separated segments of mid-dorsal pereon in the mature female is variable as either five (Schultz, 1977; Shimomura & Ohtsuka, 2008) or six segments (Sars, 1885; Sebastian, 1970; Drago & Albertelli, 1975) due to presence or absence of the segment on the pereomere 1.

Gotto (1983) described an immature female (body length: 1.6 mm) of Heterophryxus and attributed it as an immature H. appendiculatus or the young stage of an unknown species. Based on our studies we feel this species is probably H. appendiculatus, because no other species in the genus has been collected from the Atlantic Ocean, and the Gotto sample was close to the type locality of H. appendiculatus.

The original description of H. elongatus from the Southern Ocean does not provide detail either: the presence or absence of the broad lamellae. The interval between the left row and the right row of pereopods 1–4 is very narrow (Schultz, 1977) and the brooding of eggs are not known; we therefore doubt that the holotype of H. elongatus is an immature specimen, even though Gotto (1983) regarded it as adult. Moreover this species may possibly be conspecific with H. australis representing the adult form of the species. The reasons are as follows: (1) the body length of H. australis is large (6.2 mm) whereas that of H.
**Extended Text**

**NEW DAJID ISOPOD FROM NORTH PACIFIC**

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**Included species:** *Heterophryxus appendiculatus, H. australis?, H. elongatus, H. pacificus* sp. nov.

**Heterophryxus pacificus** sp. nov.  
(Figs. 2–4)  
http://zoobank.org/urn:lsid:zoobank.org:act:E7A64638-4045-4674-989A-B4D22F75FBA8

**Material examined**  
Holotype: OMNH-Ar-10035, immature female (body length: 1.3 mm), St. 902 (31°N, 164°W; Fig. 1), 0–150 m deep, 10 December 2013, coll. Tohoku National Fisheries Research Institute.

**Description**  
Body (Figs. 2–3), maximum width about half of length, posterior one fourth narrowed. Cephalon + pereomere 1 0.60 mm in width (W) and 0.37 mm in mid-dorsal length (L), flattened, roundish rectangular, curved antero- and lateroventrally; anterior margin slightly convex, without hollow. Other pereomeres 6-segmented; pereomeres 2–3 short (pereomere 2 0.63 mm in W and 0.05 mm in L, pereomere 3 0.64 mm in W and 0.11 mm in L), lengthened

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**Fig. 1.** Map showing the collected sites of *Heterophryxus* species in the Pacific Ocean and the Southern Ocean. A, Shimomura & Ohtsuka (2008); B, Gómez-Gutiérrez & Castellanos-Osorio (2010).
lateroventrally, with round lateroventral swellings; pereomere 4 long (0.61 mm in W and 0.25 mm in L), shortened lateroventrally, with distinct crosswise boundary in middle and round lateroventral swellings; pereomere 5 long (0.45 mm in W and 0.23 mm in L), extremely shortened lateroventrally, posterior margin roundly convex; pereomere 6 very short (0.26 mm in W and 0.01 mm in L), lengthened lateroventrally; pereomere 7 0.28 mm in W and 0.23 mm in L, semiglobular, both lateral margins attached with large swelled coxae of pereopods 5. Pleon (Fig. 4B) vestigial, fused with posterior margin of pereomere 7; anus opened ventrally.

Cephalon (Fig. 4A) with small oral cone at center of ventral surface, pair of mandibular gnathobases visible in mouth opening; antenna 1 with broad peduncle and short thin flagellum, antenna 2 with 3-segmented peduncle and 6-articulated flagellum; pair of scaled structures present posteriorly. Pereopod 1 (Fig. 4A) with 6 articles; basis pyriform, ischium–carpus short, propodus longish ovate, dactylus short; inside and outside of pereopod with anlagen of oostegite and shallow hollow, respectively. Pe-
reopod 5 (Figs. 2C, 3A), basis–merus slightly curved, projection of carpus pointed, postero-distal corner of propodus with small tubercular process. Pleon (Fig. 4B), both sides each bearing minute seta (probably rudiment of uropod).

**Etymology**
Referring to the type locality, the Pacific Ocean.

**Remarks**
The holotype of *Heterophryxus pacificus* sp. nov. is an immature female and can be distinguished from other immature females of *H. appendiculatus* and *H. elongatus* mainly by the wider and thicker body and the cephalon without anterior hollow. The pereomeres 2 to 4 are a complex shape, while those of the latter two species are simple. The new species *H. pacificus* also differs from *H. appendiculatus* in having (1) shorter pereomeres 5 to 6, (2) a wider pereomere 7, (3) a vestigial ovate pleon, (4) a longer antenna 2, (5) shorter pereopods 1 to 4, and (6) an ovate pereopod 5 coxa. Lastly, it differs from *H. elongatus* in having a smaller pereomere 7.

**Hosts**
*Heterophryxus* species are known to only infest euphausiids (Gómez-Gutiérrez & Castellanos-Osorio, 2010). The present specimen was not
attached to any host when it was collected. However the specimen is most probably ecto-parasitic, because it lacks appendages for swimming and has pereopod 5 developed as highly modified clasping limbs. Euphausiids species collected with *Heterophryxus pacificus* sp. nov., one of which might have been its host, are listed in Table 1. The other *Heterophryxus* species have not been reported from the hosts listed, although Gómez-Gutiérrez & Castellanos-Osorio (2010) collected *H. appendiculatus* from the Caribbean Sea together with *Thysanopoda aequalis* Hansen, 1905, *Euphausia hemigibba* Hansen, 1910, and *E. tenera* Hansen, 1905. Two other dajid, *Bran-chiophryxus koehleri* Nierstrasz & Brender à Brandis, 1931 and *Oculophryxus bicaulis* Shields & Gómez-Gutiérrez, 1996, are parasitic on *Stylocheiron affine* Hansen, 1910 (Sebastian, 1970; Shields & Gómez-Gutiérrez, 1996).

### Table 1. Potential euphausiid hosts collected together with *Heterophryxus pacificus* sp. nov.

| Species                          | Body length* (mm) |
|----------------------------------|-------------------|
| *Thysanopoda aequalis* Hansen, 1905 | 10.5              |
| *Euphausia hemigibba* Hansen, 1910 | 7.4–12.4          |
| *E. tenera* Hansen, 1905          | 8.7               |
| *Stylocheiron abbreviatum* Sars, 1883 | 4.7–4.9          |
| *S. affine* Hansen, 1910          | 4.9               |

* from the base of rostrum to the tip of telson

### Distribution

The new species *H. pacificus* is known only from the type locality in the central North Pacific (Fig. 1).

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