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A New Deep-Water Shrimp of the Genus *Pandalopsis* (Decapoda, Caridea, Pandalidae) from Sagami Bay, Japan

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Abstract A new species of pandalid shrimp, *Pandalopsis gibba*, obtained by means of deep-water commercial traps for scampi from 250–300 m depths in Sagami Bay, central Japan, is described and illustrated on the basis of 22 specimens. The new species is unique within the genus in having a strongly elevated tergum of the third abdominal somite that is somewhat compressed, hump-like median ridge, and also in the enlarged posteriormost tooth on the ventral series of the rostrum.
Key words: Crustacea, Decapoda, Caridea, Pandalidae, *Pandalopsis*, new species, Sagami Bay, Japan.

During the years 2001 2002 the National Science Museum, Tokyo, carried out a survey on marine benthic fauna of Sagami Bay, Pacific coast of central Japan. Material was collected by commercial fishing traps for scampi *Metanephrops japonicus* Tapparone-Canefri or Japanese giant crab *Macrocheira kaempferi* (Temminck), gill nets and dredge, and thus the Showa Memorial Institute, the National Science Museum was enriched with the vast collections of various invertebrate specimens as well as decapod crustacean specimens. This material provided 22 specimens of a distinctive shrimp of the pandalid genus *Pandalopsis* Bate, 1888, collected by means of traps for scampi. In this paper, we describe a new species based upon these specimens.

The type specimens are deposited in the Showa Memorial Institute and Department Zoology, National Science Museum, Tokyo (NSMT), the Natural History Museum and Institute, Chiba (CBM) and Muséum National d'Histoire Naturell, Paris (MNHN). The illustrations were prepared with the aid of a drawing tube mounted on OLYMPUS SZH or LEIKA MZ8 stereomicroscopes. The postorbital carapace length (CL) is used as a standard measurement indicating the size of specimens. The descriptive terminology follows Komai (1999).

Taxonomy

Family Pandalidae

Genus ***Pandalopsis*** Bate, 1888

Pandalopsis gibba sp. nov.

[New Japanese name: Kobu-morotoge-ebi]

(Figs. 1–5)

Type series. Holotype. Sagami Bay, 35° 04.68′N, 139°45.32′E, 250 m, FB *Ido-Inkyo Maru No. 3*, traps for scampi, 8 March 2002, coll. H. Namikawa and Y. Imahara, female (CL 26.2 mm) (NSMT-Cr S:001).

Paratypes. Data as for holotype: 2 males (CL 13.0, 22.0 mm), 1 juv. (CL 9.4 mm) (NSMT-Cr S:002); 1 ovigerous female (CL 27.2 mm)

(CBM-ZC 6425). Sagami Bay, 35°04.39′N, 139°44.38′E, 300 m, FB *Ido-Inkyo Maru No. 3*, traps for scampi, 20 February 2001, 2 males (CL 17.6–18.3 mm), 6 transitional males (CL 21.2–23.3 mm), 7 females (CL 20.3–25.8 mm) (NSMT-Cr 14551); 1 male (CL 18.4 mm), 1 female (CL 24.6 mm) (MNHN).

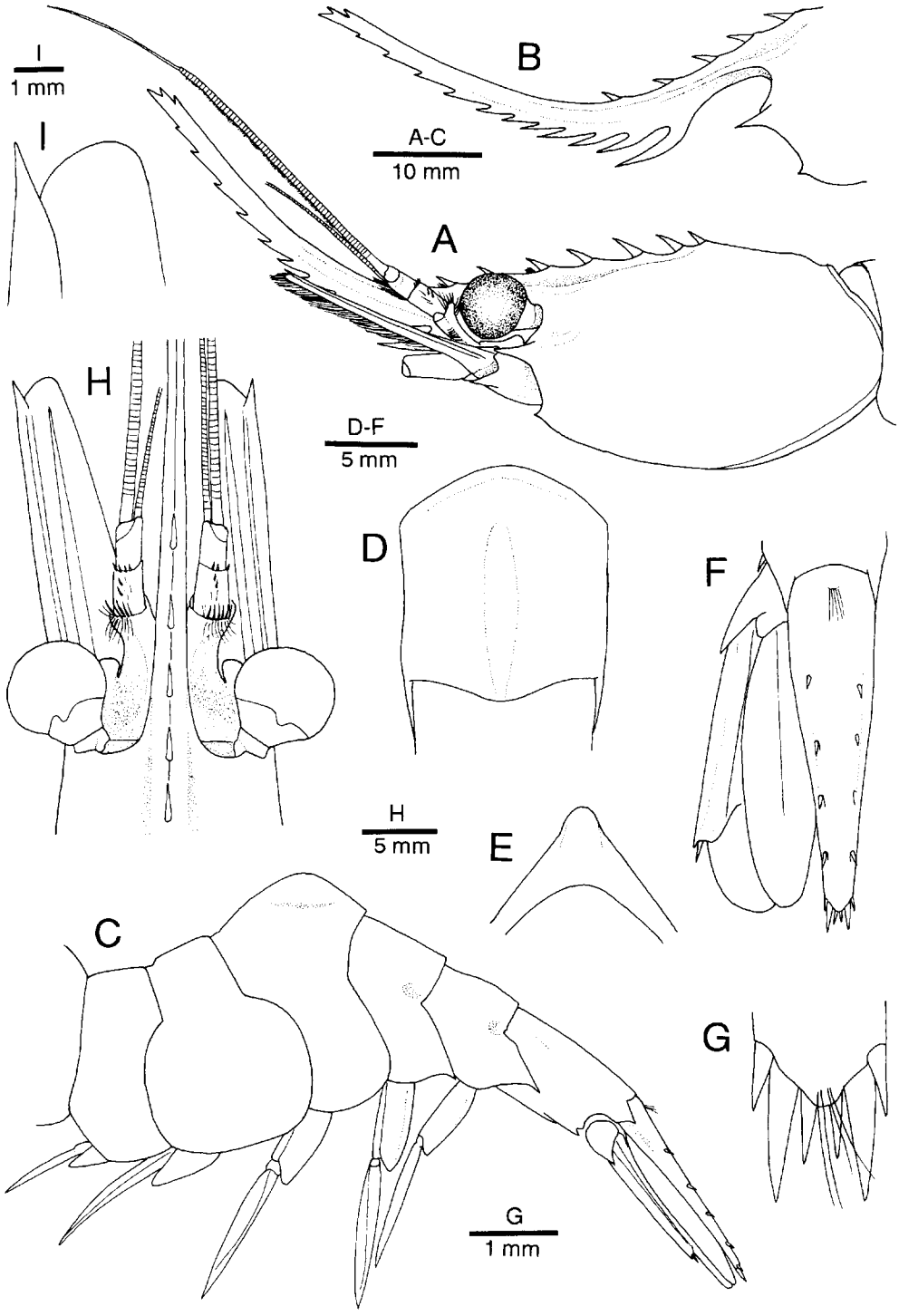
Description of holotype. Body (Fig. 1) relatively robust. Integument of body firm; surface smooth, glabrous, devoid of tegumental scales.

Rostrum (Fig. 2A, B) strongly curved dorsally, not arched over eyes, distinctly overreaching distal margin of antennal scale, 1.56 times as long as carapace; dorsal margin armed with 8 rather widely spaced movable spines, including 4 on carapace posterior to orbital margin, posteriormost spine arising from 0.57 of carapace length, and with 2 fixed tooth near apex, leaving subdistal 0.70 unarmed; ventral margin armed with 11 teeth becoming noticeably larger posteriorly (posteriormost tooth very large, elongate); lateral carina blunt, not conspicuous. Carapace (Fig. 2A) with postrostral ridge relatively high, extending to level of posterior 0.30 of carapace length, with peak at just posterior to posteriormost spine of dorsal series; suborbital lobe poorly developed; antennal spine relatively large, slightly overreaching dorsodistal lateral lobe of antennal basicerite; branchiostegal spine small.

Tergum of third abdominal somite (Fig. 2D, E) bearing somewhat compressed, hump-like median ridge with rounded general outline in lateral

Fig. 1. *Pandalopsis gibba* sp. nov. Entire animal in lateral view. Holotype female (CL 26.2 mm) from Sagami Bay (NSMT-Cr S:001).

Fig. 2. *Pandalopsis gibba* sp. nov. Holotype female (CL 26.2 mm) from Sagami Bay (NSMT-Cr S:001). A, carapace and cephalic appendages, lateral; B, rostrum, lateral (setae omitted); C, abdomen, lateral (most setae omitted); D, third abdominal somite, dorsal; E, tergum of third abdominal somite, posterior; F, telson and left uropod, dorsal (setae omitted); G, posterior margin of telson, dorsal; H, anterior part of carapace, proximal part of rostrum and cephalic appendages, dorsal (setae partially omitted, distal part of antennular flagella omitted); I, distal part of antennal scale, dorsal (setae omitted).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view; posterodorsal margin of third somite weakly produced posteriorly. Pleura of anterior three abdominal somites (Fig. 2C) broadly rounded, those of fourth and fifth somites (Fig. 2C) each with acute posteroventral tooth. Sixth abdominal somite (Fig. 2C) 0.51 times as long as carapace and 1.88 times as long as proximal depth, with small posteroventral tooth; posterolateral tooth moderately large, acuminate. Telson (Fig. 2C, F) 1.40 times as long as sixth somite, armed with 5 pairs of dorsolateral spines (including 1 pair at posterolateral corners) in posterior 0.75; posterior margin (Fig. 2G) with small, blunt median lobe bearing several submarginal setae, and 2 pairs of spines (lateral pair distinctly longer than mesial pair, stout).

Eye (Fig. 2A, H) with large, spherical cornea (maximal diameter 0.25 of carapace length); ocellar sinus distinct, but ocellus inconspicuous.

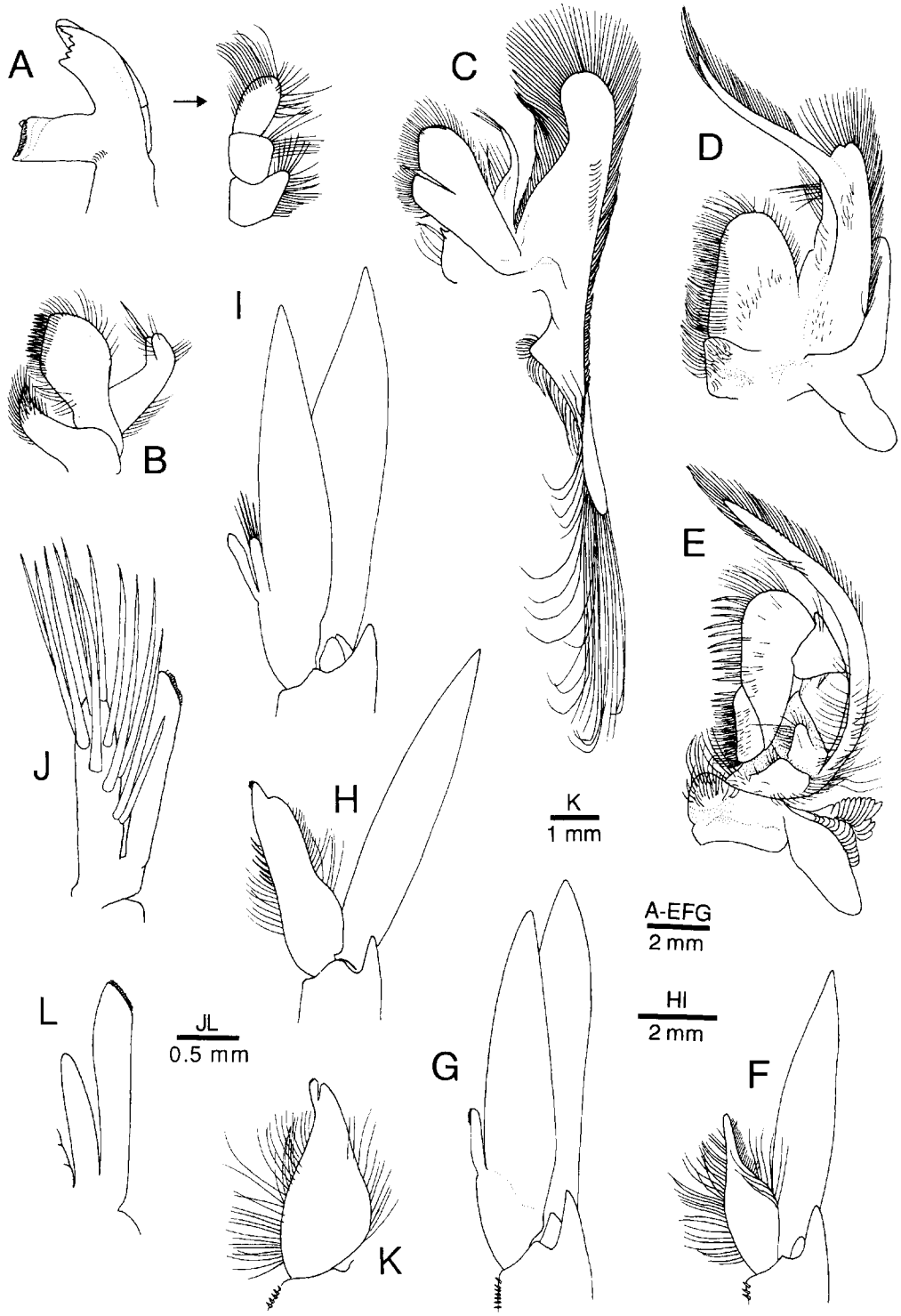
Antennular peduncle (Fig. 2A, H) slightly overreaching midlength of antennal scale; stylocerite short, broadly rounded; intermediate segment with few slender spinules on dorsal surface and row of several spinules on dorsodistal margin. Lateral flagellum with aesthetasc-bearing portion equal in length to carapace, distal portion shorter than aesthetasc-bearing portion; mesial flagellum much slender and somewhat shorter than lateral flagellum.

Antennal scale (Fig. 2A, H) 0.76 times as long as carapace, 3.68 times longer than wide; lateral margin almost straight, terminating in acute tooth just reaching roundly truncate distal margin of blade (Fig. 2I). Basicerite with moderately large ventrolateral distal tooth.

Mouthparts typical of genus (cf. Komai, 1994b) (Fig. 3A–E). Third maxilliped (Fig. 4A) reaching distal margin of antennal scale; antepenultimate segment with dorsal surface strongly inflated at about midlength, ventral margin sharply edged, with row of numerous stiff setae; ultimate segment nearly equal in length to penultimate segment, terminating in corneous spinule, dorsal and ventral margins weakly protuberant.

First pereopod (Fig. 4B) reaching midlength of antennal scale, minutely chelate (Fig. 4C); basis with ventrodistal corner somewhat produced distally; laminar expansion of ischium very broad, rounded distally; merus with row of low protuberances each bearing tufts of curved stiff setae on dorsal surface, ventral margin slightly expanded proximally and bearing low protuberances and stiff setae; carpus with numerous stiff setae on dorsal margin, ventral margin slightly protuberant, bearing tufts of short to long stiff setae; chela 0.69 times as long as carpus, somewhat compressed laterally, tapering distally, both dorsal and ventral margins bearing stiff setae, mesial surface with cluster of grooming setae on proximal half. Second pereopods (Fig. 4D, left illustrated) moderately slender, subequal, overreaching distal margin of scaphocerite by length of chela and 0.25 of carpus; ischium with weak expansion on ventral margin proximally; merus about half length of merus; carpus composed of 24 articles in left, 23 articles in right, distalmost article subequal in length to next three articles combined; chela (Fig. 4E) 0.33 times as long as carpus; dactylus 0.65 times as long as palm. Third to fifth pereopods (Fig. 4F, J, K) moderately slender, slightly becoming shorter posteriorly; ischia each with 1 ventral spine. Third pereopod (Fig. 4F) overreaching distal margin of scaphocerite by length of dactylus and half of propodus; merus 0.84 times as long as carapace, with 6 lateral and 6 ventral spines; carpus 0.55 times as long as propodus, with 2 lateral spines on distal half and with few spinules and tufts of setae on

Fig. 3. *Pandalopsis gibba* sp. nov. Left appendages. A–G, holotype female (CL 26.2 mm) from Sagami Bay (NSMT-Cr S:001); H–J, paratype male (CL 22.0 mm) from same haul (NSMT-Cr S:002); K, L, functional male (CL 23.0 mm) from Sagami Bay (NSMT-Cr 14551). A, mandible, external (setae on palp omitted); inset, palp, lateral; B, maxillule, external; C, maxilla, external; D, first maxilliped, external; E, second maxilliped, external; F, H, first pleopod, ventral (setae on protopod and exopod omitted); G, I, second pleopod, ventral (setae on protopod and exopod omitted); J, L, appendices masculina and interna, dorsomesial; K, endopod of first pleopod, ventral.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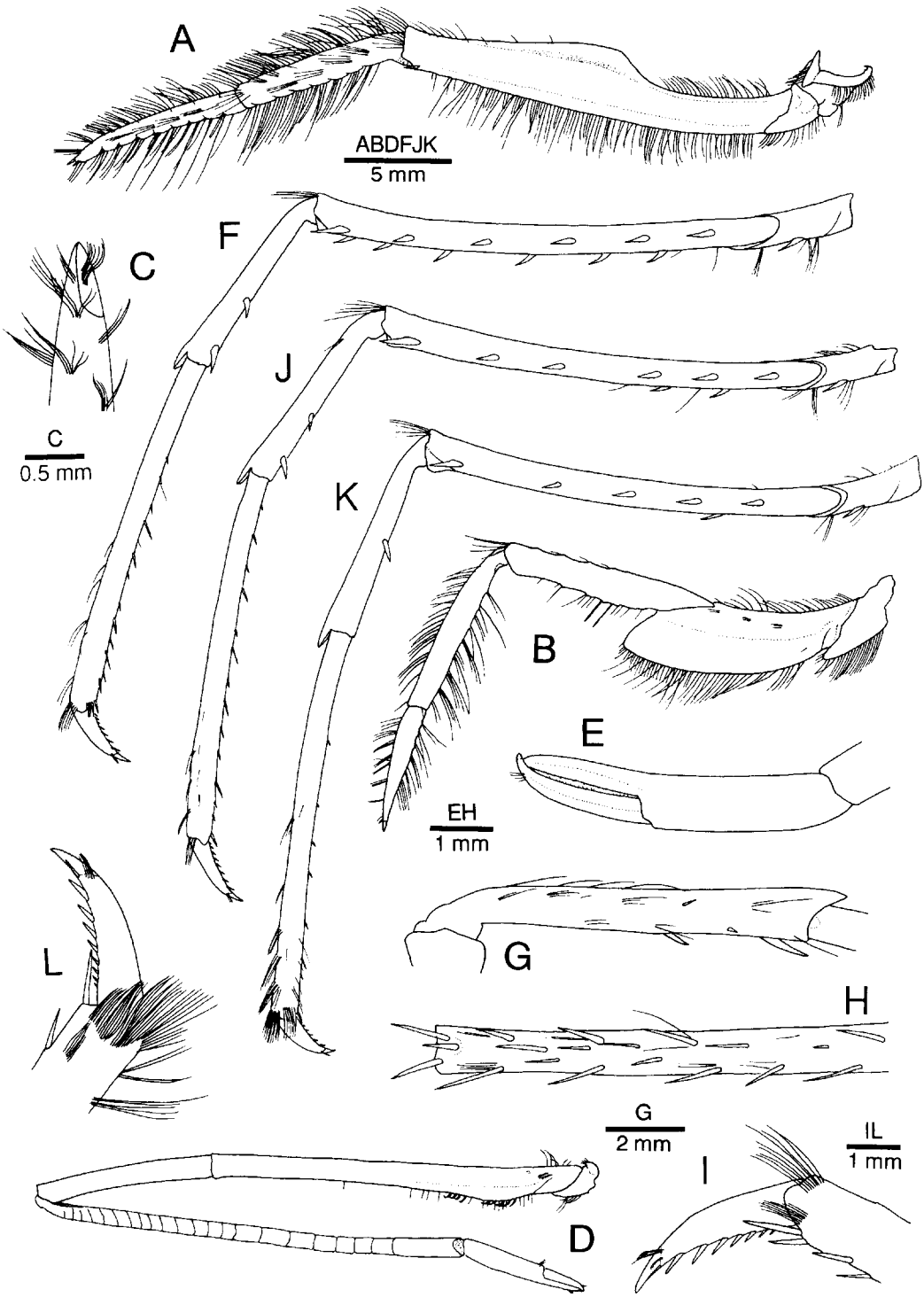
mesial face (Fig. 4G); propodus with few setae on dorsal and lateral surfaces, and with 2 rows of sparse slender spinules flanked by rows of longer spines on flexor surface (Fig. 4H); dactylus (Fig. 4I) 0.22 times as long as propodus, with 8 accessory spinules over entire length of flexor margin and 1 subterminal spinule closely appressed to unguis. Fourth pereopod (Fig. 4J) similar to third pereopod, overreaching distal margin of scaphocerite by length of dactylus and 0.25 of propodus; merus 0.78 times as long as carapace, with 6 (left) or 10 (right) lateral spines and 3 (both) ventral spines. Fifth pereopod (Fig. 4K) also generally similar to third pereopod, overreaching distal margin of scaphocerite by length of dactylus and 0.10 of propodus; merus 0.76 times as long as carapace, with 5 (left) or 7 (right) lateral spines and 3 (left) or 1 (right) ventral spines; propodus with tufts of grooming setae on distal part (Fig. 4L); dactylus (Fig. 4L) 0.17 times as long as propodus.

First pleopod (Fig. 3F) with row of spinules on ventromesial margin of protopod; endopod about 0.60 times as long as exopod, distal half rather abruptly tapering distally, forming narrow lobe. Second pleopod (Fig. 3G) with protopod bearing row of spinules on ventromesial margin; endopod slightly shorter than exopod; appendix interna arising from proximal 0.30 of mesial margin, with distomesial cluster of cincinnuri. Uropod (Fig. 2F) with protopod bearing acute posterolateral tooth; both endopod and exopod slightly falling short of posterior end of telson; exopod with nearly straight lateral margin terminating in small acute tooth; 1 movable spine just mesial to posterolateral tooth; dieresis oblique.

Notes on paratypes. Paratypes are generally similar to the holotype except for some meristic characters and counts. Rostrum variable in proportional length, tending to decrease with growth (Fig. 5), ranging from 2.18 from 1.40; dorsal margin armed with 6–9 spines, including 3–5 on carapace, posteriormost spine arising from 0.52–0.55 of carapace length, and with 2 fixed teeth near apex, subdistal 0.73–0.80 leaving unarmed; ventral margin with 10–12 teeth. Telson armed with 5 or 6 spines on either side (usually paired). Eye with maximal diameter 0.22–0.25 of carapace length. Antennule with aesthetasc-bearing portion of lateral flagellum 0.83–1.00 times as long as carapace. Antennal scale 0.79–0.90 times as long as carapace. Second pereopods with carpus composed of 18–22 articles. Third pereopod with merus 0.82–0.89 times as long as carapace, armed with 6 or 7 lateral and 4–6 ventral spines; dactylus with 6–8 accessory spinules on flexor margin. Fourth pereopod with merus 0.82–0.85 times as long as carapace, armed with 5–7 lateral and 0–5 ventral spines; dactylus with 6–8 accessory spinules. Fifth pereopod with merus 0.75–0.82 times as long as carapace, with 4–6 lateral and 0–2 ventral spines; dactylus with 6–8 accessory spinules.

Endopod of first pleopod and appendix masculina of second pleopod showing sequential change associated with sex change. Endopod of first pleopod in functional male (Fig. 3H) 0.55 times as long as exopod, bilobed distally, mesial lobe (=appendix interna) with cluster of cincinnuri distomesially, lateral lobe little developed, not produced; lateral margin of endopod sinuous, mesial margin less sinuous, with short row of slender spines extending distally from midlength. Endopod of first pleopod in transitional male broader than in functional males; appendix interna subterminal, with cluster of cincinnuri; lateral lobe more developed than in functional male. Second pleopod (Fig. 3I) with appendix masculina in functional male (Fig. 3J) slightly shorter than appendix interna, bearing 12 long spines.

Fig. 4. *Pandalopsis gibba* sp. nov. Left appendages. Holotype female (CL 26.2 mm) from Sagami Bay (NSMT-Cr S:001). A, third maxilliped, lateral; B, first pereopod, lateral; C, distal part of chela of first pereopod, extensor; D, second pereopod, lateral; E, chela of second pereopod, extensor; F, third pereopod, lateral; G, carpus of third pereopod, mesial; H, distal part of propodus of third pereopod, flexor; I, distal part of propodus and dactylus of third pereopod, lateral; J, fourth pereopod, lateral; K, fifth pereopod, lateral; L, distal part of propodus and dactylus of fifth pereopod, lateral.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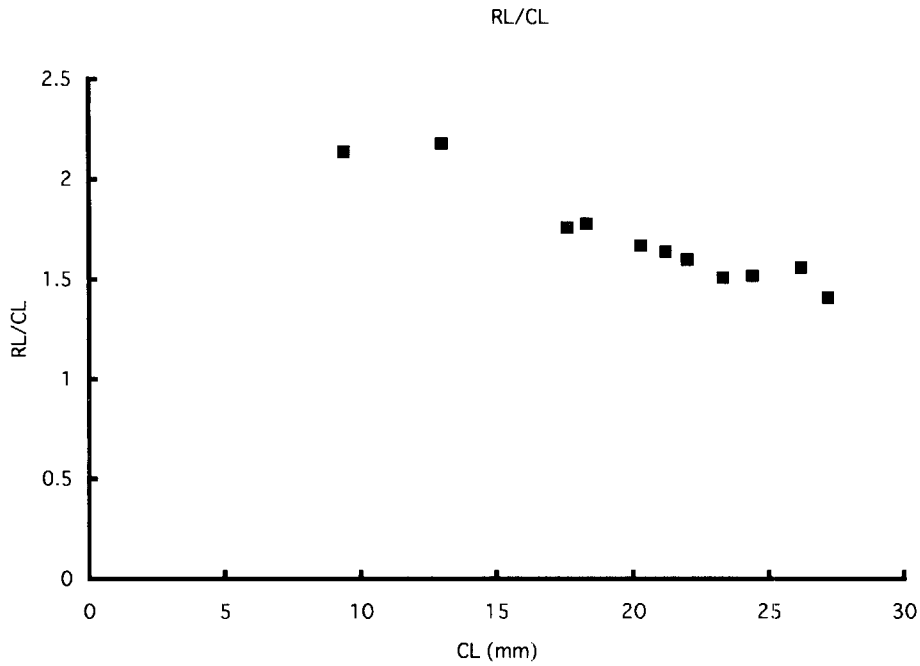

Fig. 5. *Pandalopsis gibba* sp. nov. Plot of proportional length of rostrum (RL/CL) agaisnt carapace length (CL). N=11.

Appendix masculina in transitional male greatly reduced, without spines. Protopods of first to fifth pleopods smooth on ventromesial margin in males, with row of spinules in functional males and females.

Eggs large, longer axis 2.6–2.7 mm, shorter axis 2.4–2.5 mm.

Size. Functional males CL 13.0–22.0 mm; transitional males CL 21.2–23.3 mm; females CL 20.3–27.2 mm (ovigerous female CL 27.2 mm).

Coloration. See Fig. 1. Carapace and abdomen generally light orange-red. Rostrum dark red in distal 0.40, remainder nearly transparent, with tinge of red dorsally. Third abdominal somite with distinct white transverse band across summit of median carina. Antennular peduncle orange-red; flagellum generally dark red, with white band proximally and subdistally. Antennal scale generally orange-red, bordered with dark red on lateral margin proximally. Third maxilliped and pereopods generally pink. Meri of third to fifth pereopods each with 2 broad dark red bands; distal parts of propodi and dactyli dark red.

Etymology. Named in reference to the characteristic "hump-like" median ridge on third abdominal somite.

Distribution. So far known only from Sagami Bay, Japan, at depths of 250–300 m.

Remarks. There is an indication of protandry evidenced from the morphology of the anterior two pairs of pleopods (Fig. 3F–L). The six specimens (CL 21.2–23.3 mm) show a typical transitional phase (Fig. 3K, L) (cf. Butler, 1980).

The eggs carried by a single ovigerous female (CBM-ZC 6425) are apparently few and large, measuring 2.6–2.7 mm in longer axis and 2.4–2.5 mm in shorter axis, although the number has not been counted. This suggests that the new species, *Pandalopsis gibba*, has an abbreviated pattern of larval development, as documented for three congeners (Berkeley, 1930; Kurata, 1964; Komai & Mizushima, 1993).

The genus *Pandalopsis* has been represented by 16 recognized species, chiefly distributed in the North Pacific Ocean (Komai, 1994; Jensen,

1998; Hanamura *et al.*, 2000). The taxonomy of the genus was briefly reviewed by Komai (1994). The present new species appears close to *P. miyakei* Hayashi, 1986. The two share the following features: the posteriormost spine of the dorsal rostral series arises from posterior to the level of the midlength of the carapace; the dorsal margin of the rostrum is unarmed on the subdistal 0.70–0.80 length; the aesthetasc-bearing portion of the lateral flagellum of antennule is relatively short, not exceeding the carapace length; the dactyli of the third to fifth pereopods are armed with 6–8 accessory spinules distributed over the entire length of the flexor margin. However, the present new species is unique within the genus in the possession of a somewhat compressed, hump-like median ridge on the third abdominal somite. *Pandalopsis pacifica* (Doflein, 1902) has a somewhat elevated dorsal surface of the tergum of the third abdominal somite, but the tergal surface does not form a compressed ridge. The strongly enlarged posteriormost tooth on the ventral series of the rostrum is also characteristic to the new species, although similar but less developed condition is found in *P. lamelligera* (Brandt, 1851) and *P. japonica* Balss, 1914 (cf. Komai, 1994, 1997). The coloration of *P. gibba* is also distinctive in the general body color being light orange-red, having a distinct white transverse band only on the third abdominal somite.

It may be interesting to mention the superficial similarity in some morphological features and coloration between *Pandalopsis gibba* and *Pseudopandalus curvirostris* Crosnier, 1997. In the latter species, the rostrum is strongly curved dorsally and the ventral teeth become noticeably larger posteriorly; the tergum of the third somite is noticeably elevated (a strong, hook-like projection is present); the third abdominal somite bears obliquely transverse band (Crosnier, 1997). There is no doubt that the similarity is a result of convergence, as the two species are generically distinct.

The discovery of the new species having possible interest to fishery from the well-explored Sagami Bay is remarkable. It is also noteworthy to mention that no specimen representing the present new species has discovered from other regions in spite of recent scientific activities in various locations in Japan. Komai (1994, 1999) suggested that the northwestern Pacific species of *Pandalopsis* show high degree of endemism. The new species may also have very limited geographical range in the Japanese Pacific coast. Further, it is suggested that *P. gibba* prefers hard bottom for habitat where trawl fishery or dredging survey is not suitable, as the available specimens were collected only by trapping. Future survey using various types of gears, particularly targeting hard bottoms, will eventually reveal more diverse fauna in Japanese waters than we have expected.

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