



A distinctive new species of the alpheid genus *Salmoneus* Holthuis, 1955 (Crustacea: Decapoda: Caridea) from the northwestern Pacific

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Abstract

A new species of the alpheid shrimp genus *Salmoneus* Holthuis, 1955, *S. pinguis* **sp. nov.**, is described based on the holotype from Okinawa, Ryukyu Archipelago, Japan. An additional, much smaller and morphologically slightly different specimen from Panglao, Bohol Sea, the Philippines, is tentatively assigned to *S. pinguis*. **sp. nov.** The new species is one of the most unusual members of *Salmoneus* presenting a combination of several unique characters, including the unusually stout, plump body; the carapace strongly domed dorsally, with a broadly rounded rostrum, and without orbital teeth; the second abdominal pleuron conspicuously enlarged; the fourth pleuron greatly overlapping the fifth pleuron; the antennular and antennal flagella furnished with long setae; and the major cheliped comparatively small, and with the distally blunt, slightly bulbous fingertips.

Key words: Decapoda, Caridea, Alpheidae, shrimp, *Salmoneus*, new species, Japan, Philippines

Introduction

The alpheid genus *Salmoneus* Holthuis, 1955 is characterised by the well-developed rostrum; the orbital hoods completely or partly covering the eyestalks in dorsal view; the unequal and asymmetrical first pereopods or chelipeds, with the major cheliped lacking a snapping mechanism; the sixth abdominal somite lacking a distinct articulated flap at posteroventral angle; and the second pleopod with an appendix masculina in all individuals, including ovigerous ones, suggesting some form of hermaphroditism (see Anker 2011a). Most species of *Salmoneus* have cryptic life habits, dwelling in crevices in coral rocks, spaces deep under rocks or coral rubble, or in burrows of other decapod crustaceans, including larger alpheid shrimps and callinassid ghost shrimps. Recent sampling efforts and taxonomic studies (e.g., Anker & Marin 2006; Anker 2007, 2010, 2011a, 2011b; Komai 2009) dramatically increased the number of species over the last decade, with hitherto 44 valid species worldwide (De Grave & Fransen 2011; Anker 2011b).

In 2009, the first author conducted fieldwork in the Ryukyu Islands, in collaboration with skillful local divers, specifically targeting decapod crustaceans. During one of the dives, one specimen of a very distinctive alpheid shrimp was collected at Manza, Okinawa Island, at a depth of 2 m. A second specimen of presumably the same species was found by the second author while sorting the alpheid material collected by the Panglao 2004 Marine Biodiversity Project in the Philippines. Examination of both specimens revealed that they belong to a species of *Salmoneus* new to science. In the present contribution, this species is described as new.

The type specimen from the Ryukyu Islands is deposited in the collections of the Natural History Museum and Institute, Chiba, Japan (CBM). The additional specimen from the Philippines is deposited in the collections of the Muséum national d'Histoire naturelle, Paris, France (MNHN). Carapace length (cl, in mm) was measured from the tip of the rostrum to the posterior margin of the carapace. The term “spiniform seta” is used for a structure also known as “movable spine”.

Taxonomic account

Salmoneus pinguis sp. nov.

Figs. 1–6

Type material. Holotype: ovigerous specimen (cl 5.7 mm), Japan, Ryukyu Archipelago, Okinawa Island, Manza, depth 2 m, cracking of coral rocks with a hammer, 1 July 2011, coll. N. Shirakawa, CBM-ZC 10666.

Additional material examined. 1 non-ovigerous specimen (cl 3.0 mm), Philippines, Bohol Sea, Panglao Island, Station B8, Napaling, 9°37.1'N, 123°46.1'E, depth 3 m, subtidal reef platform, dead coral and rubble brushing, 7 June 2004, coll. Panglao 2004 Marine Biodiversity Project, MNHN-IU-2010-5564.

Description (based on holotype). Body stout, bulky, plump, with relatively soft integuments. Carapace glabrous, conspicuously domed dorsally, steeply sloping anteriorly into rostrum; anterolateral region without distinct suture, however, with shallow notch on anterolateral margin dorsal to rounded pterygostomial angle (Fig. 1); posterior margin with deep cardiac notch. Rostrum very short, broadly triangular, with rounded tip, reaching distal margin of second article of antennular peduncle, strongly deflexed; dorsal surface smooth, without a distinct carina; ventral surface flattened, unarmed (Figs. 1, 2A, C). Orbital teeth absent (Figs. 1, 2A, C).

Pleura of first four abdominal somites enlarged, rounded posteroventrally; fourth pleuron greatly overlapping fifth pleuron, latter with rounded posteroventral angle (Figs. 1, 2A); sixth somite without distinct articulated flap, with very faint suture only (Fig. 2D); preanal plate rounded. Telson relatively broad, widest at base, posteriorly tapering; dorsal surface with two pairs of minute spiniform setae inserted at some distance from lateral margin, located at about 0.63 and 0.82 telson length, respectively; posterior margin approximately half as long as anterior margin, with moderately deep, U-shaped, median incision, two pairs of long spiniform setae on either side of median incision (mesial ones slightly longer and stouter than lateral ones), and one pair of long stiff setae arising from lateral margins of median incision (Fig. 2B, E).

Eyestalks stout, short, concealed in dorsal view, fully visible in lateral view (Figs. 1, 2A, C); cornea somewhat reduced, occupying only dorsolateral part of eyestalk (Fig. 2F). Epistomial sclerites without conspicuous processes.

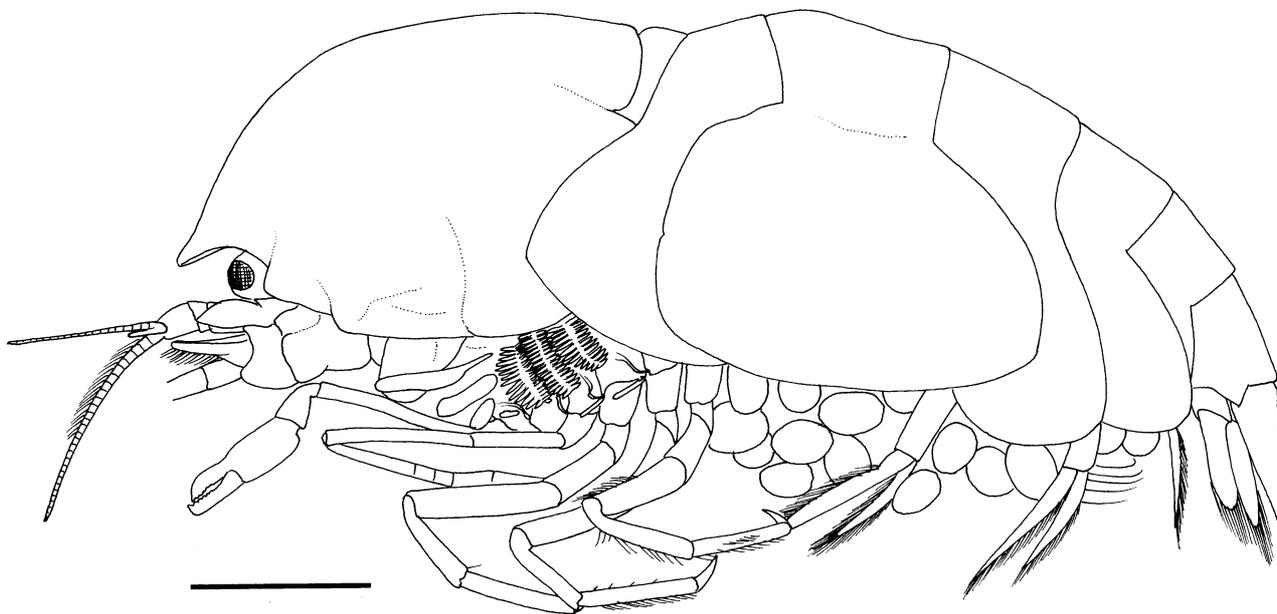


FIGURE 1. *Salmonaeus pinguis* sp. nov., holotype, ovigerous specimen (cl 5.7 mm) from Okinawa, Japan, CBM-ZC 10666, entire animal in lateral view (note: lateral surface of carapace somewhat curled up, probably caused by water absorption during preservation).

Antennular peduncles widely separated basally, short, stout, with second article slightly wider than long; first article without distinct tooth on ventromesial carina; stylocerite with subacute tip reaching distal margin of second article; lateral flagellum biramous, fused portion short, with two or three very short articles; accessory ramus con-

sisting of four articles with aesthetascs; both flagella setose (Fig. 2C). Antenna with basicerite ending in short subacute tooth distolaterally, with prominent, blunt process distodorsally; scaphocerite more rounded than ovate, short, 1.4 times longer than wide, reaching distal margin of third article of antennular peduncle; distal margin of blade broad, rounded, reaching well beyond small, subacute, distolateral tooth; carpocerite very short, stout, barely reaching mid-length of scaphocerite; flagellum conspicuously setose (Figs. 2A, C; 3A).

Mouthparts fairly typical for genus. Mandible with moderately strong molar process bearing setal rows on dorsal surface; incisor process strong, distal margin with seven teeth, latter unequal in size; palp flattened, with oval distal article (Fig. 3B–E). Maxillule with slender, inwardly curved coxal endite; basal endite curved, armed with two rows of slender spinules on distal margin; endopod strongly curved, ventral lobe bearing one stiff apical seta, dorsal lobe broad, rounded, with smaller setae (Fig. 3F, G). Maxilla comparatively small; coxal endite not reaching basal endite; basal endite divided into two subequal, subquadrate lobes; endopod stout, tapering distally; scaphognathite with short, rounded posterior lobe (Fig. 3H). First maxilliped with a few short setae on mesial margin of coxal endite; basal endite distally rounded; endopod biarticulated, consisting of broad basal article and slender, distally tapering distal article; exopod with narrow caridean lobe, flagellum well developed; epipod moderately large, subquadrate (Fig. 3I, J). Second maxilliped with prominently produced mesial margin of coxa; propodus and dactylus apparently partly fused (articulation distinct only dorsally); exopodal flagellum well developed, with one long, stiff seta on lateral margin proximal to mid-length; epipod suboval (Fig. 3K).

Third maxilliped slender, falling short of distal margin of antennal scale when fully extended; coxa with ovate lateral plate above mastigobranch; antepenultimate article longer than penultimate and ultimate articles combined; penultimate article about 2.5 times as long as wide, slightly widening distally, with two transverse rows of serrulate setae distomesially; ultimate article tapering distally, with transverse rows of thick serrulate setae mesially, apex with at least one small spiniform seta; exopod falling short of distal margin of antepenultimate article (Fig. 4A–C); arthrobranch well developed (not drawn in Fig. 4A).

Chelipeds short relative to body and other pereopods (Fig. 1), slightly unequal in size, asymmetrical in shape (Fig. 4D, F); minor (right) cheliped about 0.9 length of major (left) cheliped, with stouter ischium and merus, comparatively longer carpus, and significantly smaller and shorter chela (Fig. 4F, G); both chelipeds capable of folding under cephalothorax when not in use (therefore mostly invisible in Fig. 5). Major cheliped reaching beyond distal margin of antennal scale, slender; ischium not widening distally, unarmed on ventrolateral surface; merus about 5.2 times as long as wide, smooth, compressed laterally; carpus short, cup-shaped, about 0.3 merus length; chela somewhat compressed, smooth, mesial margin slightly concave; palm with deep proximal constriction; fingers distinctly longer than palm, terminating in blunt, slightly bulbous, curving and crossing tips; cutting edges of both dactylus and pollex with row of low, blunt teeth (Fig. 4D, E). Minor cheliped with ischium lacking spiniform seta on ventrolateral surface; merus about 3.5 times as long as wide, smooth, dorsal margin slightly convex, ventral surface shallowly sulcate in distal half; carpus elongate, slightly shorter than merus, distally widening; chela smooth, simple, with slightly swollen palm; fingers moderately stout, in length subequal to palm; cutting edges smooth, unarmed; tips slightly curved, not strongly crossing (Fig. 4F, G).

Second pereopod slender; ischium without spiniform setae; merus slightly longer than ischium; carpus four-articulated (but see under Variation), ratio of carpal articles (from proximal to distal) approximately equal to: 2.5: 0.4: 0.5 : 1.0; chela simple, slightly longer than distal-most carpal article (Fig. 4H). Third pereopod relatively stout, compressed laterally; ischium with two tiny spiniform setae on ventrolateral surface; merus about 3.2 times as long as wide, unarmed, with stiff setae along on dorsal margin; carpus more slender than merus, about 0.8 merus length, with stiff setae on dorsal surface; propodus with one spiniform seta on ventral margin distal to mid-length and one pair of stouter, longer spiniform setae on distoventral margin, dorsal margin with rows of stiff setae; dactylus about 0.4 times as long as propodus, simple, moderately slender, slightly curving distally, unguis clearly demarcated (Fig. 4I, J). Fourth pereopod generally very similar to third pereopod (Fig. 4K). Fifth pereopod in length subequal to third pereopod, however, with longer carpus and propodus combined; ischium unarmed; merus in length subequal to carpus; propodus with two spiniform setae and about five rows of short, serrulate setae in distal 0.4, distoventral margin with two slender spiniform setae (Fig. 4L).

Second pleopod with appendix masculina about half-length of appendix interna, its apex and mesial margin being furnished with stiff setae (Fig. 3L). Uropod with lateral lobe of protopod unarmed; endopod and exopod narrowly ovoid; diaeresis on exopod not distinct; exopod with minute distolateral tooth adjacent to slender spiniform seta (Fig. 3M).

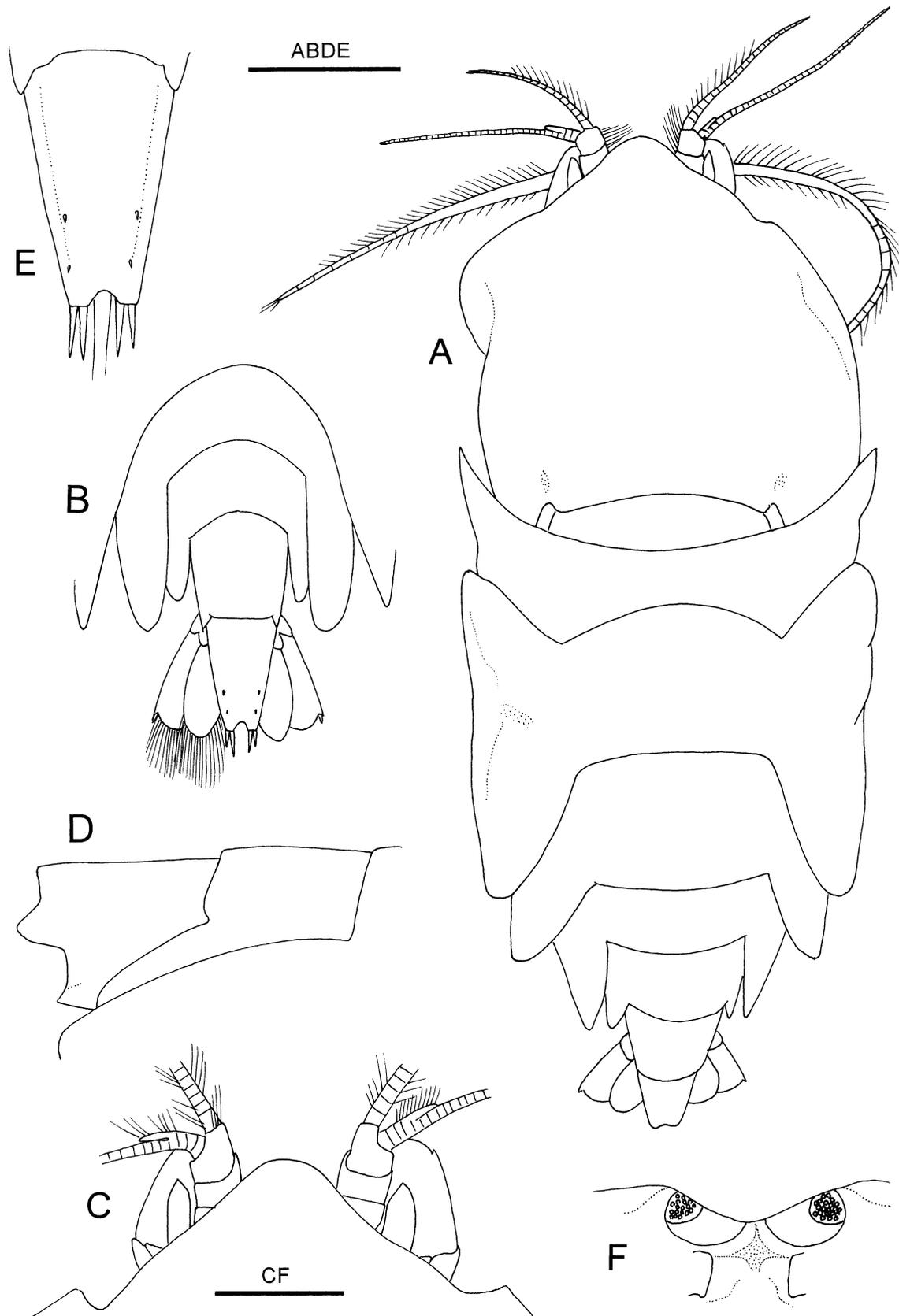


FIGURE 2. *Salmoneus pinguis* sp. nov., holotype, ovigerous specimen (cl 5.7 mm) from Okinawa, Japan, CBM-ZC 10666. A, entire animal, dorsal view; B, fourth to sixth abdominal somites, telson and uropods, perpendicular dorsal view; C, frontal margin and antennae, anterodorsal view; D, fifth and sixth abdominal somites, lateral view (right side); E, telson, dorsal view; F, eyes, frontal view. Scale bars: 2 mm for A, B; 1 mm for C, D–F.

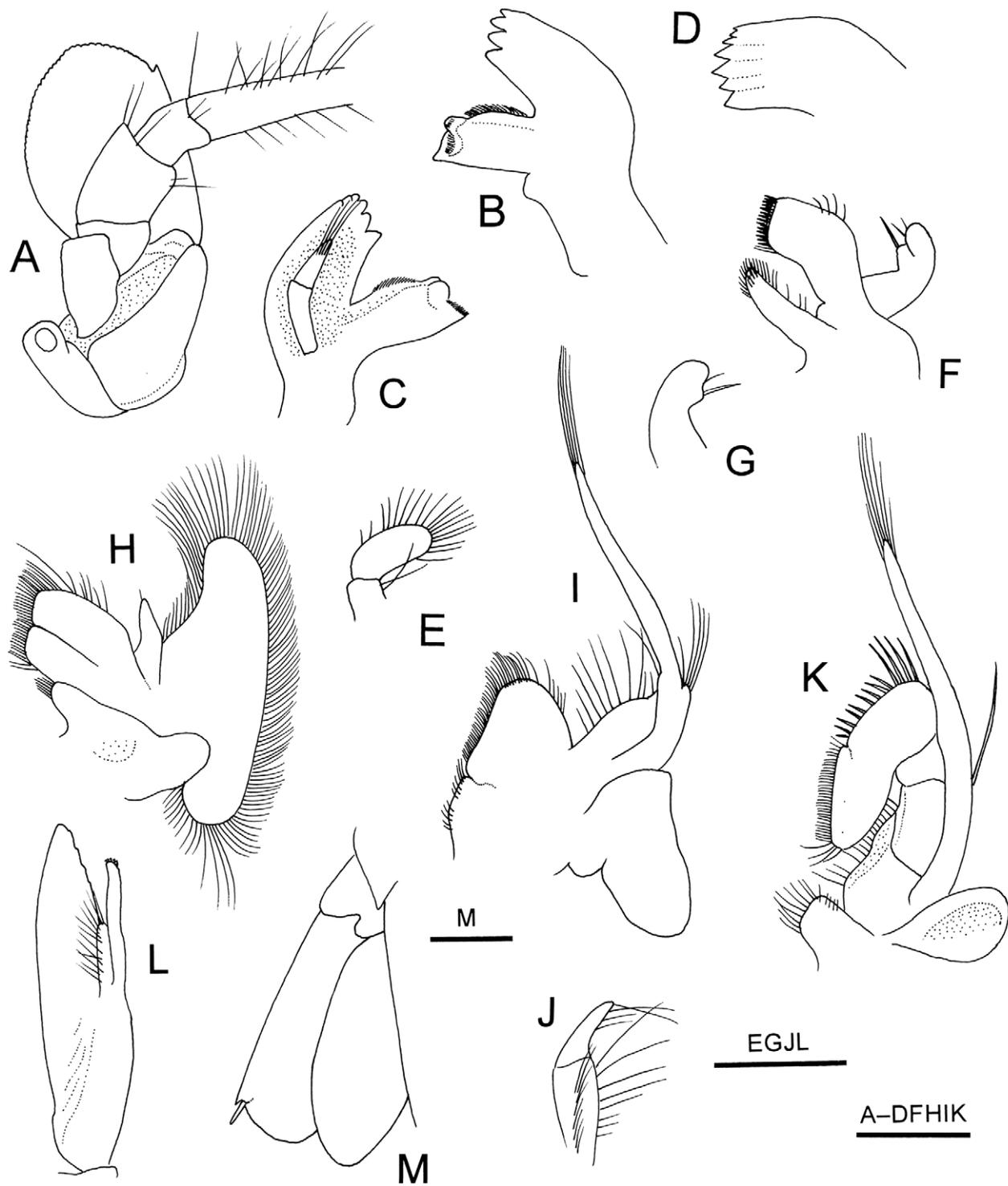


FIGURE 3. *Salmones pinguis* sp. nov., holotype, ovigerous specimen (cl 5.7 mm) from Okinawa, Japan, CBM-ZC 10666, left appendages. A, antenna, ventral view (distal part of flagellum omitted); B, mandible, outer view; C, same, inner view; D, same, incisor process, oblique outer view; E, same, distal article of palp; F, maxillule, outer view; G, same, distal part of endopod, inner view; H, maxilla, outer view; I, first maxilliped, outer view; J, same, endopod, inner view; K, second maxilliped, outer view; L, endopod of second pleopod, dorsal view; M, left uropod, dorsal view. Scale bars: 0.5 mm.

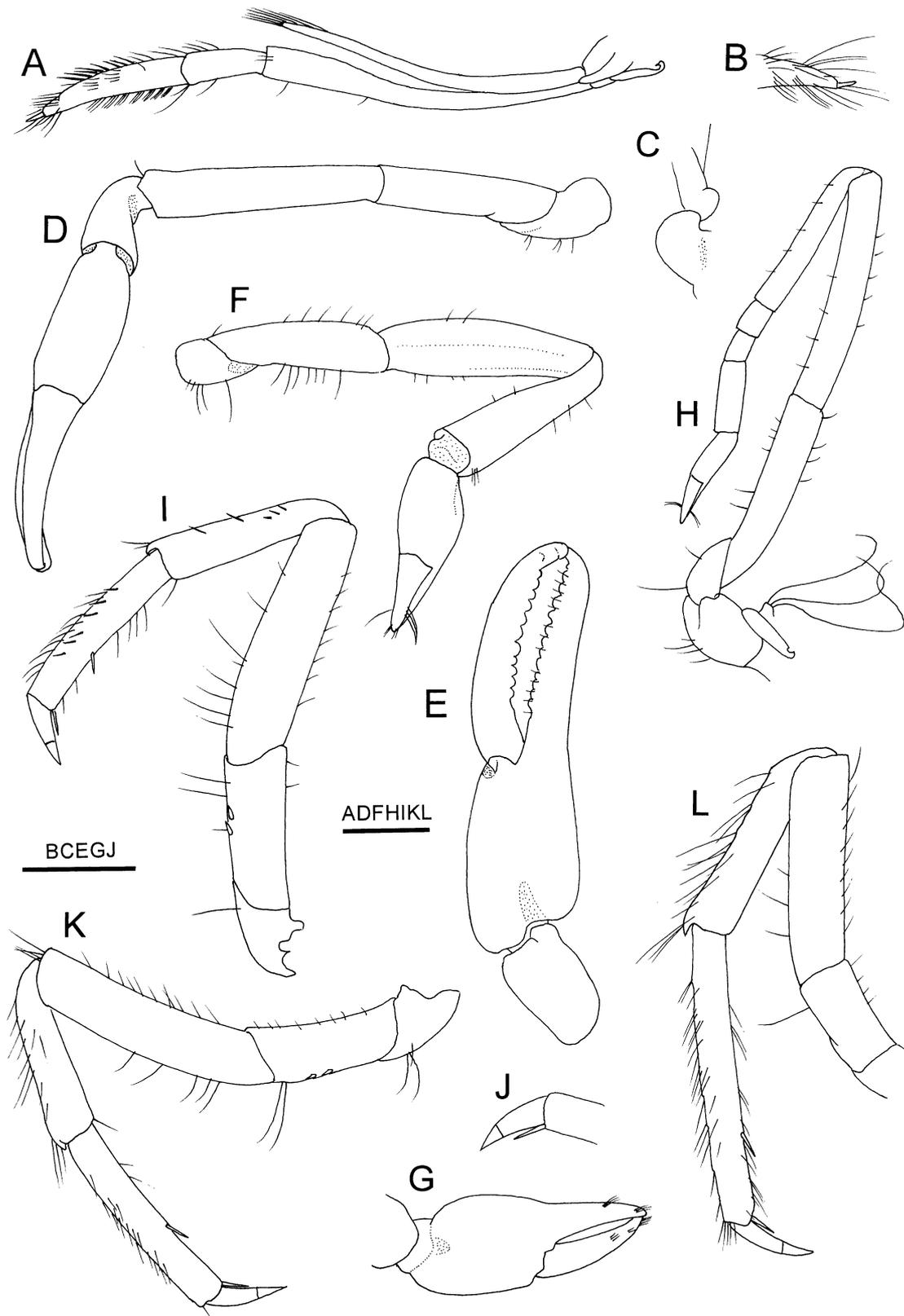


FIGURE 4. *Salmoneus pinguis* sp. nov., holotype, ovigerous specimen (cl 5.7 mm) from Okinawa, Japan, CBM-ZC 10666. A, left third maxilliped, lateral view; B, same, distal part of ultimate segment, mesial view; C, same, coxal lateral plate, dorsal view; D, left first pereopod (cheliped), lateral view; E, same, chela and carpus, extensor view; F, right first pereopod (cheliped), lateral view; G, same, chela, extensor view; H, left second pereopod, lateral view; I, left third pereopod, lateral view; J, same, dactylus and distal part of propodus, lateral view; K, left fourth pereopod, lateral view; L, left fifth pereopod, lateral view. Scale bars: 0.5 mm.



FIGURE 5. *Salmoneus pinguis* sp. nov., holotype, ovigerous specimen (cl 5.7 mm) from Okinawa, Japan, CBM-ZC 10666, habitus and colour in life. Photograph courtesy of Ryo Minemizu.

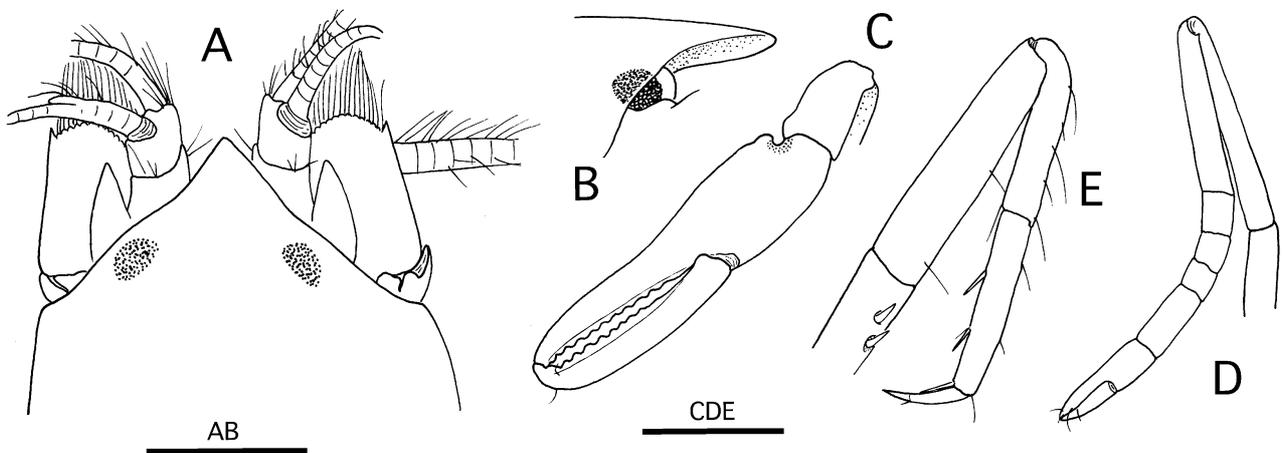


FIGURE 6. *Salmoneus pinguis* sp. nov., non-type, post-ovigerous specimen (cl 3.0 mm) from Panglao, the Philippines, MNHN-IU-2010-5564, A, frontal margin of carapace and frontal appendages, dorsal view; B, frontal margin of carapace, lateral view; C, major chela, lateral view; D, second pereopod, lateral view; E, third pereopod, lateral view. Scale bars: 0.5 mm.

Gill-exopod formula typical for genus.

Colour in life. Semitransparent, with yellowish tinge; ovary and eggs bright yellow-orange (Fig. 5).

Variation. The apparently post-ovigerous specimen from Panglao is much smaller than the holotype (cl 3.0 mm compared to cl 5.7 mm in the holotype) and differs from the latter by the more triangular rostrum (Fig. 6A), the eyestalks being more concealed in lateral view (Fig. 6B), the second pereopods with a five-articulated carpus (vs. four-articulated in the holotype) (Fig. 6D), and the third pereopod with a somewhat more slender dactylus, and with two spiniform setae on the ventral margin of the propodus (vs. one in the holotype) (Fig. 6E). In all other features,

this specimen agrees well with the holotype, including all of the new species' diagnostic features, such as the stout, plump body; the general shape of the frontal margin of the carapace (including the absence of orbital teeth); the general shape and proportions of the antennules and antennae, including their setose flagella (Fig. 6A); the general shape and details of the major cheliped, including the very diagnostic blunt fingertips of the major chela (Fig. 6C); the proportions and ischial armature of the third pereopod (Fig. 6E), and the general shape and dorsal armature of the telson. Therefore, the Panglao specimen is tentatively assigned to *S. pinguis* **sp. nov.**, awaiting collection of more specimens in both the Philippines and southern Japan.

Etymology. From the Latin word "pinguis", meaning bulky, plump, referring to the new species' general body shape.

Type locality. Manza, Okinawa Island, Ryukyu Archipelago, Japan.

Distribution. Tropical northwestern Pacific: presently known only from the Ryukyu Archipelago, Japan; possibly also in the Bohol Sea, the Philippines (see above).

Habitat. The holotype was extracted from a crevice in large coral rock broken apart with a hammer. No association with other invertebrates was noted in the field (N. Shirakawa and R. Minemizu, pers. comm.). The non-type specimen was collected by brushing coral rubble lifted from about 3 m, on a reef platform.

Remarks. In spite of its morphological distinctiveness, *S. pinguis* **sp. nov.** is clearly a species of *Salmoneus*, as indicated by the possession of an appendix masculine in ovigerous specimens, the presence of a median notch on the posterior margin of the telson, the major chela with a deep proximal constriction on the palm and with serrate finger cutting edges, all features typical to *Salmoneus* (Anker & Marin 2006; Anker et al. 2006). *Salmoneus pinguis* **sp. nov.** is presently the only species in the genus combining the carapace strongly domed or swollen dorsally (Fig. 1); the frontal margin of the carapace broadly triangular, with a rounded rostrum and no trace of orbital teeth (Fig. 2C); the second abdominal pleuron conspicuously enlarged (Fig. 1, 2A); the fourth pleuron greatly overlapping the fifth pleuron (Fig. 1); the antennular and antennal flagella densely covered with long setae (Fig. 2A); the major cheliped with distally blunt, slightly bulbous fingertips (Fig. 4D, E); and the uropodal exopod without a distinct diaeresis (Fig. 3M). The orbital teeth are absent or greatly reduced in two other species of *Salmoneus*: *S. brucei* Komai, 2009 and *S. degravei* Anker, 2010; however, both differ from *S. pinguis* **sp. nov.** by numerous other morphological characters and ecology (Komai 2009; Anker 2010), and are not closely related to the new species. The carapace of *S. babai* Miyake & Miya, 1966 is somewhat domed, but this species has sharp orbital teeth and additionally differs from *S. pinguis* **sp. nov.** by the shape of the major cheliped and the much stouter dactylus on the third to fifth pereopods (Miyake & Miya 1966).

The great number of autapomorphic characters of *S. pinguis* **sp. nov.** obscures its affinities and makes it difficult to place in one of the previously established species groups of *Salmoneus* (Anker & Marin 2006). As pointed out by Anker (2011a), with the rapidly increasing number of species and new character combinations, some of these species groups are becoming of rather limited usage. The intra-generic structure of *Salmoneus* will need to be assessed with a comprehensive phylogenetic analysis based on both morphological and molecular data. However, such an analysis would only make sense after redescription of some poorly described species (e.g., *S. latirostris* (Coutière, 1897) and *S. tafaongae* Banner & Banner, 1966) and description of at least 10 new taxa worldwide (A. Anker, pers. obs.).

Acknowledgments

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