



Communication

Salmoneus chelocrassus sp. nov., a New Morphologically Distinctive Species of the Genus *Salmoneus* Holthuis, 1955 (Decapoda: Caridea: Alpheidae) from Taiwan [†]

Hossein Ashrafi ^{1,*} , Chia-Wei Lin ^{2,3} and Zdeněk Ďuriš ¹

¹ Department of Biology and Ecology, Faculty of Science, University of Ostrava, Chittussiho 10, CZ-71000 Ostrava, Czech Republic; zdenek.duris@osu.cz

² Department of Marine Biotechnology and Resources, National Sun Yat-sen University, Kaohsiung 80424, Taiwan; linchiawei@nmmba.gov.tw

³ National Museum of Marine Biology and Aquarium, Pingtung 94450, Taiwan

* Correspondence: ashrafi.hossein.s@gmail.com

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Abstract: During a faunal investigation using SCUBA in Taiwan in 2014, a single ovigerous specimen of an alpheid shrimp belonging to the genus *Salmoneus* Holthuis, 1955, was collected. Notably, the specimen stood out due to its extremely robust major cheliped compared to other species within the genus. Detailed examination of the specimen unveiled its morphological distinctiveness from all known *Salmoneus* species, confirming its novelty to science. Apart from the remarkably inflated major cheliped devoid of depressions along the ventral margin, the characteristics of *S. chelocrassus* sp. nov., include the markedly reduced arthrobranch on the third maxilliped and the absence of microserrulate setae on the propodus of the fifth pereopod.

Keywords: alpheid shrimps; Indo-West Pacific; new taxa; *Salmoneus*; taxonomy



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1. Introduction

The alpheid shrimp genus *Salmoneus* Holthuis, 1955 is one of the largest genera within the family of Alpheidae Rafinesque, 1815 [1]. The first three species of the genus were described by Coutière [2], and over time, approximately 60 species have been added to the genus [3–8]. Anker and Marin [9] proposed seven informal species groups within the genus based on morphological traits. Amidst the diverse array of body shapes and appendages that characterize species within the genus [10–14], the gill formula remains remarkably consistent [4,15–17]. Representatives of *Salmoneus* typically have five pleurobranches, the presence of arthrobranch at the base of the third maxilliped, the absence of a podobranch, sac-shaped epipods on the first and second maxillipeds, epipods on the third maxillipeds to the fourth pereopods, and setobranchs on all pereopods [9,10]. However, modification in arthrobranch, such as a notably reduced size or hypertrophy, can be observed among some members of the genus, albeit quite infrequently [18,19].

During the examination of material collected from Taiwan in 2014, a single specimen emerged as an outlier, featuring a remarkably inflated major chela. A thorough examination of this specimen led to the realization that it did not align with any of the six groups established by Anker and Marin [9], but rather represents a previously undescribed species. In this study, we provide a description of this newfound species, accompanied by GenBank accession numbers for two mitochondrial genes, 16S rRNA and COI.

The specimen studied herein was collected during a field trip to Taiwan in 2014. The type material is deposited in the collection of the National Museum of Marine Biology and Aquarium, Pingtung, Taiwan (NMMBA; NMMBCD refers to the collection of Crustacea). The DNA extraction, amplification, and sequencing procedures were conducted as described in Ashrafi et al. [20].

2. Taxonomy

Family Alpheidae Rafinesque, 1815 [21].

Genus *Salmoneus* Holthuis, 1955 [22].

Salmoneus chelocrassus sp. nov.

Figures 1–4.

2.1. Material Examined

Holotype: 1 ovigerous female, cl 5.1 mm; Independent Rock, South Bay, Kenting, Taiwan; leg. C.-W. Lin [fcn 20140909-phot.19], 9 September 2014: NMMBCD5636.

2.2. Description

Small-sized alpheid shrimp (cl 5.1 mm). carapace (Figure 1A,B) sparsely covered by short setae; frontal region partly concealing eyes in dorsal view; rostrum triangular in dorsal view with subacute tip, unarmed ventrally, reaching to approximately distal margin of second antennular article, approximately 1.2 times as long as broad; rostral carina obsolete; orbital teeth small, approximately 1/14th length of carapace, subacute, reaching to proximal fourth of first antennular article, approximately twice as long as wide; anterolateral suture present, pterygostomial angle broadly rounded, cardiac notch deep.

Pleon (Figure 1C) with pleura of first to third pleonites rounded anteroventrally and posteroventrally; fourth pleuron angulate posteroventrally; fifth pleuron with small subacute projection posteroventrally; sixth pleuron with subtriangular projection flanking each side of telson, posteroventral suture incomplete.

Telson (Figure 1D) sub-rectangular, slightly tapering distally, approximately 5 times as long as distal width; dorsal surface with 2 pairs of small spiniform setae located at approximately 0.5 and 0.7 of telson length; posterior margin broadly U-shaped, median notch furnished with 2 plumose setae and 2 pairs of spiniform setae, mesial pair slightly longer than lateral pair and the former pair approximately 3.5 times as long as spiniform setae on dorsal surface.

Antennule (Figure 1A,B) with peduncle relatively stout; first article slightly longer than broad; stylocerite relatively robust, with subacute tip, reaching to approximately distal margin of second article; second article approximately as long as broad; third article slightly longer than second article; lateral antennular flagellum biramous, fused portion with three subdivisions, shorter ramus well developed, reaching to approximately eighth subdivision of longer ramus, with six groups of aesthetascs.

Antenna (Figure 1A,B) with stout basicerite, distoventral margin armed with subacute tooth, superior margin with small blunt projection; scaphocerite reaching to approximately middle of third article of antennular peduncle, lateral tooth falling short of reaching distal margin of blade; carpocerite reaching to distal margin of second article of antennular peduncle; flagellum somewhat slender.

Third maxilliped (Figure 3C) with coxa bearing strap-like epipod and broadly rounded lateral plate; antepenultimate article slender, approximately 10 times as long as proximal part; penultimate article slender, slightly broadening distally, approximately 0.3 times as long as antepenultimate article; ultimate article approximately 1.7 times as long as penultimate article, distally armed with subapical spiniform seta; exopod slender, falling short of reaching distal margin of antepenultimate article; arthrobranch small in size but still distinctly lamellate.

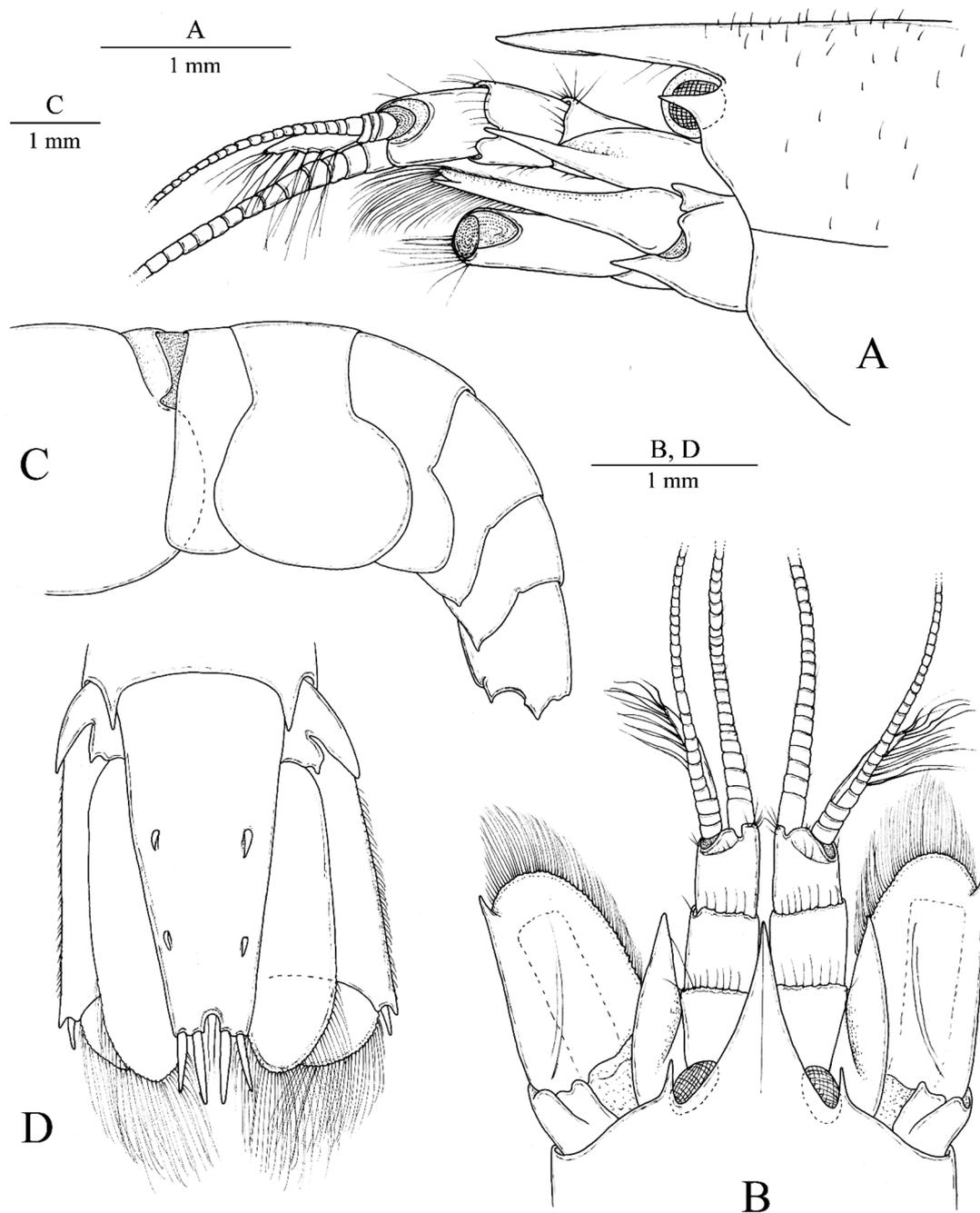


Figure 1. *Salmoneus chelocrassus* sp. nov., holotype, NMMBCD5636. (A), anterior region, lateral view; (B), same, dorsal view; (C), pleon; and (D), telson and uropods.

First pereiopods (chelipeds) (Figure 2) asymmetrical in both size and shape. Major cheliped (Figure 2A–C) robust, carried flexed under body when not in use; coxa with a strap-like epipod and setobranch; ischium 4 times as long as wide, unarmed ventrally; merus widening distally, approximately 2.3 times as long as ischium; carpus small, vase-shaped; chela enlarged, strongly swollen; palm robust, subcylindrical, approximately 1.8 times as long as wide, proximal half slightly depressed on mesial side, with shallow depression mid-dorsally and deep complex groove ventro-proximally, palm approximately twice as long as fingers; fingers slightly twisted when seen dorsally or ventrally, with strongly crossing fingertips, not gaping when closed; pollex with cutting edge armed with 10 teeth, middle teeth strongest, slightly decreasing in size on both sides; dactylus armed with 10 teeth on cutting edge. Minor cheliped (Figure 2D,E) with coxa bearing strap-like

epipod and setobranch; ischium slender, approximately 4 times as long as broad, unarmed ventrally; merus slender, approximately 1.5 times as long as ischium; carpus subequal to merus, widening distally; chela simple, with palm approximately as long as fingers; cutting edges of fingers unarmed.

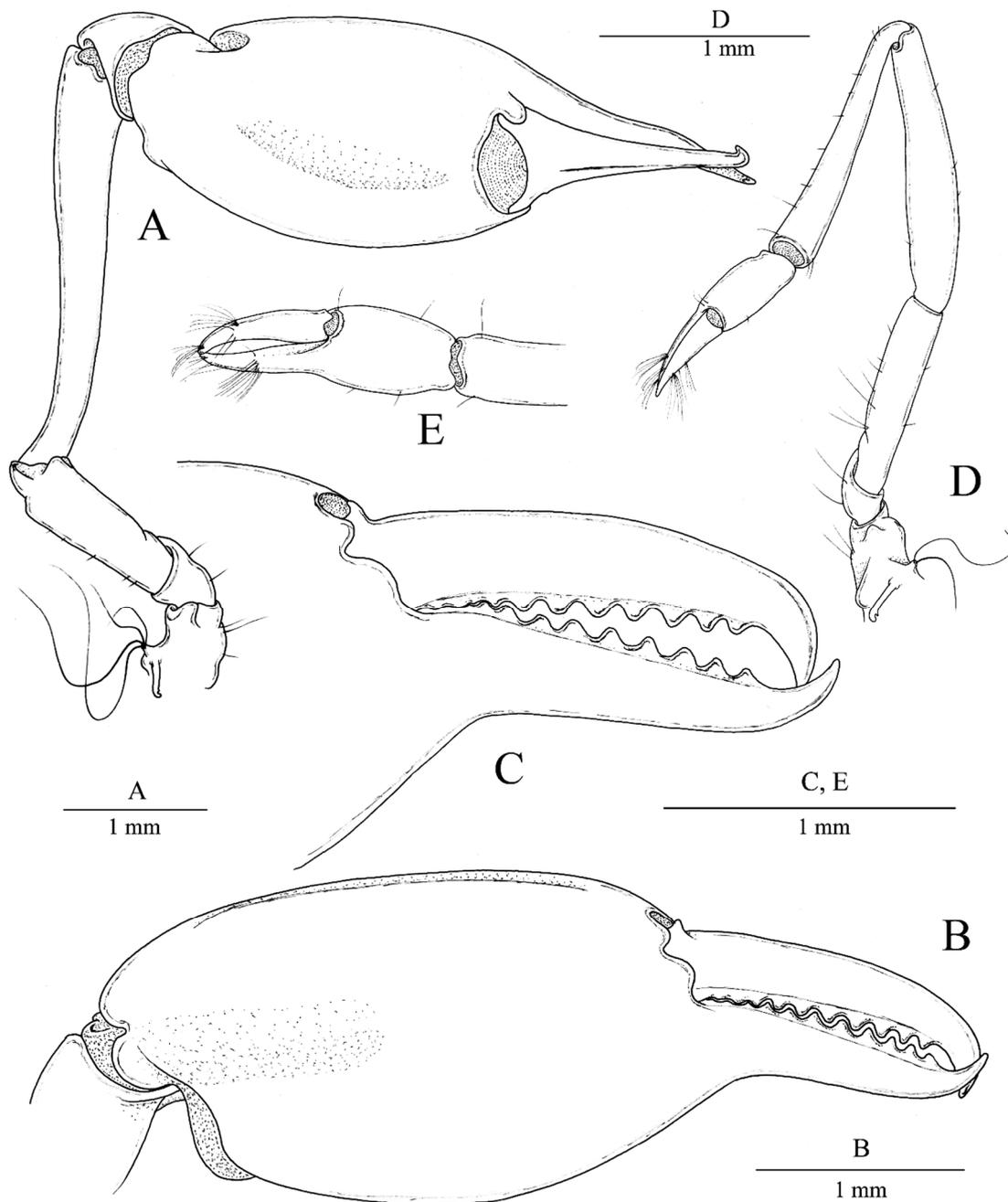


Figure 2. *Salmeoneus chelocrassus* sp. nov., holotype, NMMBCD5636. (A), major cheliped, lateral view; (B), same, chela, mesial view; (C), same, open fingers; (D), minor cheliped, lateral view; and (E), same, chela, mesial view.

Second pereopod (Figure 3B) moderately long, slender; coxa with strap-like epipod and setobranch; basis short, furnished with 2 thick setae on ventral margin; ischium approximately 10 times as long as wide, unarmed ventrally; merus slender, slightly longer than ischium; carpus 1.5 times as long as merus, with 5 subdivisions, proximal one approximately 1.2 times as long as sum of others, middle three subdivisions subequal to

each other, distalmost subdivision subequal to sum of third and fourth subdivisions; chela approximately 0.3 times as long as carpus, fingers slightly longer than palm.

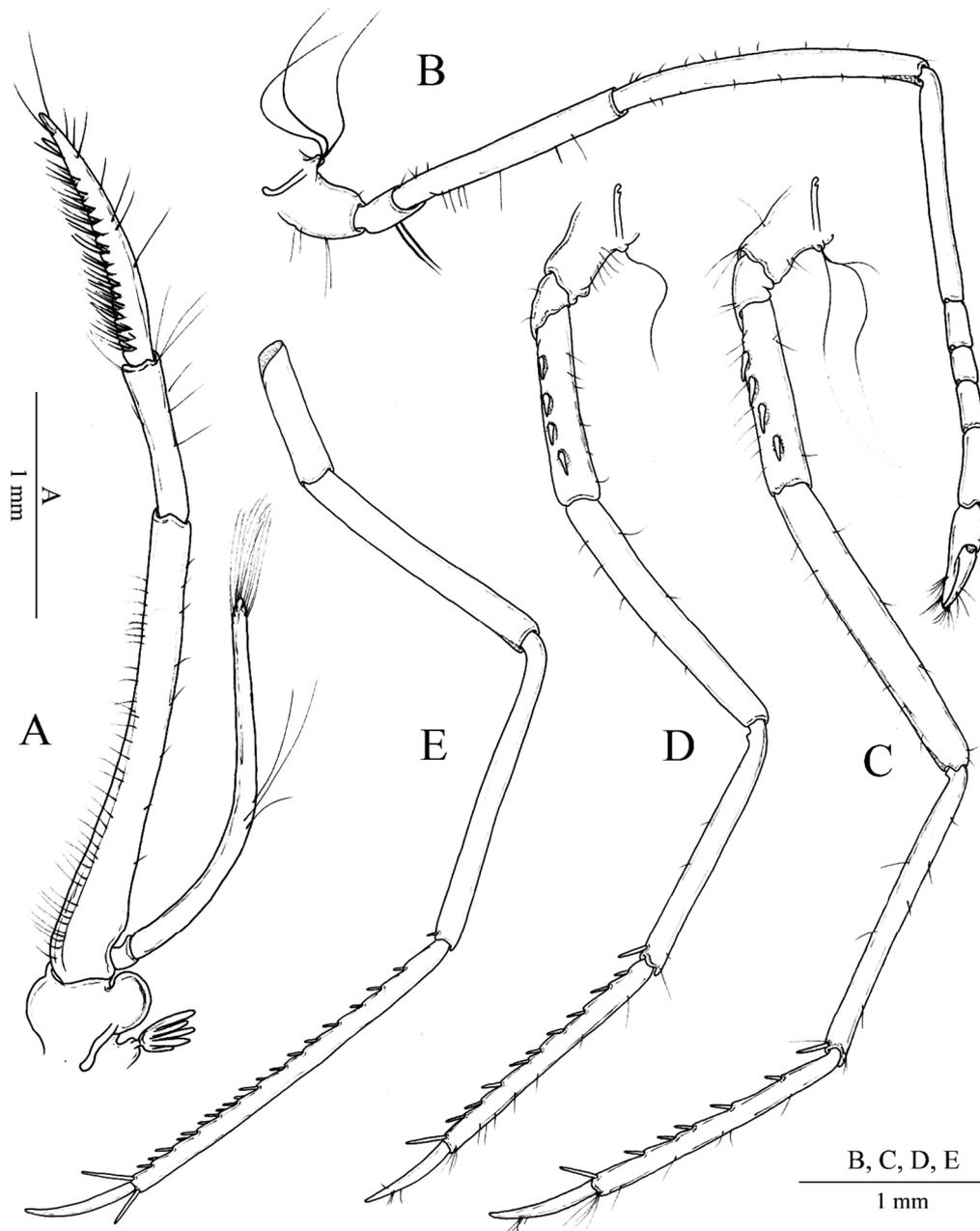


Figure 3. *Salmeoneus chelocrassus* sp. nov., holotype, NMMBCD5636. (A), third maxilliped, ventrolateral view; (B), second pereiopod, lateral view; (C), third pereiopod, lateral view; (D), fourth pereiopod, lateral view; and (E), fifth pereiopod, lateral view.

Third pereiopod (Figure 3C) slender; coxa with strap-like epipod and setobranch; ischium approximately 4 times as long as wide, armed with 4 spiniform setae on ventrolateral surface; merus slender, approximately 1.9 times as long as ischium; carpus more slender and slightly shorter than merus, 7 times as long as wide, with spiniform seta on distoventral margin; propodus slightly shorter than carpus, ventral margin armed with 5 spiniform setae in addition to distal pair of spiniform setae flanking dactylar base; dactylus simple, moderately robust, slightly curved, approximately 0.3 times as long as propodus. Fourth pereiopod (Figure 3D) similar to third pereiopod, somewhat more slender; propodus with 9 spiniform setae on ventral margin and 1 distal pair of spiniform setae adjacent to dactylus.

Fifth pereiopod (Figure 3E) similar to fourth pereiopod; coxa with setobranch but without strap-like epipod; ischium unarmed ventrally; carpus approximately 1.2 times as long as merus, armed with small spiniform seta on distoventral margin; propodus approximately 1.3 times as long as carpus, armed with 2 rows of spiniform setae on ventral margin, mesial row with 13 spiniform setae distributed on entire margin, lateral row with 6 spiniform setae distributed on distal half; microserrulate setae entirely lacking, distal margin with 1 pair of slender spiniform setae on ventral margin and 1 seta on dorsal margin.

Uropods (Figure 1D) with lateral lobe of protopod elongated, subacute distally; exopod ovate, distolateral margin with small triangular tooth adjacent to spiniform seta, diaeresis complete, with blunt lobe mesial to posterolateral spiniform seta; endopod slightly longer than exopod.

2.3. GenBank Accession Numbers

The GenBank accession numbers for the partial fragments of COI and 16S DNA sequences of the new species are OR570294 and OR567541, respectively.

2.4. Coloration

The body and appendages are generally translucent; and the eggs are a vivid orange (Figure 4).

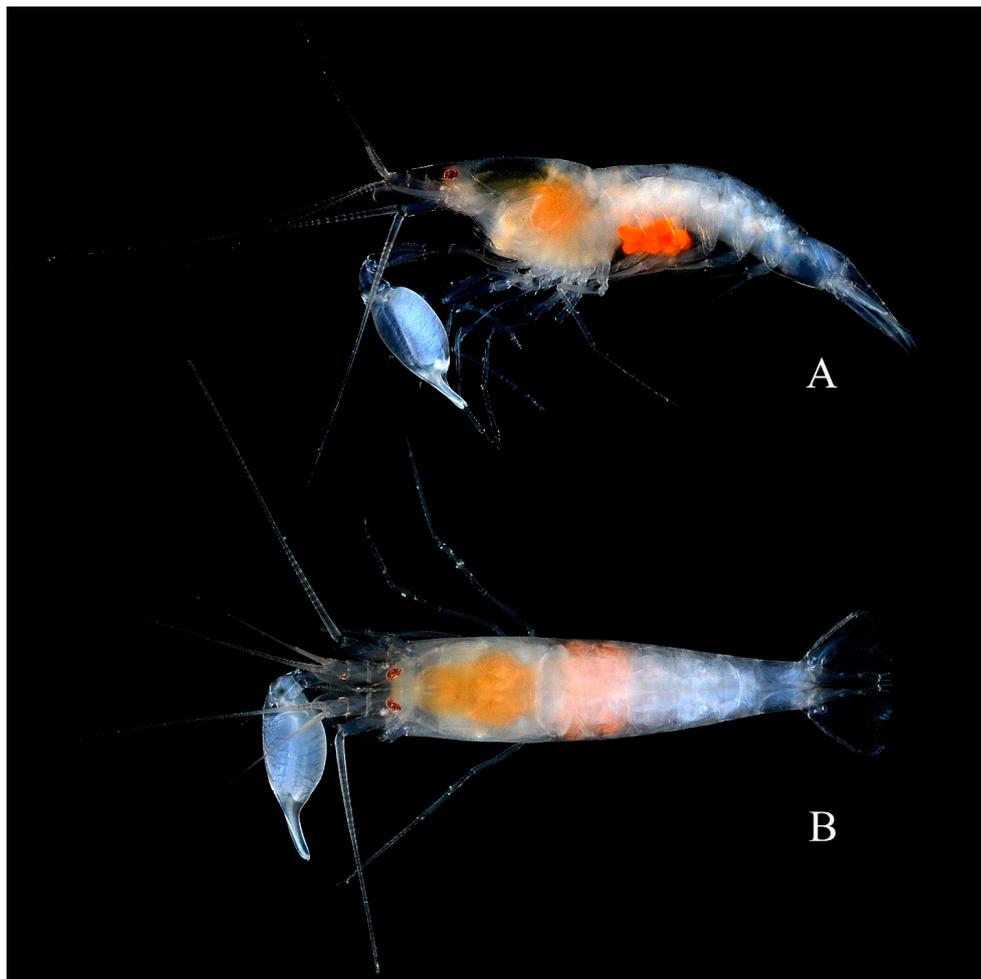


Figure 4. *Salmoneus chelocrassus* sp. nov., holotype, NMMBCD5636, shrimp in life: (A), lateral view; (B), dorsal view. Photographs by C.-W. Lin.

2.5. Etymology

The specific epithet is derived from the Latin word ‘*crassus*’, signifying ‘stout and bulky’, combined with ‘*chela*’ to denote the markedly inflated oval shape of the major chela.

2.6. Ecology

The single specimen of the new species was found while flipping a large rock buried in coral sand (approximately 5–8 cm deep) at a depth of 32 meters. It is uncertain whether the species is a symbiont that resides in burrows (and was therefore found incidentally while demolishing an unknown animal’s burrow) or if it is free-living.

2.7. Remarks

The new species stands out within *Salmoneus* due to the following three distinctive characteristics: (1) a notably reduced-in-size arthrobranch on the third maxilliped; (2) a greatly inflated major cheliped palm, devoid of depressions along the ventral margin; and (3) the propodus of the fifth pereopod which is lacking microserrulate setae and instead features spiniform setae on the distal half of its ventrolateral margin. Notably, the second of these characters can independently serve as distinguishing features for setting *S. chelocrassus* sp. nov. apart from all other *Salmoneus* species.

Although consistently present at the base of the third maxillipeds, the arthrobranch can exhibit size variation across species within *Salmoneus*. However, assessing the size of the arthrobranch may not always be straightforward, as several previous studies have not given careful attention to gill size. The majority of species possess well-developed arthrobranches [6,17,23], and instances of hypertrophy or remarkable reduction are uncommon [18,19]. *Salmoneus sketi* Fransen, 1991, and *S. chelocrassus* sp. nov. are the only known species showcasing such reduced-in-size arthrobranches. *Salmoneus sketi*, originally described from a marine cave within the Adriatic Sea, presents marked morphological dissimilarities from the new species. Clear distinctive characters include a robust rostrum, possession of both major and subminor chelipeds in *S. sketi*, in contrast to *S. chelocrassus* sp. nov., possessing major and minor chelipeds, and a distinctive structure and arrangement of teeth along the major cheliped’s cutting edge [18].

The absence of microserrulate setae on the propodus of the fifth pereopod is a distinguishing feature shared between *S. chelocrassus* sp. nov. and just one other species in the genus: *S. falcidactylus* Anker and Marin, 2006. However, the status of these setae in these two species differs. In the new species, the microserrulate setae are replaced by spiniform setae, whereas in *S. falcidactylus*, the microserrulate setae are completely absent. Moreover, several differentiating traits set the new species apart from *S. falcidactylus*, including distinct orbital teeth in *S. falcidactylus*, a notably bulky and inflated chela in *S. chelocrassus* sp. nov. compared to the much slenderer chela in *S. falcidactylus*, and relatively stout dactyli on the last three pereopods of the new species as opposed to the very slender, sickle-shaped dactyli in *S. falcidactylus*.

Lastly, the chela of the major cheliped are another distinctive trait of *S. chelocrassus* sp. nov. In this species, the palm is markedly inflated, devoid of prominent depressions, a characteristic that lends its name to the species. Two shallow depressions, positioned on the mesial side of the proximal half and on the mid-dorsal surface, are the only depressions observed. While a significantly inflated palm is also found in members of the *S. ortmanni* (Rankin, 1898) group, as defined by Anker and Marin [9], the *S. ortmanni* group can be readily differentiated from *S. chelocrassus* sp. nov. due to the presence of a pronounced depression on the ventral margin.

The distinct characteristics exhibited by *S. chelocrassus* sp. nov. pose challenges in categorizing this newly described species within the species groups outlined by Anker and Marin [9]. As noted in various previous studies [12,13,24], numerous species defy classification within the six defined groups, and Anker [12] proposed that introducing a new group solely for species featuring distinct and occasionally unconventional traits may lack rationale. A forthcoming phylogenetic investigation (Ashrafi et al., in preparation)

is anticipated to provide further insights into the interrelationships among the species in *Salmoneus*.

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