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NEW AND ADDITIONAL RECORDS OF *SALMONEUS* HOLTHUIS, 1955 (DECAPODA, CARIDEA, ALPHEIDAE) FROM BRAZIL, WITH A KEY TO THE SOUTHERN ATLANTIC SPECIES

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ABSTRACT

Two species of the alpheid shrimp genus Salmoneus Holthuis, 1955, are reported from shallow waters of São Sebastião (SP), southeastern Brazil. Salmoneus depressus Anker, 2011 is recorded for the first time in Brazil and the southwestern Atlantic; this species was previously known only from the Caribbean region. Salmoneus ortmanni (Rankin, 1898) is recorded for the first time in southern Brazil (23°S), being previously known in Brazilian waters from a single confirmed record from Atol das Rocas (03°S), with older records referring to Salmoneus carvachoi Anker, 2007. A hitherto unknown morphological variation in S. depressus is discussed and illustrated. Both species are shown in colour to facilitate their identification in the field. A key to the southern Atlantic species of Salmoneus is also provided.

KEY-WORDS: Alpheidae; *Salmoneus*; New records; Artificial reef substrate; Southwest Atlantic.

INTRODUCTION

The alpheid shrimp genus *Salmoneus* Holthuis, 1955, is represented in the western Atlantic by at least 13 species (Chace, 1972; Felder & Manning, 1986; Anker, 2007, 2010, 2011), four of which are known to occur in Brazilian waters: *Salmoneus carvachoi* Anker, 2007; *S. ortmanni* (Rankin, 1898); *S. rocas* Anker, 2007; and *S. setosus* Manning & Chace, 1990 (Christoffersen, 1982; Anker, 2007). Based on

material deposited in the crustacean collection of the Museum of Zoology, University of São Paulo, the most abundant species in Brazil appears to be *S. carvachoi*, which is found in coastal mangrove or estuarine areas of Pernambuco, Sergipe, Bahia, São Paulo, and Paraná (Anker, 2007; Almeida *et al.*, 2012). The other three species are known from only one or a few specimens in Brazil, all from Atol das Rocas (*S. rocas*, *S. ortmanni*, *S. setosus*) and Fernando de Noronha (*S. setosus*) (Anker, 2007). As pointed out by Anker

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(2007), most other records of *S. ortmanni* from Brazil (e.g., Christoffersen, 1982) refer to *S. carvachoi*.

During a short visit of CEBIMar in São Sebastião, São Paulo, Brazil, in October 2013, the authors collected two specimens of *Salmoneus* in the rocky intertidal area around the marine station. An additional specimen was found among samples that came from an Artificial Reef Substrate (hereafter ARS) placed for 14 months in about 3–4 m deep water in the São Sebastião channel off CEBIMar, and retrieved and dismantled in April 2013. Two specimens (including the one from an ARS) were identified as *Salmoneus depressus* Anker, 2011; the third specimen was identified as *S. ortmanni*. This material represents (1) the first record of *S. depressus* for Brazil and the southwestern Atlantic and (2) the first confirmed record of *S. ortmanni* for southern Brazil.

MATERIAL AND METHODS

Two specimens were collected in the rocky intertidal at low tide, by turning over very large rocks and then browsing muddy water or catching shrimps visually with a small dip net. One specimen was found by extracting mobile macrofauna from one of the ARS. The ARS were constructed of five tubes of PVC of 10 cm of inner diameter attached to each other, filled with plant fibers, forming a block of 40 cm long. Four of these ARS were deployed at depths of 3 to 4 m on sandy-mud bottoms off CEBIMar (Marine Biology Center, University of São Paulo) in São Sebastião, São Paulo, Brazil. The ARS were retrieved after 14 months, dismantled and examined for mobile and sessile macrofauna.

Drawings were made under a Wild MZ6 stereomicroscope equipped with a camera lucida. Carapace length (cl, in mm) was measured along the dorsal mid-line from the tip of the rostrum to the posterior margin of the carapace. All Brazilian material is deposited in the crustacean collection of the Museum of Zoology, University of São Paulo (MZUSP). Comparative material is deposited in the collections of the Florida Museum of Natural History, University of Florida, Gainesville, FL, U.S.A. (FLMNH UF).

All individuals of *Salmoneus*, including breeding (ovigerous) ones, possess a well-developed appendix masculina on each of the second pleopods, suggesting some type of hermaphroditism (Carvacho, 1989; Anker, 2011). However, until *Salmoneus* is experimentally and anatomically shown to be hermaphroditic, the actual sex of the shrimps cannot be determined and only a simple distinction between non-ovigerous and ovigerous specimens can be made.

TAXONOMY

Family Alpheidae Rafinesque, 1815 Genus *Salmoneus* Holthuis, 1955

Salmoneus depressus Anker, 2011

Figs. 1, 2

Salmoneus depressus Anker, 2011: 44, figs. 4–6.

Material examined: Brazil, São Paulo: 1 ovigerous specimen (cl 5.2 mm), MZUSP 30934, São Sebastião, Praia do Segredo, near CEBIMar, 23°49'43.53"S, 45°25'24.68"W, rocky intertidal, low tide (0.2 m tide), near low tide mark, under very large rock on mixed gravel-sand substrate, sieving muddy water with dip-net, P.P.G. Pachelle, A. Anker, J.B. Mendonça coll., 31 October 2013; 1 non-ovigerous specimen, missing minor cheliped (cl 3.8 mm), MZUSP 28412, São Sebastião channel, off CEBIMar, near tide-gauge, mud-rock bottom, depth 3–4 m, from ARS (retrieved after 14 months), M. Tavares and J.B. Mendonça coll., 17 April 2013.

Comparative material: Caribbean Sea, St. Martin: 1 non-ovigerous specimen, missing major cheliped (cl 5.4 mm), FLMNH UF 31907, Tintamarre Island, near Remorqueur wreck, coral rubble brushing under rocks, depth 10–15 m, A. Bemis *et al.*, 10 April 2012 [field collection number BSTM 0227].

Description: See detailed description in Anker (2011); some additional drawings of the Brazilian specimens are provided in Fig. 1.

Colour in life: Semitransparent beige to pale straw-yellow; eggs and ovary pale rusty-orange (Fig. 2).

Distribution: Caribbean Sea (Panama, Venezuela, Barbados, St. Martin) (Anker, 2011; present study); Brazil (São Paulo) (present study).

Remarks: The material from São Sebastião agrees reasonably well with the description of *S. depressus* in Anker (2011) based mainly on material from the Caribbean coast of Panama. In addition, the two Brazilian specimens were directly contrasted to a more recently collected specimen from St. Martin, eastern Caribbean Sea. The differences observed between the Brazilian and Caribbean specimens include the shape and size of the orbital teeth, development of the rostral carina, armature of the major chela, fifth and sixth pleonite, and ischium of the fifth pereopod.

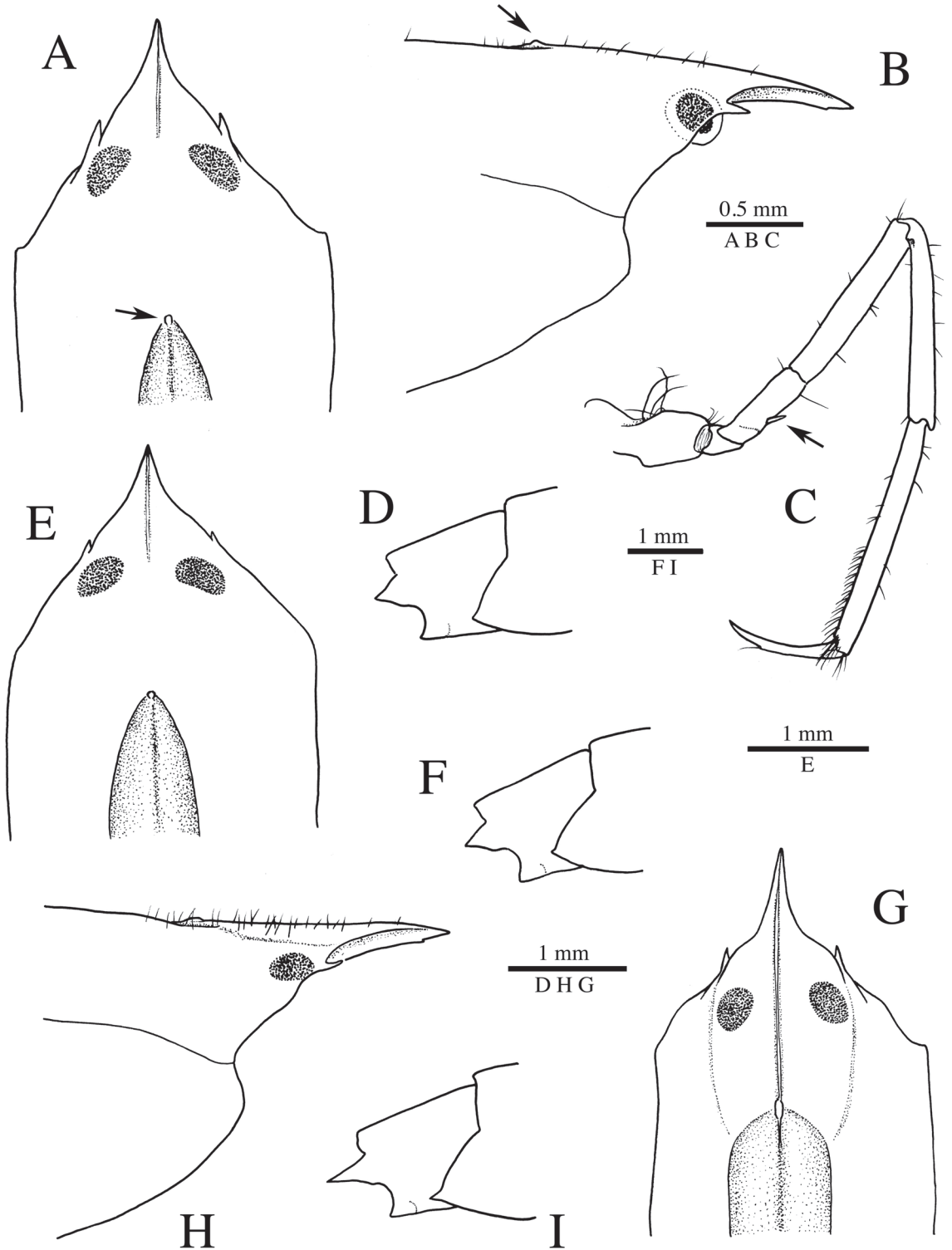


FIGURE 1: A-I, *Salmeoneus depressus* Anker, 2011. A-D, non-ovigerous specimen from São Sebastião, Brazil, MZUSP 28412. E-F, ovigerous specimen from São Sebastião, Brazil, MZUSP 30934; G-I, non-ovigerous specimen from St. Martin, Caribbean Sea, FLMNH UF 31907. A, E, G – anterior region of carapace, dorsal view. B, H – anterior region of carapace, lateral view. C – right fifth pereiopod, lateral view. D, F, I – distal fifth pleuron and sixth pleonite, lateral view. Scale bars = 1 mm. Note in 1A, E, G differences in the development of the orbital teeth; in 1A-B, E, G, H (arrow in A and B) low elevation near the anterior edge of the dorsal depression of the carapace; and in 1C (arrow) a spiniform seta on the ischium of the fifth pereiopod.

The two Brazilian specimens of *S. depressus* markedly differ from each other in the development of the orbital teeth (Fig. 1A, E). In the larger ovigerous specimen (Fig. 1E), the orbital teeth are distinctly smaller than in the smaller non-ovigerous specimen (Fig. 1A), in which they are similar to those of the non-ovigerous specimen from St. Martin (Fig. 1G)

and the type specimens from Panama (Anker, 2011: Fig. 4A, M). In fact, in the development of the orbital teeth, the ovigerous specimen from São Sebastião (Fig. 1E) approaches *S. excavatus* Anker, 2011, the presumed eastern Pacific sister species of *S. depressus* (Anker, 2011: fig. 1A). However, the two species can still be separated from each other by the presence (in

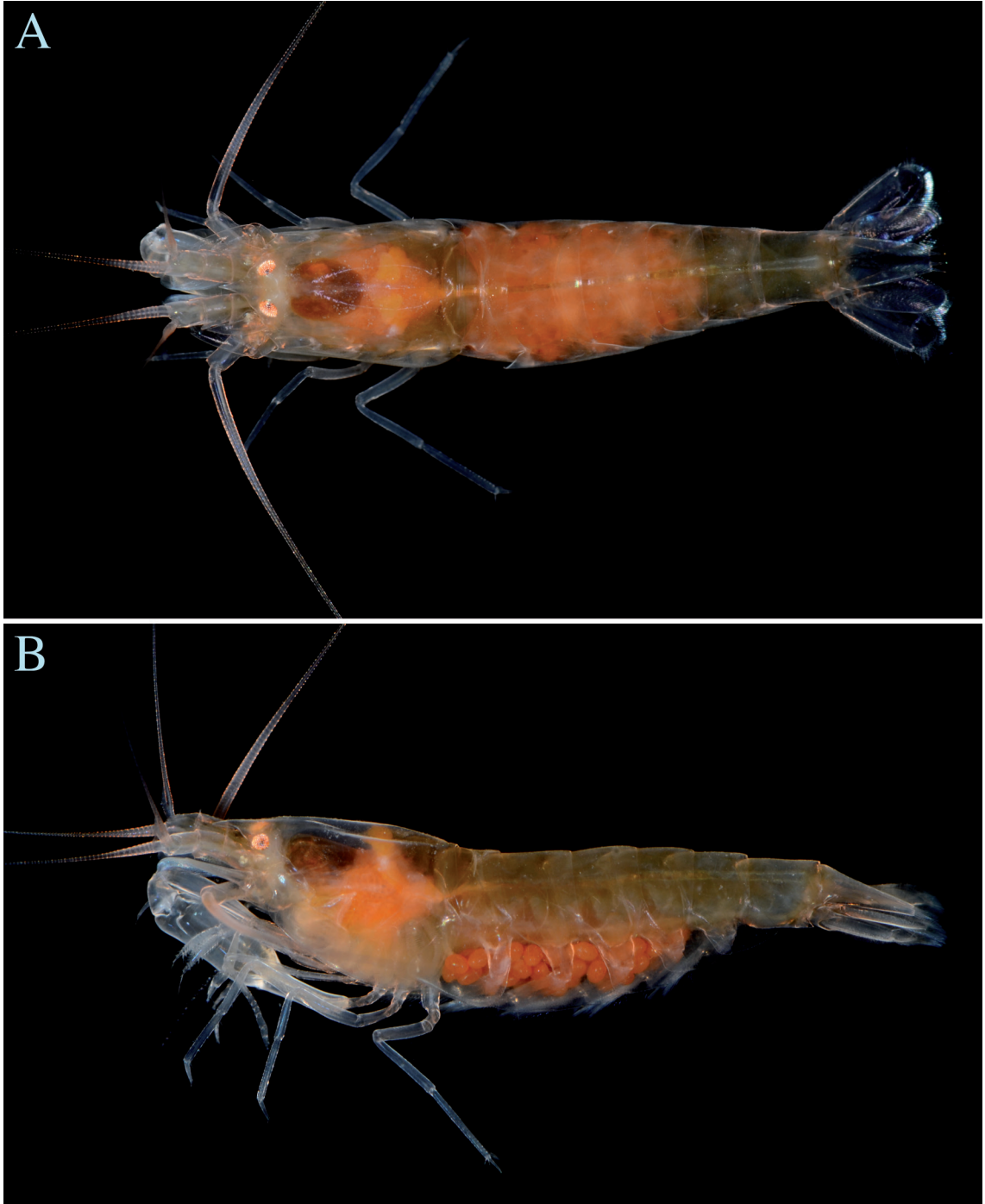


FIGURE 2: *Salmoneus depressus* Anker, 2011, ovigerous specimen from São Sebastião, Brazil, MZUSP 30934, dorsal (A) and lateral (B) views.

S. depressus) and absence (in *S. excavatus*) of a stout spiniform seta on the ischium of the minor cheliped, as well as the comparatively longer second article of the antennular peduncle in *S. excavatus* (Anker, 2011).

In both specimens of *S. depressus* from São Sebastião, the rostral carina is rather poorly marked, relatively short, and does not extend posterior to the level of the eyes (Fig. 1A, E). In the specimen from St. Martin, the rostral carina is more conspicuous, extending into the dorsal depression (Fig. 1G). In addition, in all three specimens examined, the rostral carina bears a low elevation, sometimes in the form of a tubercle, near the anterior edge of the dorsal depression of the carapace (Fig. 1A, B, E, G, H). This feature was not mentioned in the original description of *S. depressus*, although a low broad elevation can be seen in Anker's (2011: fig. 4E). This elevation is rather inconspicuous in the larger ovigerous specimen from São Sebastião (Fig. 1E) and is most developed in the non-ovigerous specimen (Fig. 1A, B) and in the specimen from St. Martin (Fig. 1G, H). A similar, minor elevation on the mid-dorsal line of the carapace, at the anterior edge of the dorsal depression, is present in *S. excavatus* (Anker, 2011: fig. 1D, F).

In the Brazilian specimens of *S. depressus*, the major chela fingers are armed with 12-13 teeth, *i.e.*, one or two teeth more than in the type series from Panama (11-12 teeth, *cf.* Anker, 2011). In the general shape of the major chela, including the characteristic depressions on the palm, the Brazilian specimens closely resemble the type series.

In both specimens from São Sebastião, the posteroventral margin of the fifth pleuron ends in a small, blunt tooth, whilst the posterior margin of the sixth pleonite is produced into a moderately long, sharp tooth (Fig. 1D, F). In the specimen from St. Martin, the posteroventral margin of the fifth pleuron is produced into a much larger, subacute tooth, whilst the sixth pleonite is produced into a much stouter, sharp tooth (Fig. 1I), which is distinctly longer than the tooth illustrated for a type specimen from Panama (Anker, 2011: fig. 4G).

Anker (2011) stated that the ischium of the fifth pereopod is unarmed in *S. depressus*, see Anker (2011: fig. 5I). The ovigerous specimen from São Sebastião also has no trace of a spiniform seta on the ischium of the fifth pereopod. However, in the smaller non-ovigerous specimen, a very conspicuous spiniform seta is present on the ischia of both fifth pereopods (Fig. 1C). Thus, the presence or absence of a spiniform seta on the ischium of the fifth pereopod is now considered to be a variable feature in *S. depressus*.

The morphological variation shown herein for *S. depressus*, especially in the rostro-orbital region (Fig. 1A, E, G; see also Anker, 2011: fig. 4A, M) and in the configuration of the posterior abdominal somites (Fig. 1D, F, I; see also Anker, 2011: fig. 4G), is rather significant. However, with the presently available material (type series from Panama, two heavily damaged specimens from Venezuela and Barbados, one incomplete specimen from St. Martin, one complete and one incomplete specimens from Brazil), it is not possible to make more conclusive statements. The apparently disjunct, Caribbean – southern Brazil distribution of *S. depressus* may be simply due to insufficient collecting of this cryptically living shrimp along the eastern- and north-eastern Brazilian coast.

Salmoneus ortmanni (Rankin, 1898)

Fig. 3

Athanas ortmanni Rankin, 1898: 251, pl. 30, fig. 7.

Jousseumea ortmanni – Schmitt, 1936: 367, pl. 12, fig. 2.

Salmoneus ortmanni – Chace, 1972: 79 (part. ?); Banner & Banner, 1981: 56, fig. 7h-k; Anker, 2007: 23, fig. 1, 2; Anker, 2010: 199, figs. 12b-f, 13a, 14e.

Not *Salmoneus ortmanni* – Carvacho, 1979: 453; Christoffersen, 1982: 94; Christoffersen, 1998: 362 (part.); Coelho dos Santos & Coelho, 2001: 78 (= *S. carvachoi* Anker, 2007); Carvacho & Ríos, 1983: 283; Ríos & Carvacho, 1983: 462; Villalobos Hiriart *et al.*, 1989: 16; Ríos, 1992: 7 (= *Salmoneus* sp. aff. *ortmanni* A and B, Anker, in prep.).

For complete synonymy see Anker (2007).

Material examined: Brazil, São Paulo: 1 non-ovigerous specimen (cl 6.7 mm), MZUSP 30935, São Sebastião, Praia do Cabelo Gordo near CEBIMar, 23°49'35.85"S, 45°25'18.50"W, rocky intertidal, low tide (0.2 m tide), large tide pool among rocks, under very large rock on sand, dip-net, J.B. Mendonça, A. Anker, P.P.G. Pachelle coll., 31 October 2013.

Description: Rankin (1898) provided a very superficial description of *S. ortmanni* accompanied by a single general drawing; for a redescription and detailed illustrations see Anker (2007), and Schmitt (1936) and Anker (2010) for additional figures.

Colour in life: Semitransparent bright orange-yellow (Fig. 3).

Distribution: Caribbean Sea (e.g., Panama, Costa Rica), Bahamas, Bermuda (Anker, 2007, 2010); Brazil (Atol das Rocas and São Paulo) (Anker, 2007; present study).

Remarks: The single specimen from São Sebastião agrees well with the material from Atol das Rocas reported in Anker (2007). This specimen represents the first confirmed record of *S. ortmanni* in southern Brazil and also the first record of this species on the

continental coast of Brazil. Anker (2007) stated that most Brazilian records and identifications of *S. ortmanni* before 2007 (e.g., Christoffersen, 1982, 1998) actually refer to *S. carvachoi*. The two species can be easily separated by the length and shape of the dactyli of the third to fifth pereopods, as well as markedly different colour patterns (Anker, 2007, 2010; see also Fig. 3 and key below). In addition, most collecting records of *S. carvachoi* are from estuarine and mangrove habitats, indicating the species' preference for

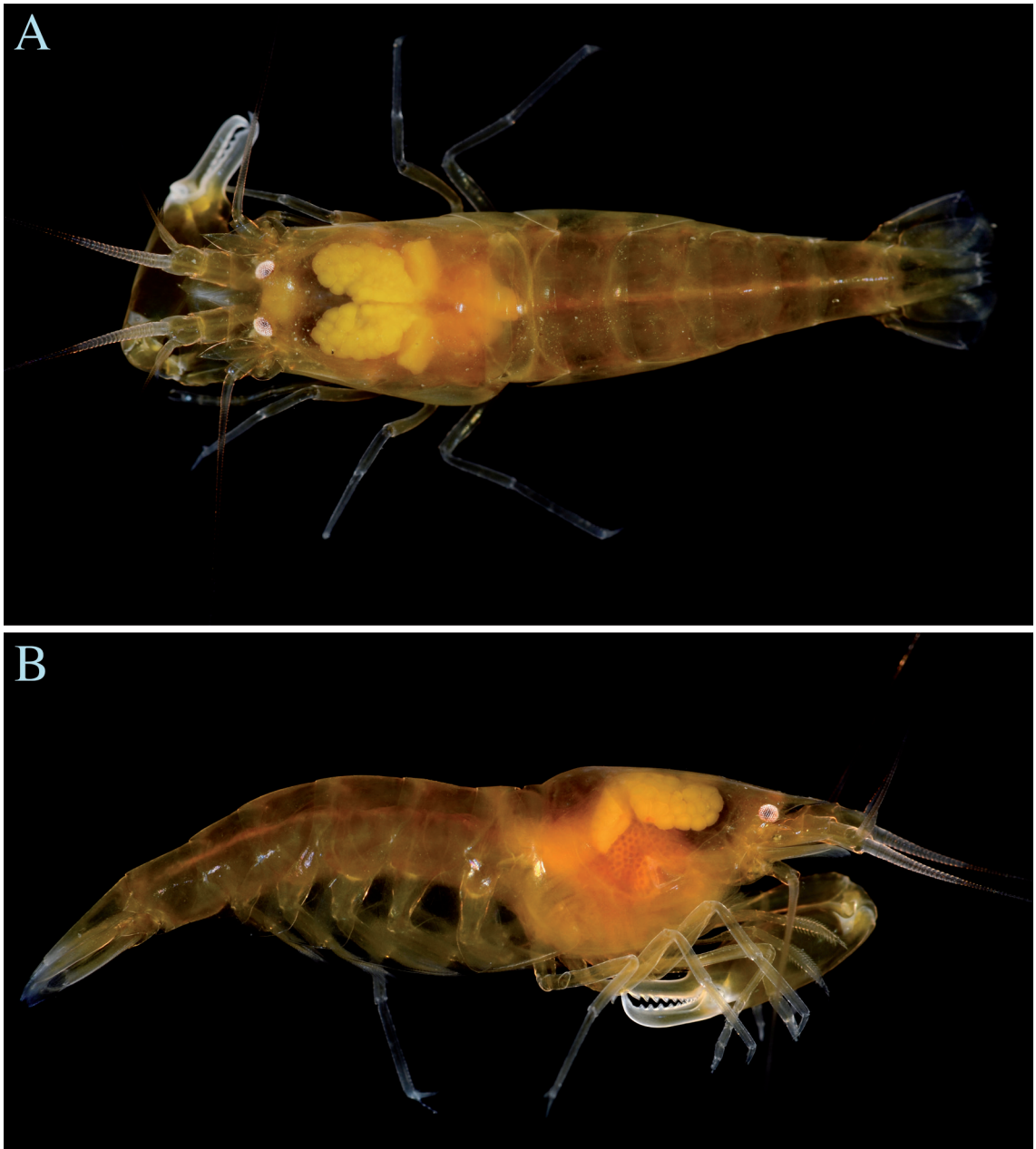


FIGURE 3: *Salmoneus ortmanni* (Rankin, 1898), non-ovigerous specimen from São Sebastião, Brazil, MZUSP 30935, dorsal (A) and lateral (B) views.

soft sediments (Anker, 2007), with some specimens encountered in burrows of *Alpheus estuariensis* Christoffersen, 1984. In contrast, *S. ortmanni* appears to be associated with more saline, sand-rock or rubble-rock

habitats, e.g., in Atol das Rocas and Panama (Anker, 2007, 2010), which is corroborated by the present specimen found under a large rock in the intertidal pool.

Key to the known species of *Salmoneus* from the southern Atlantic Ocean

1. Carapace with deep depression on dorsal surface *S. depressus* Anker, 2011
- 1'. Carapace without deep depression on dorsal surface 2
2. Major cheliped with merus conspicuously widening and excavated distally; major chela with deep depression ventrally 3
- 2'. Major cheliped with merus not or slightly widening, at most shallowly depressed distally; major chela not deeply depressed ventrally 4
3. Dactylus of third and fourth pereopods very long and slender, more than 0.6-times length of propodus; colour in life: semitransparent with purplish-bluish transverse bands on abdomen
..... *S. carvachoi* Anker, 2007
- 3'. Dactylus of third and fourth pereopods not particularly long or slender, less than 0.5-times length of propodus; colour in life: bright orange-yellow *S. ortmanni* (Rankin, 1898)
4. Rostrum about as wide as long; orbital teeth small, not reaching 0.3 length of rostrum
..... *S. teres* Manning & Chace, 1990
- 4'. Rostrum distinctly longer than wide; orbital teeth large, reaching 0.4 length of rostrum 5
5. Carapace covered with numerous, very thick, erect setae *S. setosus* Manning & Chace, 1990
- 5'. Carapace smooth, without thick, erect setae *S. rocas* Anker, 2007

RESUMO

Duas espécies de camarões Alpheidae do gênero Salmoneus Holthuis, 1955, são registradas para águas litorais de São Sebastião (SP), sudeste brasileiro. Salmoneus depressus Anker, 2011, previamente conhecida da região do Caribe, é registrada pela primeira vez para o Brasil e para o Atlântico sul ocidental. Salmoneus ortmanni (Rankin, 1898), conhecida anteriormente de um único registro confirmado para o Atol das Rocas (03°S), é mencionada aqui para o litoral sudeste do Brasil (23°S). Os registros prévios de S. ortmanni para o Brasil referem-se, na realidade, à Salmoneus carvachoi Anker, 2007. Variações morfológicas em S. depressus são discutidas e ilustradas. Fotografias em cor de S. depressus e S. ortmanni obtidas a partir de exemplares vivos são fornecidas, assim como uma chave para as espécies de Salmoneus conhecidas para o Atlântico sul.

PALAVRAS-CHAVE: Alpheidae; *Salmoneus*; Novos registros; Recifes artificiais; Atlântico sul ocidental.

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