

## A new species of *Alpheus* from the tropical eastern Atlantic (Crustacea: Decapoda: Alpheidae)

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### Abstract

*Alpheus ribeiroae* sp.n. is described on the basis of two female specimens collected from a burrow on a tidal sandflat in the Cape Verde Islands, eastern tropical Atlantic Ocean. The new species belongs to the *A. brevisrostris* group, and shows affinities to the Indo-West Pacific *A. barbatus* COUTIÈRE and the Eastern Pacific *A. aequus* KIM & ABELE. The new species is distinguishable from all other Atlantic species of the *A. brevisrostris* group in a number of characters, including a very short rostrum, and a simple, conical dactylus on the third to fifth pereopods.

**Key words:** Alpheidae, Cape Verde Islands, new species.

### Zusammenfassung

*Alpheus ribeiroae* sp.n. wird anhand von zwei weiblichen Exemplaren beschrieben, die von Bauten in einem Sandwatt auf den Kap Verde Inseln (tropischer Ostatlantik) gesammelt wurden. Die neue Art gehört zur *A. brevisrostris* Gruppe und zeigt Ähnlichkeiten mit dem Indo-westpazifischen *A. barbatus* COUTIÈRE und dem ostpazifischen *A. aequus* KIM & ABELE. Die neue Art unterscheidet sich von allen andern atlantischen Arten der *A. brevisrostris* Gruppe durch zahlreiche Merkmale, wie ein sehr kuzes Rostrum und einen einfachen konischen Dactylus an den dritten bis fünften Pereiopoden.

### Introduction

The alpheid fauna of the eastern Atlantic Ocean (delimited here as the coasts of western and northern Europe including the British Isles, the Mediterranean region, the Black Sea, coasts of western Africa from Morocco south to the Cape Province, Canary Islands, Azores, Madeira, Cape Verde Islands, and the islands in the Gulf of Guinea) comprises now approximately 45 species, distributed among 10 genera: *Alpheus* FABRICIUS, 1798 (23 species); *Metalpheus* COUTIÈRE, 1906 (one species); *Synalpheus* BATE, 1888 (four species); *Alpheopsis* COUTIÈRE, 1896 (one species); *Salmoneus* HOLTHUIS, 1955 (four species); *Deioneus* DWORSCHAK, ANKER & ABED-NAVANDI, 2000 (one species), *Betaeus* STIMPSON, 1860 (one species), *Automate* DE MAN, 1888 (three species), *Athanas* LEACH, 1814 (four to seven species) and *Potamalpheops* POWELL, 1979 (four species, one undescribed, two exclusively in fresh water) (cf. HOLTHUIS 1951, 1952, HOLTHUIS & GOTTLIEB 1958, RIBEIRO 1964, 1968, CROSNIER & FOREST 1966, POWELL 1979, TÜRKAY 1982, FRANSEN 1992, DWORSCHAK & al. 2000). Two more genera (one new) and several

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new species will be reported in the near future from Nigeria, Turkey and Spain, which will raise the total number of genera to 12 (DE GRAVE & ANKER, in prep.; GRIPPA, in prep.; T. ILIFFE, pers. comm., auch J. DAUME, pers. comm.).

The most extensive collections of Alpheidae from the Cape Verde Archipelago were made by three expeditions: the "Challenger" (BATE 1888), the "Atlantide" (HOLTHUIS 1951), and the "Calypso" (CROSNIER & FOREST 1966). For instance, the "Calypso" material contained nine species of Alpheidae, while two more recent expeditions to the Cape Verde Archipelago, with an emphasis on subtidal and intertidal decapods and the islands previously not sampled, yielded only five species from this family (TÜRKAY 1982). RIBEIRO's (1968) collection of Caridea from Cape Verde contained only three species. The collecting techniques used during these two expeditions were of a classic nature, and included dredges, collection by diving and intertidal sampling. The investigation of more specialized microhabitats, such as mudshrimp burrows, has only been carried out very recently. A short field trip by D. Abed-Navandi in September 1999, focusing specifically on thalassinidean burrows, resulted in the collection of several interesting alpheid shrimps, including the type-material for two recently described species (DWORSCHAK & al. 2000): *Salmoneus caboverdensis* DWORSCHAK, ANKER & ABED-NAVANDI, 2000 and *Deioneus sandizelli* DWORSCHAK, ANKER & ABED-NAVANDI, 2000, which were both collected with the aid of a bait pump ("yabby pump") on a fine-sand tidal flat near Moia-Moia on the island of São Tiago. In the present report we take the opportunity to describe a further new species from this interesting locality.

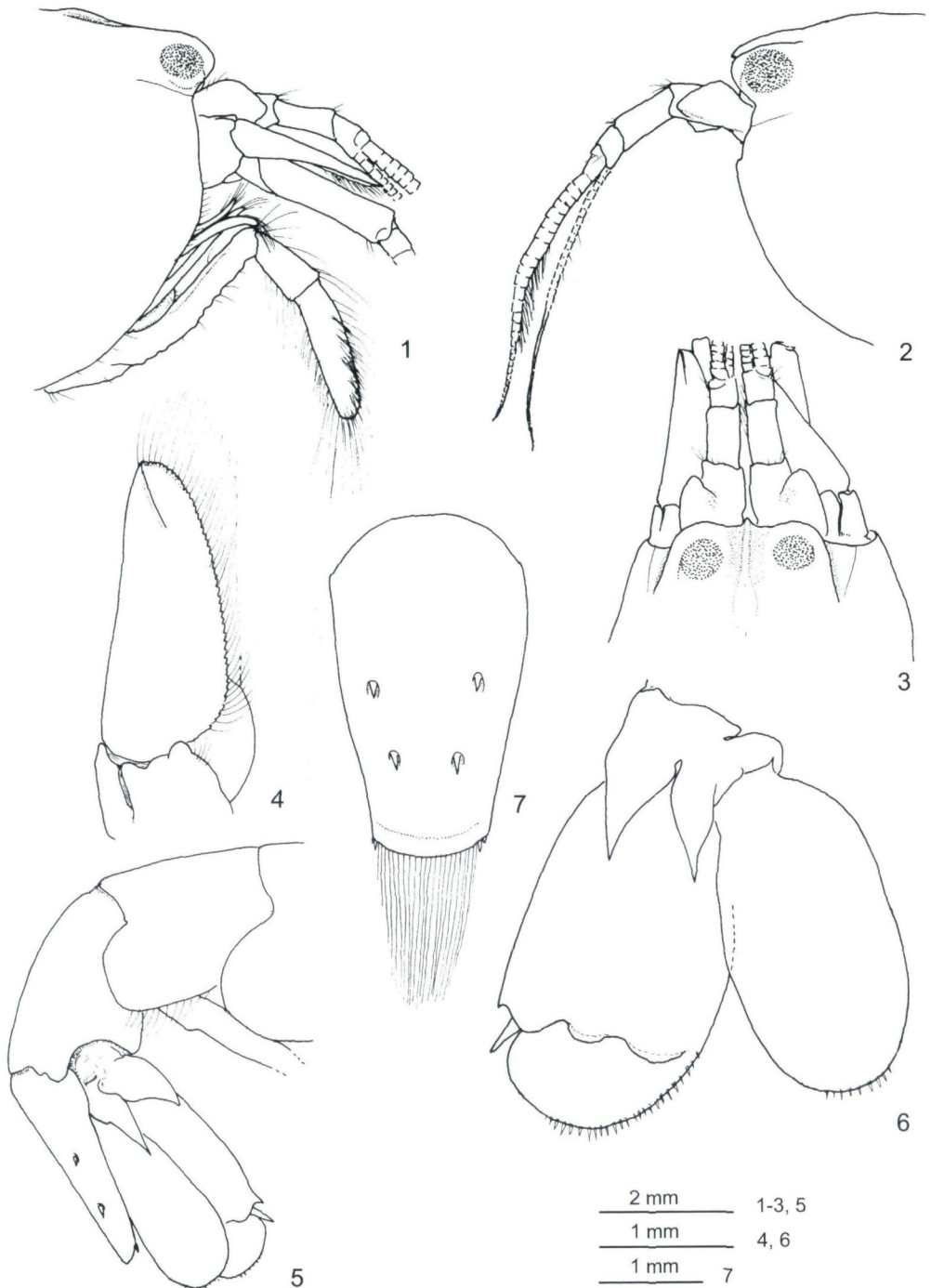
Two female specimens of *Alpheus* collected at Moia-Moia could not be assigned to any species known to occur in the eastern Atlantic. The larger specimen is lacking its minor cheliped, and the smaller specimen its major cheliped. According to the features of the major cheliped, the species is clearly a member of the speciose *Alpheus brevirostris* group. After comparing the specimens to all members of this group (including both Atlantic and the Indo-Pacific species), and particularly to two very closely related species, we came to the conclusion that the species from Moia-Moia is undescribed. The fact that the both specimens are females (sometimes both sexes are needed to identify a species of *Alpheus*) had been initially seen as an obstacle to proceed to a formal description of this species. In this particular case however, the male features, and particularly the male minor cheliped, seem to be of less importance for a species diagnosis. In view of several unique features clearly separating our Cape Verde specimens, not only from all other species of *Alpheus* present in the eastern and western Atlantic, but also from all Indo-Pacific species of the *A. brevirostris* group, we decided to describe it as a new species.

The carapace length (CL) and the total length (TL), measured from the tip of the rostrum to the posterior margin of the carapace and the tip of the telson, respectively, are given in mm. Abbreviations as used in the text: MNHN - Muséum National d'Histoire Naturelle, Paris; MNRJ - Museu Nacional Rio de Janeiro; NHMW - Naturhistorisches Museum Wien; YMP - Yaeyama Marine Park Research Station.

### *Alpheus ribeiroae* sp.n. (Figs. 1 - 27)

**Holotype:** female (CL 9.7 mm, TL 25 mm), NHMW 19842, tidal flat at Moia-Moia, NE coast of Ilha do São Tiago, Cabo Verde (Cape Verde Islands), fine sand, September 1999, yabby pump, D. Abed-Navandi, coll.

**Paratype:** female (CL 5.1 mm, TL ca. 14 mm), NHMW 19843, same data as for the holotype.



Figs 1 - 7. *Alpheus ribeiroae* sp.n., holotype NHMW 19842: frontal region, lateral view (1); same from the other side, left A2 removed (2); same, dorsal view (3); left scaphocerite (4); tail fan and abdominal somites 5 and 6, lateral view (5), left uropod (6) and telson (7), dorsal view.

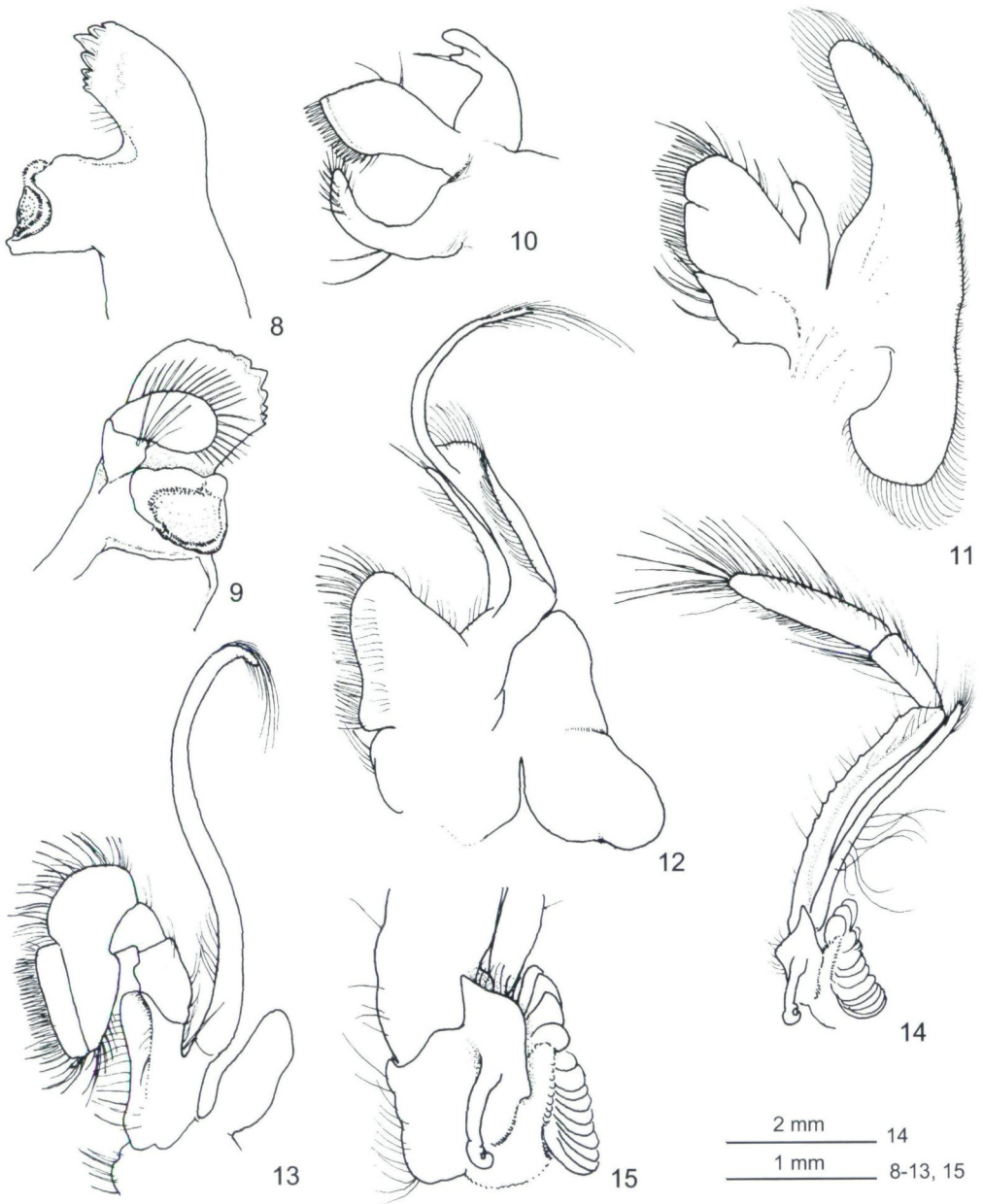
**Description:** Carapace smooth, not setose, laterally not particularly compressed, stout, almost as high as long, dorsally somewhat inflated (especially in the larger female), anterior half convex in lateral view (Fig. 1). Rostrum very short, blunt distally (Fig. 2); medio-rostral carina sharp, posteriorly more flattened (Fig. 3); orbito-rostral grooves shallow, with margins not sharply delimited (Fig. 3); orbito-rostral process not conspicuous. Orbital hoods inflated, lacking teeth, frontal margin of each orbital hood convex. Antero-lateral margin of carapace with a small longitudinal suture ventral to orbital hoods; pterygostomial angle rounded, slightly protruding (Fig. 2); branchiostegal margin furnished with scarce setae; cardiac notch very small. Eyes completely concealed in dorsal, lateral and partly in frontal view; ocellar beak well developed, vertically protruding towards the rostrum.

Antennular peduncles relatively short, second segment slightly longer than first segment; stylocerite short, distally rounded, reaching only to 3/4 or 4/5 of length of the first segment; mesio-ventral carina of first segment bearing broadly triangular tooth (Fig. 2); outer flagellum with secondary ramus feebly developed, short, with numerous aesthetasc tufts. Projection at the base of antennule weakly developed, obtuse. Antennae relatively small, basicerite with ventro-lateral tooth reduced (Fig. 1); carpocerite slender, reaching slightly beyond scaphocerite; scaphocerite exceeding distal margin of antennular peduncle, more than twice as long as wide, tapering distally, outer margin straight, anterior margin slightly exceeding disto-lateral tooth; cleft between disto-lateral tooth and blade deep (Fig. 4); tip of disto-lateral tooth slightly curved and dorsally covered by a small medio-distal portion of blade.

Mouthparts not species specific, typical for *Alpheus* (Figs 8 - 15). Mandible with incisor process very stout, bearing distally rounded teeth (Fig. 8); molar process also stout. Maxillula, maxilla, first and second maxillipeds as illustrated, not species specific. Third maxilliped rather stout (Fig. 14); antepenultimate segment flattened, ventral margin irregularly serrated; ultimate segment very setose; coxa with lateral plate ear-shaped, distally furnished with setae (Fig. 15); arthrobranch well developed.

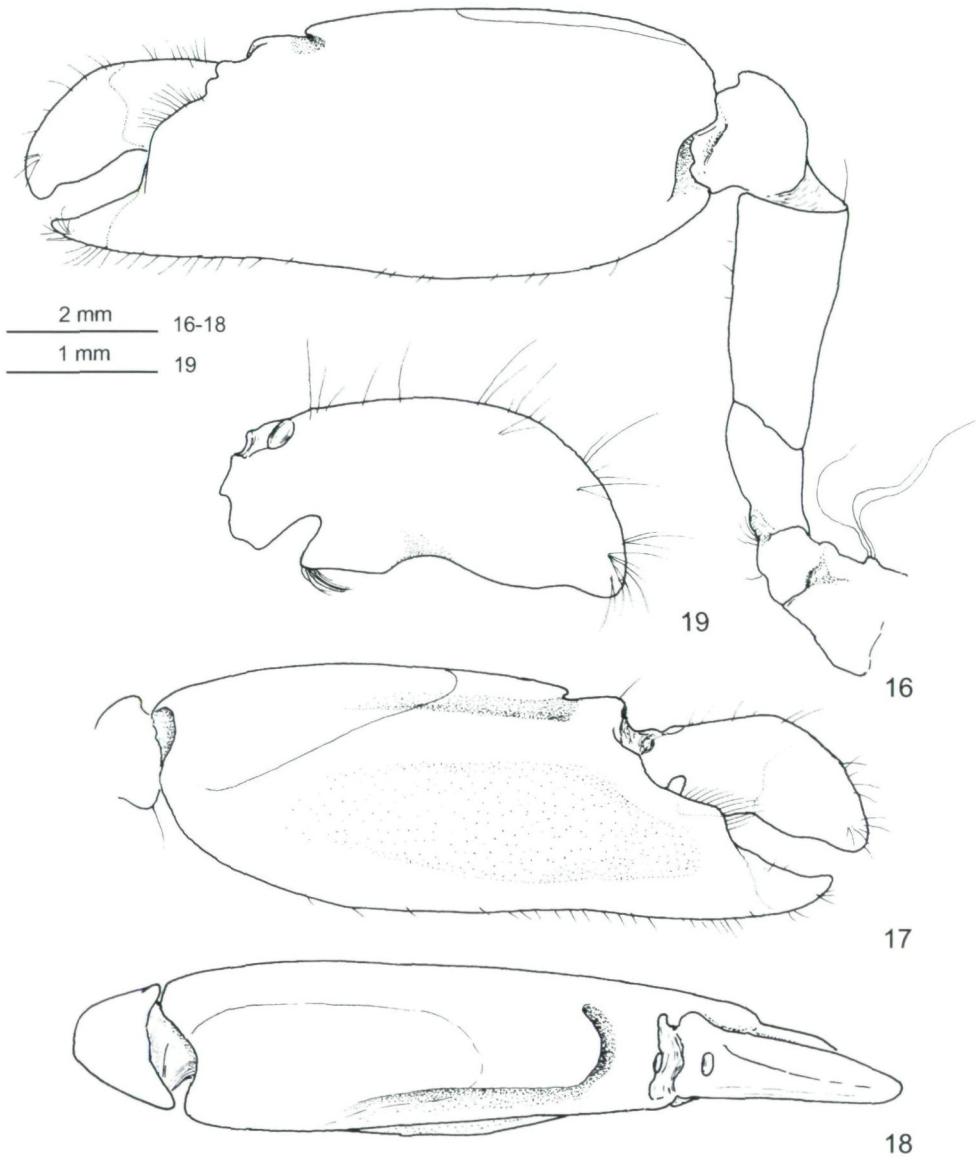
Major cheliped of holotype (Figs 16 - 18) with ischium short; merus stout with dorso-distal margin blunt, not projecting; ventro-mesial and ventro-lateral margins unarmed except for small distal tooth on mesial margin; carpus cup-shaped, with distal lobes feebly developed; chela oval-rectangular in shape, laterally compressed; dorsal face of palm with subdistal, transverse, broadly U-shaped, shallow groove; proximal shoulder (proximal margin of groove) overhanging groove (latter appearing therefore oblique in lateral view, cf. Fig. 17); mesial face of palm smooth, except transverse groove incising its superior margin subdistally (Fig. 16); lateral face with a shallow, longitudinal, super-lateral depression extending from the transverse groove to the proximal third of chela, and with another, much broader depression extending from the pollex to about middle of the palm (Fig. 17), these two depressions being divided by a flattened longitudinal ridge; fingers about half as long as palm; outer face of pollex divided by obliquely descending ridge (Fig. 17); dactylus with plunger short and truncated, distally with a group of flexible setae (Fig. 19); adhesive discs rather small (Fig. 18); linea impressa feebly marked.

Minor cheliped of paratype (Figs 25, 26) with merus about three times as long as broad, ventro-lateral margin slightly rugose, distal margin ending in blunt tooth; carpus, short,



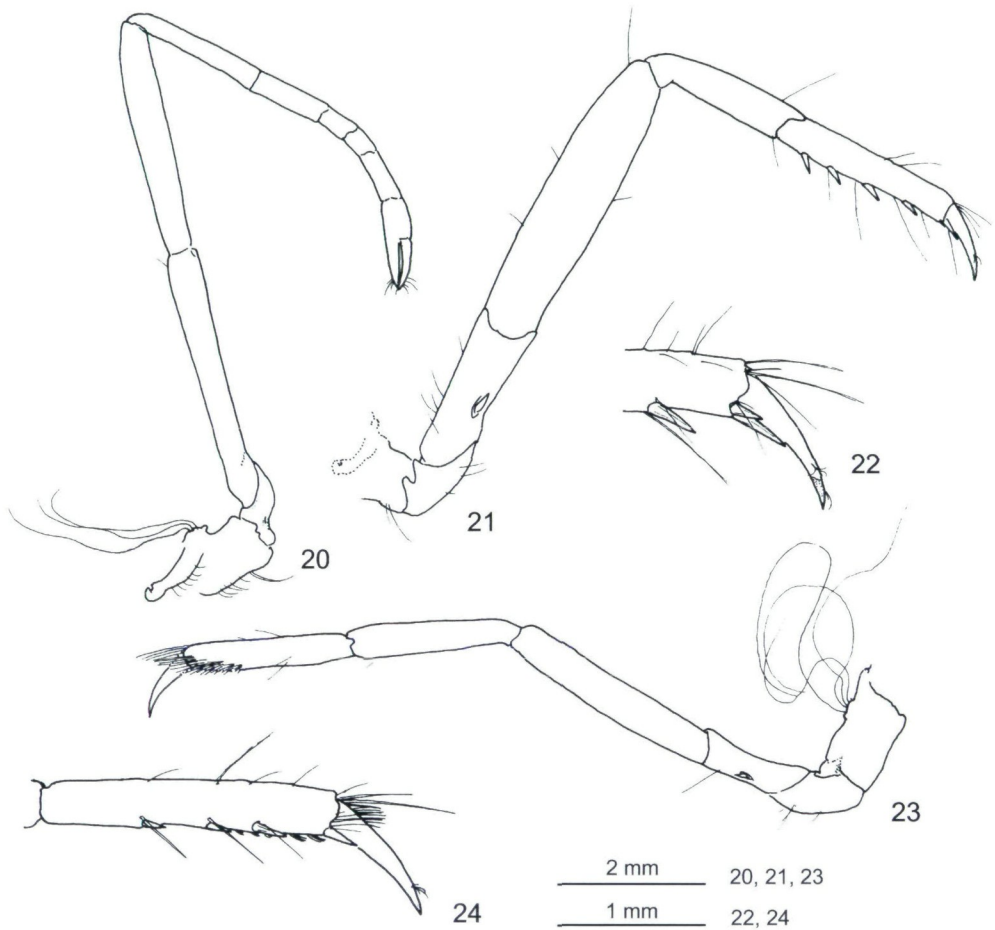
Figs. 8 - 15. *Alpheus ribeiroae* sp.n., holotype NHMW 19842: lateral (8) and mesial (9) view of left mandible; lateral aspects of left first (10) and second (11) maxilla, first (12), second (13) and third (14) maxilliped; basal portion of third maxilliped (15).

cup-shaped, with a small rounded disto-lateral lobe; chela slender, palm about  $\frac{2}{3}$  as long as fingers, smooth, ventral margin evenly concave, linea impressa well marked, fingers elongated and slender, with numerous tufts of stiff setae, tips crossing.



Figs. 16 - 19. *Alpheus ribeiroae* sp.n., holotype NHMW 19842: major cheliped, mesial (16), lateral (17) and dorsal (18) view; same, dactylus, lateral view (19).

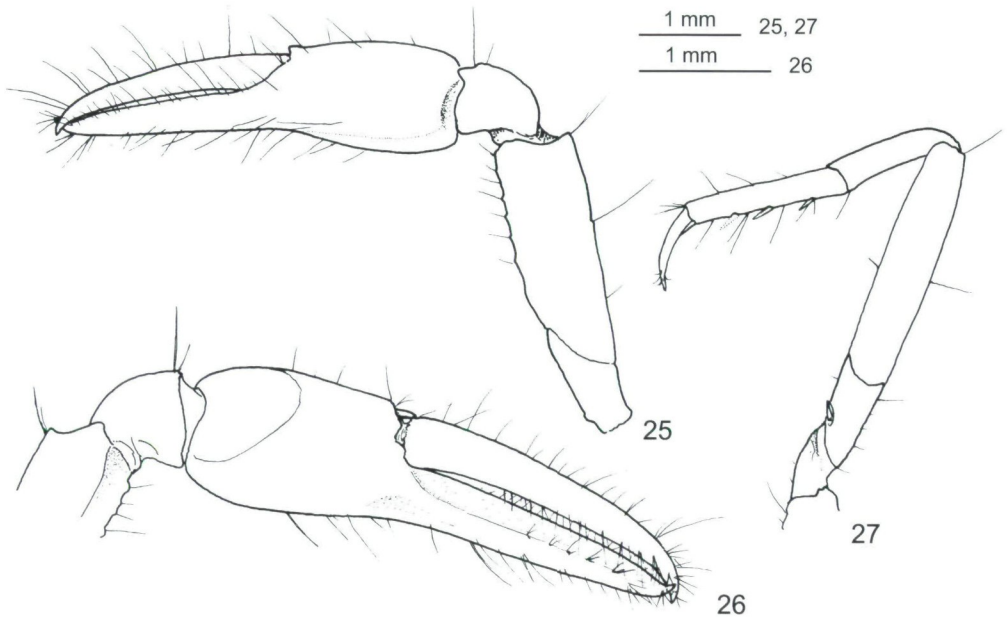
Second pereiopod (Fig. 20) slender; ischium slightly longer than merus; carpus five-articulated, first article longest, ratio of carpal articles (from proximal to distal) approximately equal to 5 : 3 : 1 : 1 : 2; chela simple, as long as second carpal article. Third pereiopod (Fig. 27) and fourth pereiopod (Fig. 21) similar, moderately slender; ischium ventrally with spine; merus unarmed, disto-ventral margin not acutely produced; carpus unarmed; propodus with three-four spines on ventral margin, two disto-ventral spines



Figs. 20 - 24. *Alpheus ribeiroae* sp.n., holotype NHMW 19842: lateral aspects of second (20) and fourth (21) pereiopod; distal portion of fourth pereiopod (22); lateral aspect of fifth pereiopod (23); propodus and dactylus of fifth pereiopod, mesial view (24).

(one quite long, cf. Fig. 22) and numerous stiff, elongated setae (Fig. 22); dactylus simple, conical, slightly flattened, but not spatulate, gradually curved toward tip, with two tufts of setae, very distal portion separated from the remaining basal portion by a inconspicuous suture, tip acute (Fig. 22). Fifth pereiopod (Fig. 23) more slender than fourth pereiopod; ischium ventrally with small spine; propodus armed with four spines on ventro-mesial margin (Fig. 24); grooming setae on latero-ventral margin well developed (5-6 rows); dactylus similar to that of fourth pereiopod, suture not distinct.

Abdominal segments with postero-ventral margins broadly rounded; fifth segment with ventro-posterior margin rounded-angular; sixth segment without articulated flap, posterior margin straight, dorso-lateral projections rounded (Fig. 5); preanal plate rounded. Uropod (Fig. 6) with sympodite bearing two very pronounced acute teeth; exopod with diaeresis appearing sinuous due to the presence of three broadly rounded teeth; lateral



Figs. 25 - 27: *Alpheus ribeiroae* sp.n., paratype NHMW 19843: minor cheliped, mesial (25) and lateral (26) aspect; third pereopod (27).

spine strong, elongated; distal margins of exopod and endopod furnished with a row of spinules (Fig. 6). Telson (Fig. 7) broad, slightly tapering towards posterior margin, with two pairs of dorsal spines, first pair slightly anterior of an imaginary line dividing telson in two halves, both pairs of spines inserted at considerable distance from lateral margins (Fig. 7); posterior margin broad, slightly convex, with two pairs of small postero-lateral spines, inner spines being longer than outer spines, and with no less than 20 long setae between these spines; anal tubercles present.

Gill formula typical for genus: pleurobranchs above first to fifth pereopods; podobranch absent; one arthrobranch associated with third maxilliped; exopods on first to third maxilliped; strap-like epipods (mastigobranchs) on coxae of third maxilliped to fourth pereopod; setobranchs on coxae of first to fifth pereopods.

**Colour in life:** Apparently not a brightly coloured species. Field notes indicated only that the ovary (containing eggs) was orange.

**Distribution and habitat:** Known only from the type-locality, a tidal flat north of Moia-Moia village on the island of São Tiago, Cape Verde Archipelago, Eastern Atlantic Ocean. ABED-NAVANDI (2000) provided a photo and a short description of this tidal flat situated in a very protected bay. The sediment consisted of black fine sand of volcanic origin. Syntopic crustacean macrofauna included an unidentified large stomatopod, the callianassid mudshrimps *Corallianassa intesi* (DE SAINT-LAURENT & LEOEUFF, 1979) and *Neocallichirus pachydactylus* (A. MILNE-EDWARDS, 1870), and the alpheid shrimps *Deioneus sandizelli* DWORSCHAK, ANKER & ABED-NAVANDI, 2000 and *Salmonaeus*



*caboverdensis* DWORSCHAK, ANKER & ABED-NAVANDI, 2000 (ABED-NAVANDI, 2000). All specimens, including *Alpheus ribeiroae* sp.n. were obtained from burrows at low tide, with the aid of a yabby pump. Two other *Alpheus* species, *A. holthuisi* RIBEIRO, 1964, and *A. paracrinitus* MIERS, 1881, were collected intertidally on a sand-rubble substrate in a shallow bay just north of Moia-Moia village.

## Discussion

The laterally compressed, sub-rectangular major chela, with the dactylus bearing a truncated plunger and palm having longitudinal grooves, indicates clearly that *Alpheus ribeiroae* sp.n. is a member of *A. brevisrostris* species group. Within this speciose species group (more than 30 described species), *A. ribeiroae* sp.n. belongs to the *A. barbatus* species complex, which also contains *A. barbatus* COUTIÈRE, 1897 from the Indo-West Pacific, *A. aequus* KIM & ABELE, 1988 from the tropical Eastern Pacific, and an undescribed species closely related to *A. aequus* from the Atol das Rocas off north-western Brazil (A. Anker, pers. obs., MNRJ material).

The members of the *A. barbatus* species complex can be separated from all other species of the *A. brevisrostris* group by the combination of the following features: (1) rostrum short, (2) sympodite of the uropods distally with very strong, acute teeth, (3) diaeresis of the uropod bearing three large rounded teeth, (4) major chela with U-shaped transverse groove, latter being more or less overhung by the proximal shoulder, (5) minor chela with fingers furnished with rows of stiff, elongated setae (except in *A. ribeiroae* sp.n.), (6), dactylus of the third pereopod simple, conical, not spatulate (7) stylocerite very stout, and distally blunt, not pointed, (8) mesio-ventral carina of the first segment of antennular peduncle bearing broadly triangular tooth, and (9) basicerite of antenna lacking acute ventro-lateral tooth.

*Alpheus aequus* is presently known only from two localities: Playa Blancas, Pacific coast of Costa Rica, and Barrington Island, Galapagos Archipelago (KIM & ABELE 1988). Although rather rarely collected, *Alpheus barbatus* appears to be widely distributed in the Indo-West Pacific, with records from Djibouti (type-locality, COUTIÈRE 1897), northern Red Sea, Kenya, Somalia, Madagascar, Mauritius (BANNER & BANNER 1981, 1983), Maldives (COUTIÈRE 1905), Philippines (BANNER & BANNER 1978), Indonesia (DE MAN 1911), southern Japan and Ryukyu Islands (NOMURA & al. 1996), Taiwan (JENG 1997), and Queensland, Australia (Banner & Banner 1982). Important morphological variation, e.g. in the shape of the scaphocerite, the frontal margin (including the length of rostrum), the shape of the dactylus and the proportions of the major chela, the presence/absence of spines on the merus of the major cheliped (cf. COUTIÈRE 1899, BANNER & BANNER 1981, 1982), and differences in colour patterns (NOMURA 2000) suggest that *A. barbatus* could be a cryptic species complex instead of one morphologically variable species.

While reporting important differences in colour pattern of *A. barbatus* from southern Japan, NOMURA (2000) attributed them to day-night fluctuations, influencing the intensity of red pigments in the chromatophores. The overall pattern was varying from almost transparent milky-white to opaque white with longitudinal crimson or dark red bands (cf. NOMURA, 2000, Fig. 1). However, some specimens showed whitish patches on the

crimson-red major chela, while others did not and had a rather uniformly coloured orange chela. Examination of five specimens from Nomura's material (YMP-2462, YMP-359, YMP-1145 (2 sp.) and YMP-1700) and another specimen from Ambon, Indonesia (MNHN 14267) revealed clear differences in the shape of the major chela, particularly in the shape and the length of dactylus, and in the presence/absence of a deep notch on pollex, proximal to the anterior margin of fossa. These differences are probably not due to age, and could be therefore important in species separation. However, more specimens must be examined for this purpose prior to any conclusions.

*Alpheus ribeiroae* sp.n. can be separated from both *A. barbatus* (cf. BANNER & BANNER 1982: 164, fig. 49) and *A. aequus* (cf. KIM & ABELE 1988: 56, fig. 23) by the scaphocerite being more elongated, with disto-lateral tooth not exceeding the anterior margin of the blade; the major chela being much more slender and having different palm-fingers proportions; the lateral grooves on the lateral face of the palm being more conspicuous; the merus of the major cheliped being more elongated; and the minor chela lacking a dense mesial row of setae on the pollex, at least in the female (male minor cheliped is unknown). The new species also differs from *A. barbatus* by having a much more slender second pereopod, and from *A. aequus* by the major chela with fingers being subequal, while in the latter species the dactylus reaches far beyond the pollex (cf. KIM & ABELE 1988). *Alpheus* sp. aff. *aequus* from Atol das Rocas, which will be described elsewhere (ANKER, in prep.), can be separated from *A. ribeiroae* sp.n. by the same criteria as *A. aequus*.

*Alpheus ribeiroae* sp.n. differs in a number of characters from all other eastern Atlantic species of the *A. brevirostris* group, namely *A. glaber* (OLIVI, 1792), *A. talismani* COUTIÈRE, 1898, *A. floridanus* KINGSLEY, 1878, *A. africanus* BALSS, 1916 (originally described as *A. floridanus* var. *africana*, also known as *A. floridanus africanus*) and *A. migrans* LEWINSOHN & HOLTHUIS, 1978 (a Lessepsian migrant to the eastern Mediterranean Sea, cf. DWORSCHAK & PERVESLER 2002). All these species have a well developed rostrum, a distally pointed stylocerite, and spatulate or sub-spatulate dactyli of the third to fifth pereopods, and are not closely related to *A. ribeiroae* sp.n. *Alpheus glaber*, *A. talismani* and especially *A. floridanus* exhibit morphological variation in several taxonomically important characters, e.g., in the frontal region, first, second and third pereopods (HOLTHUIS 1951, CROSNIER & FOREST 1966, CHACE 1972), and a thorough revision of these problematical species or species complexes remains to be done.

Both type-specimens of *A. ribeiroae* sp. n. were collected with a bait suction pump ("yabby pump") from a burrow made in the fine sand by the shrimps themselves, or by another burrowing animal. Interestingly, *A. barbatus* is known to associate with large, burrowing, intertidal echiurid worms, such as *Ikedesoma* sp. in Taiwan (TZENG & CHEN 1992: 151) and *Ochetostoma erythrogrammon* LEUCKART & RÜPPELL, 1828 in Japan (NOMURA 2000). Whether *A. ribeiroae* sp.n. and *A. aequus* are associated with echiurids or other burrowing invertebrates remains unknown. The present records of *A. ribeiroae* sp.n. and its closest American relatives *A. aequus* and *A. aff. aequus* suggest that for some reason these three ecologically and morphologically very similar species are more likely to be found on protected and clean sand flats on islands situated far off continental shores (Cape Verde, Galapagos, Atol das Rocas).

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