Arthropoda Selecta 24(3): 247–258

Two new snapping shrimps (Decapoda: Caridea: Alpheidae: *Alpheus*) from the tropical eastern Pacific

Два новых вида раков-щелкунов (Decapoda: Caridea: Alpheidae: *Alpheus*) из тропических вод восточной Пацифики

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KEY WORDS: Decapoda, Caridea, Alpheidae, snapping shrimp, mudflat, East Pacific, new species.

КЛЮЧЕВЫЕ СЛОВА: Decapoda, Caridea, Alpheidae, раки-щелкуны, илистые отмели, Восточная Пацифика, новые виды.

ABSTRACT. Two snapping shrimps from the *Alpheus edwardsii* (Audouin, 1826) species group are described based on material collected on estuarine mudflats of the Pacific coast of Panama. *Alpheus burukovskyi* sp.n., from Coiba Island and Azuero Peninsula, is morphologically closest to the eastern Pacific *A. villus* Kim, Abele, 1988, but can be separated from it by at least three morphological characters. In addition, *A. burukovskyi* sp.n. may be separated from most if not all other American members of the *A. edwardsii* group by a diagnostic, uniform red colouration. *Alpheus zarenkovi* sp.n., presently known only from Coiba Island, shares most morphological characters with the western Atlantic *A. heterochaelis* Say, 1818 and *A. petronioi* Almeida, Terossi, Mantelatto, 2014, and the eastern Pacific *A. villus*, but can be distinguished from each of them by at least two morphological characters.

РЕЗЮМЕ. Два вида раков-щелкунов из группы *Alpheus edwardsii* (Audouin, 1826) описаны на основе материала, собранного на илистых эстуарных мелководьях тихоокеанского берега Панамы. *Alpheus burukovskyi* sp.n. с о. Коиба и п-ва Азуэро морфологически наиболее близок к восточно-тихоокеанскому *A. villus* Kim et Abele, 1988, но отличается от него, по крайней мере, по трем морфологическим признакам. *A. burukovskyi* sp.n. можно также отличить от большинства, если не всех американских представителей группы видов *A. edwardsii* по однородной красной окраске, имеющей диагностический характер. *Alpheus zarenkovi* sp.n., известный в настоящее время только с о. Коиба, разделяет большинство морфологических признаков с западно-атлантическими *A. heterochaelis* Say, 1818 и *A. petronioi* Almeida, Terossi et Mantelatto, 2014, а также восточно-атлантическим *A. villus*, но отличается от каждого из них по меньшей мере по двум морфологическим признакам.

Introduction

The eastern Pacific members of the hyperdiverse snapping shrimp genus *Alpheus* Fabricius, 1798 were extensively treated in the monograph of Kim and Abele [1988], who listed 44 species, including several problematic taxa that were very poorly described by Lockington [1878]. The material examined by Kim and Abele [1988] came largely from the collections made by the Allan Hancock Galapagos and Pacific (Mexico to Colombia) Expeditions in the 1930s, the Smithsonian Tropical Research Institute Panama Survey in the 1970s, and some miscellaneous collections made by L.G. Abele, mostly in Panama in the 1970s. The majority of the Panamanian collection stations in Kim and Abele [1988] were either close to Panama City (e.g. Panama Canal area, Amador Causeway, Punta Paitilla, Veracruz, Playa Venao) or in Las Perlas Islands. Large areas of western and eastern Panama, including the Chiriqui Gulf and Coiba Archipelago, were either poorly sampled or not sampled at all. After Kim and Abele's [1988] study, there have been numerous changes in the taxonomy of the eastern Pacific species of *Alpheus* [e.g., Ríos, 1992; Anker et al., 2007a, b, 2008a, b; Anker, Pachelle, 2013; Bracken-Grissom, Felder, 2014], which still remains very far from being satisfactory. Most of these studies dealt with synonymies [sometimes erroneous, e.g., Ríos, 1992] or new names for species that were previously confused with already known taxa, for instance those described from the Atlantic [Anker et al., 2008a, b; Anker, Pachelle, 2013].

During a preliminary sampling of alpheid shrimps of Coiba Island in March 2007, two species of *Alpheus* were collected on an intertidal mudflat on the northwestern coast of the island. The two species could not be positively matched to any of the species reported by Kim and Abele [1988] and did not exhibit characters of the three poorly known taxa described by Lockington

[1878]. They also differed from the morphologically most similar Atlantic and Indo-West Pacific species. Therefore, in the present study, two new species of *Alpheus* are described and illustrated based on type material from Coiba Island. In addition, a single specimen of one of the species was collected on an estuarine mudflat near Río Caldera, Panama's Azuero Peninsula, in March 2015, and is included in the description below.

Material is deposited in the crustacean collections of the Muséum National d'Histoire Naturelle, Paris, France (MNHN); Oxford University Museum of Natural History, Oxford, UK (OUMNH.ZC); Museu de Zoologia, Universidade de São Paulo, Brazil (MZUSP) and Universidad de Panamá, Ciudad de Panamá, Republic of Panama (UP). Carapace length (cl) was measured along the dorsal midline, from the tip of the rostrum to the posterior margin of the carapace. The numbers in square brackets refer to field collection number (fcn) and (for some of the specimens) to a photo voucher. Abbreviations used in the text are as following: EA — eastern Atlantic; EP — eastern Pacific; WA — western Atlantic; IWP — Indo-West Pacific; ov. — ovigerous.

Taxonomy

Family Alpheidae Rafinesque, 1815
Genus *Alpheus* Fabricius, 1798

Alpheus burukovskyi **sp.n.**
Figs 1–3.

TYPE MATERIAL. Holotype: ♂ (cl 4.6 mm), MNHN-IU-2014-10165, Pacific side of Panama, Coiba Island, northwestern coast, Bahía de Santa Cruz, estuarine mudflat, under rocks in mud, coll. A. Anker et al., 21.03.2007 [fcn. 07-128]. Paratypes, all same collection data as for holotype: 1 ♂ (cl 4.1 mm), 1 ♀ (cl 4.8 mm), MNHN-IU-2014-10166 [fcn. 07-127, 07-138]; 1 ♂ (cl 4.3 mm), MNHN-IU-2014-10167 [fcn. 07-144, dissected]; 1 ov. ♀ (cl 4.9 mm), MNHN-IU-2014-10168 [fcn. 07-124]; 1 ♂ (cl 4.2 mm), 1 ov. ♀ (cl 5.2 mm), OUMNH.ZC. 2015-01-093 [fcn. 07-126, 07-135]; 1 ♂ (cl 3.9 mm), 2 ov. ♀♀ (cl 3.6, 3.9 mm), OUMNH.ZC. 2015-01-094 [fcn. 07-139, 07-131, 07-130]; 1 ♀ (cl 4.6 mm), OUMNH-ZC. 2011-03-006 [fcn 07-122]; 1 ♂ (cl 4.5 mm), MZUSP 33445 [fcn. 07-134]; 1 ♂ (cl 3.7 mm), 1 ov. ♀ (cl 3.6 mm), UP [fcn. 07-123].

ADDITIONAL MATERIAL. 1 ♂ (cl 5.3 mm), MZUSP 33446, Pacific side of Panama, southeastern Azuero Peninsula, Río Caldera, small bay with estuarine mudflat, under rocks in mud, coll. A. Anker et al., 21.03.2015.

DESCRIPTION. Small-sized species (cl of largest specimen 5.3 mm) of *Alpheus edwardsii* (Audouin, 1826) group. Rostrum short, not reaching mid-length of first article of antennular peduncle, conical, subacute distally; rostral carina feebly developed, not extending beyond level of eye mid-length; adrostral furrows very shallow; orbital hoods moderately swollen, rounded, unarmed (Fig. 1A, B). Pterygostomial angle rounded (Fig. 1B); cardiac notch well-developed.

Abdominal somites with ventrally rounded pleura. Telson relatively broad, subrectangular, slightly less than twice as long as wide, with slightly convex lateral margins, latter tapering distally; dorsal surface with two pairs of stout spiniform setae both distinctly removed from lateral margins, first pair situated at or slightly anterior to telson mid-length, second pair situated at about 0.7 of telson length; posterior margin broadly rounded, each posterolateral angle with pair of spiniform setae, lateral much shorter than mesial, margin between mesial spiniform setae with row of smaller spiniform setae (Fig. 1C).

Antennular peduncle with second article short, about 1.2 times as long as wide; stylocerite not reaching distal margin of first article, with acute tip; mesioventral carina with low, broadly triangular tooth, without anterior point (Fig. 1A, B, D). Antenna with basicerite bearing small, sharp distoventral tooth; scaphocerite relatively long, with slightly concave lateral margin and well-developed blade, latter not overreaching strong distolateral tooth; carpocerite reaching slightly beyond scaphocerite and usually exceeding end of antennular peduncle (Fig. 1A, B).

Mouthparts typical for genus in external observation. Third maxilliped slender, pediform; coxa with distally subacute lateral plate; antepenultimate article slightly flattened ventrolaterally; penultimate article more than twice as long as wide, mesioventral surface with several, long, slender, noticeably thickened setae; ultimate article with rows of short serrulate setae and longer simple setae, unarmed distally; arthrobranch well developed (Fig. 1E, F).

Major cheliped similar in both sexes, typically larger and with slightly different proportions in males; ischium very short, merus moderately stout, about 2.5 times as long as wide, blunt distodorsally, without distomesial tooth; carpus very short, cup-shaped; chela with palm about 1.8 times as long as fingers, distodorsal margin with broad transverse groove extending onto lateral surface and then posteriorly to linea impressa, and into mesial surface and then posteriorly, almost reaching linea impressa; dorsal shoulder not overhanging, rounded, sloping smoothly into transverse groove; ventral margin with deep, broad transverse groove, ventral shoulder not protruding anteriorly, rounded; dactylus slightly overreaching pollex, with stout plunger, latter furnished with stamen-shaped sensillae (Fig. 2A–D).

Male minor cheliped much smaller and more slender than major cheliped; ischium very short; merus rather slender, almost three times as long as wide, blunt distodorsally, without distomesial tooth; carpus short, cup-shaped; chela with palm slightly shorter than fingers, smooth, without transverse or longitudinal grooves, without shoulders; fingers subequal in length, slightly gaping; dactylus not conspicuously broadened, lateral and mesial surfaces with low longitudinal ridge, latter without row of balaeniceps setae (Fig. 2E, F). Female minor cheliped generally similar to male minor cheliped; chela slightly shorter (Fig. 2G).

Second pereiopod slender; ischium and merus subequal in length; carpus with five joints, their ratio approximately equal to 3.5/2.3/1/1/1.5; chela as long as second carpal segment (Fig. 1G). Third pereiopod moderately slender; ischium with small spiniform seta on

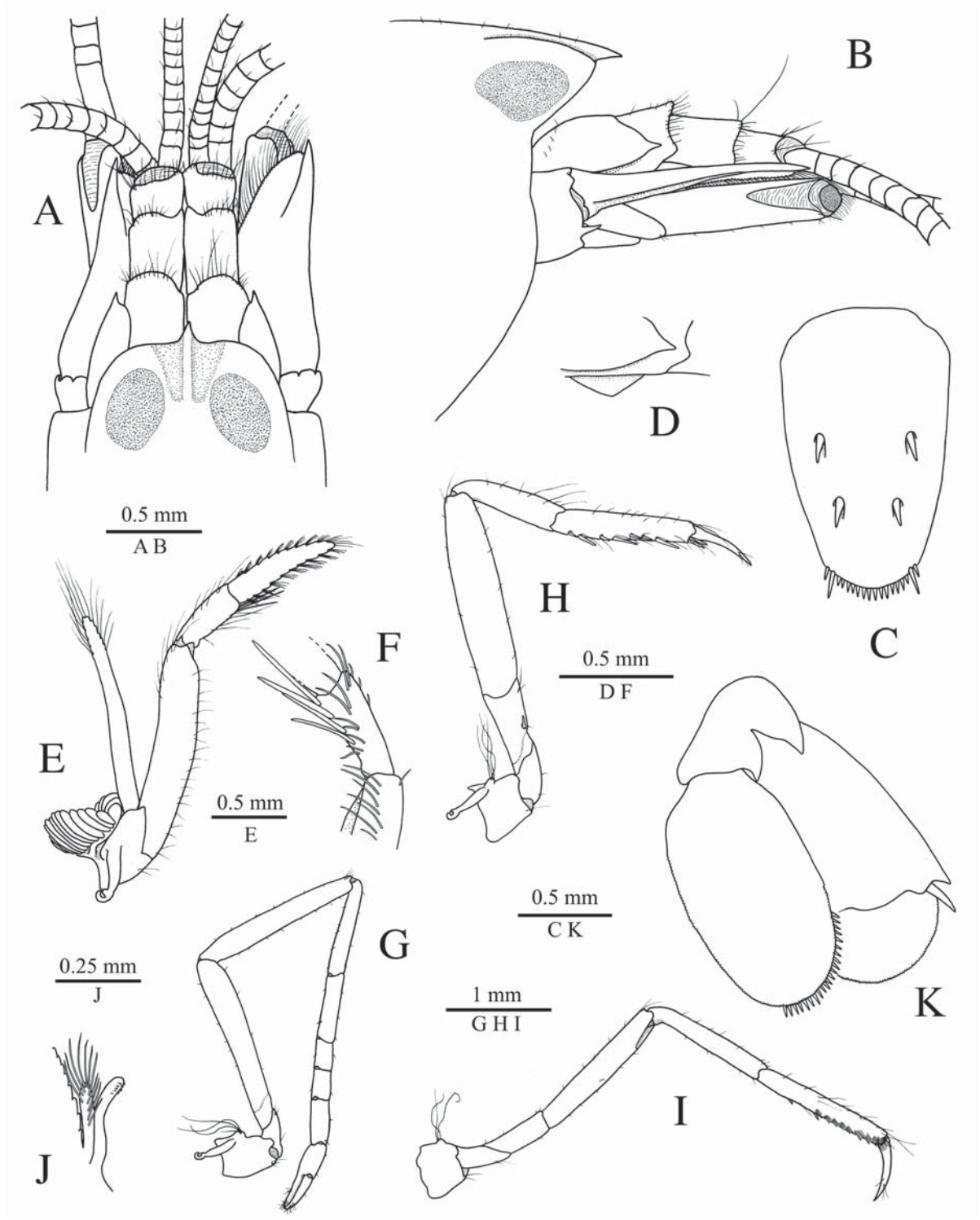

Fig. 1. *Alpheus burukovskyi* sp.n.: paratype, ♂ (cl 4.3 mm) (MNHN-IU-2014-10167) from Coiba Island, Pacific side of Panama: A — frontal region, dorsal view; B — same, lateral view; C — telson, dorsal view; D — first article of antennular peduncle, ventromesial carina, lateral view; E — third maxilliped, lateral view; F — same, penultimate article, mesial view; G — second pereiopod, lateral view; H — third pereiopod, lateral view; I — fifth pereiopod, lateral view; J — second pleopod, appendices masculina and interna, ventral view; K — uropod, dorsal view.

Рис. 1. *Alpheus burukovskyi* sp.n.: паратип, ♂ (cl 4.3 mm) (MNHN-IU-2014-10167) с о. Коиба, тихоокеанское побережье Панамы: A — фронтальный отдел, дорсальный вид; B — то же, латеральный вид; C — тельсон, дорсальный вид; D — 1-й членик стебелька антеннул, ветромезиальный гребень, латеральный вид; E — максилипед 3-й пары, латеральный вид; F — то же, предпоследний членик, мезиальный вид; G — переопод 2-й пары, латеральный вид; H — переопод 3-ей пары, латеральный вид; I — переопод 5-ой пары, латеральный вид; J — плеопод 2-ой пары, отростки мужской и внутренний, вентральный вид; K — уропод, дорсальный вид.

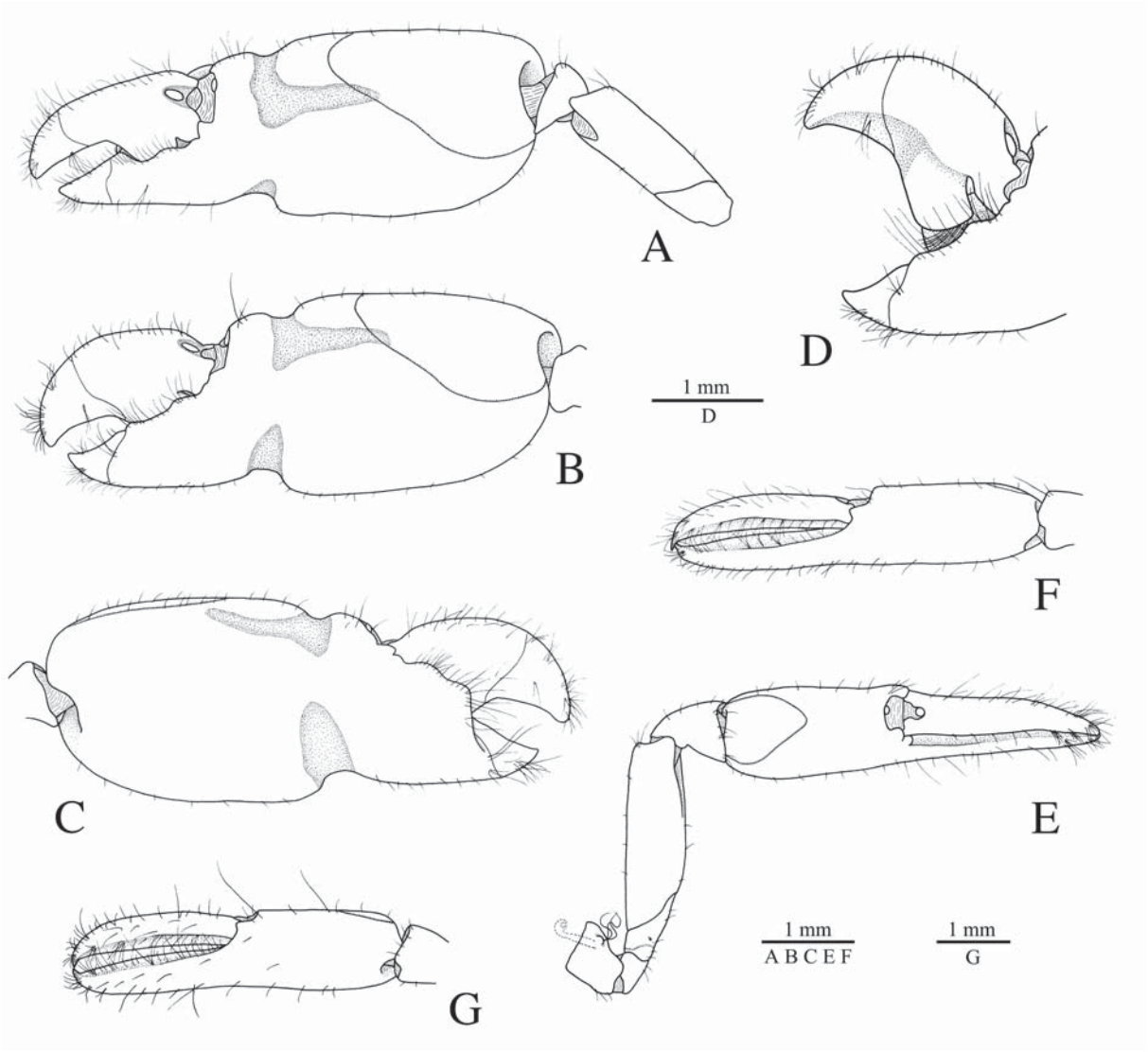

Fig. 2. *Alpheus burukovskyi* sp.n.: paratypes, ♂ (cl 4.3 mm) (MNHN-IU-2014-10167) [A–F] and ovigerous ♀ (cl 4.9 mm) (MNHN-IU-2014-10168) [G] from Coiba Island, Pacific side of Panama: A — left (major) cheliped, lateral view; B — left (major) chela, lateral view; C — same, mesial view; D — same, fingers opened, lateral view; E — right (minor) cheliped, lateral view; F — right (minor) chela, mesial view; G — same, mesial view.

Рис. 2. *Alpheus burukovskyi* sp.n.: паратипы, ♂ (cl 4.3 mm) (MNHN-IU-2014-10167) [A–F] и яйценосная ♀ (cl 4.9 mm) (MNHN-IU-2014-10168) [G] с о. Коиба, тихоокеанское побережье Панамы: A — левая (большая) хелипеда, латеральный вид; B — левая (большая) клешня, латеральный вид; C — то же, мезиальный вид; D — то же, пальцы клешни раскрыты, латеральный вид; E — правая (малая) хелипеда, латеральный вид; F — правая (малая) клешня, мезиальный вид; G — то же, мезиальный вид.

ventrolateral surface; merus about four times as long as wide, slightly inflated, unarmed; carpus about half length of merus, much more slender, unarmed; propodus significantly longer than carpus but shorter than merus, ventral margin with irregularly inserted, stout spiniform setae, including two near dactylar base; dactylus about half length of propodus, fairly slender, conical, simple (Fig. 1H). Fourth pereiopod generally similar to third, slightly more slender. Fifth pereiopod much more slender than third and fourth; ischium unarmed; merus not inflated, about six times as long as wide; carpus 0.8 length of merus; propodus with setal rows on ventrolateral surface, starting from about half-length of article and increasing in length distally, and with few spiniform setae on ventromesial surface; dactylus conical, simple, more curved than that of third pereiopod (Fig. 1I).

Male second pleopod with appendix masculina shorter than appendix interna, with stiff setae apically and along distal margins (Fig. 1J). Uropod with lateral lobe of protopod ending in acute point; exopod and endopod broad, rounded distally; diaeresis of exopod slightly sinuous, lateral portion with broadly subtriangular lobe adjacent to stout distolateral spiniform seta (Fig. 1K).

COLOURATION. Uniform reddish, due to numerous small red chromatophores more or less evenly scat-

Fig. 3. *Alpheus burukovskyi* sp.n.: paratype, ovigerous ♀ (cl 4.9 mm) (MNHN-IU-2014-10168) from Coiba Island, Pacific side of Panama, dorsal view in life. Photographer: A. Anker.

Рис. 3. *Alpheus burukovskyi* sp.n.: паратип, яйценосная ♀ (cl 4.9 мм) (MNHN-IU-2014-10168) с о. Коиба, тихоокеанское побережье Панамы, дорсальный вид, прижизненная окраска. Фотограф: А. Анкер.

tered over body, tail fan, antennular and antennal peduncles, and second to fifth pereiopods; major and minor chelae orange-red mesially (Fig. 3).

ETYMOLOGY. It is a great honour and pleasure for us to name this species after our dear colleague and friend, Dr. Rudolf N. Burukovsky (Kaliningrad State University), for his numerous carcinological contributions, and also for his participation to the examination committee of the first author's PhD thesis, in 2001.

TYPE LOCALITY. Bahía de Santa Cruz, Isla Coiba (Coiba Island), Panama.

DISTRIBUTION. Presently known only from Coiba Island and Azuero Peninsula, on the Pacific side of Panama.

ECOLOGY. All type specimens were collected by sieving muddy water under large rocks partly submerged in mud, in a shallow bay near the entrance of an estuary fringed by some mangroves. The non-type specimen was collected by hand, under a large rock in mud, near the mouth of a small river, with some scattered mangrove trees.

REMARKS. *Alpheus burukovskyi* sp.n. belongs to the morphologically and ecologically heterogeneous *A. edwardsii* species group, which is characterised essentially by the unarmed rounded orbital hoods (with one possible exception) and the presence of two transverse grooves or notches on the major chela palm, a usually well-developed dorsal groove, always extending posteriorly on the mesial face, and a variously developed ventral groove [Anker et al., 2009]. Among the American species of the *A. edwardsii* group, *A. burukovskyi* sp.n. is the only species possessing the following combination of morphological characters: (1) rostral carina low, posteriorly not widening, very short, not extending beyond half length of cornea; (2) second article of the antennular peduncle only slightly (~1.2 times) longer than wide; (3) third maxilliped with slender, not broadened antepenultimate article, and with penultimate article ventromesially furnished with long, noticeably thickened setae; (4) distomesial margin of the cheliped merus unarmed; (5) minor chela of both sexes with a weak longitudinal ridge on the dactylus, but without balaeniceps setae; (6) ischium of the third and fourth pereiopods armed with a small spiniform seta; (7) merus of the third and fourth pereiopods unarmed distoventrally; (8) dactylus of the third to fifth pereiopods non-spatulate, subconical.

Alpheus burukovskyi sp.n. has a poorly marked, longitudinal ridge on the dactylus of the male minor chela; however, this ridge is not furnished with a row of balaeniceps setae. The non-balaeniceps minor chela is a feature shared with many other eastern Pacific and Atlantic species of the genus *Alpheus*. The new species can be separated from all of them by at least two very obvious morphological characters, e.g., from *A. estuariensis* Christoffersen, 1984 (WA), *A. colombiensis* Wicksten, 1988 and *A. latus* Kim et Abele, 1988 (both EP) by the anteriorly non-angular dactylus of the major chela and the third to fifth pereiopods with conical, non-spatulate dactyli; from *A. colombiensis* also by the unarmed pleopodal protopods; from *A. latus* also by the more slender antepenultimate article of the third

maxilliped; from *A. nuttingi* (Schmitt, 1924) (WA), *A. galapagensis* Sivertsen, 1933 and *A. millsae* Anker, Hurt et Knowlton, 2007 (both EP), by the much shorter and weaker rostral carina, and the more slender major and minor chelae; from *A. holthuisi* Ribeiro, 1964 (EA) by the much shorter distolateral tooth of the scaphocerite, the noticeably shorter second article of the antennular peduncle, and the distomesially unarmed cheliped merus; from all members of the *A. armillatus* H. Milne-Edwards, 1837 species complex (WA+EP) and *A. viridari* (Armstrong, 1949) (WA) by the shorter rostrum, continued by a low, short carina (*vs.* with posteriorly flattened, usually abruptly delimited postrostral area in *A. armillatus* and related species or with a strong carina in *A. viridari*), the distomesially unarmed cheliped merus, and the shorter stylocerite, not reaching the distal margin of the first article of the antennular peduncle; from *A. pacificus* Dana, 1852 (*s. lat.*) (EP+IWP) by the non-protruding ventral shoulder of the major chela and the much shorter, less setose fingers of the minor chela; from *A. mazatlanicus* Wicksten, 1983 (EP) by the much shorter minor cheliped fingers and the anteriorly non-protruding orbital hoods; from *A. chacei* Carvacho, 1979 (WA) and *A. antepaenultimus* Kim et Abele, 1988 (EP) by the non-spatulate dactyli of the third to fifth pereiopods and the non-broadened antepenultimate article of the third maxilliped; and from *A. schmitti* Chace, 1972 (WA) and *A. umbo* Kim et Abele, 1988 (EP) by the well-developed scaphocerite blade, the third pereiopod with a distomesially unarmed merus, and the proportions of the major and minor chelae [cf. Hendrix, 1971; Chace, 1972; Carvacho, 1979; Kim, Abele, 1988; Anker et al., 2007b; Mathews, Anker, 2009; Anker, 2012].

Alpheus burukovskyi sp.n. can be easily separated from all the remaining eastern Pacific and Atlantic species of the *A. edwardsii* group, which are all characterised by the presence of balaeniceps setae on the male minor chela: *A. heterochaelis* Say, 1818, *A. petronioi* Almeida, Terossi et Mantelatto, 2014 (both WA); *A. pontederiae* de Rochebrune, 1883, *A. buckupi* Almeida, Terossi, Araújo-Silva et Mantelatto, 2013, and *A. intrinsecus* Spence Bate, 1888 (all WA+EA), *A. californiensis* Holmes, 1900, *A. lacertosus* Kim et Abele, 1988, *A. distinctus* Kim et Abele, 1988, *A. villus* Kim et Abele, 1988, and *A. firmus* Kim et Abele, 1988 (all EP) [cf. Crosnier, Forest, 1966; Christoffersen, 1984; Kim, Abele, 1988; Almeida et al., 2013, 2014].

Among all the above-listed taxa, *Alpheus villus* appears to share most morphological characters with *A. burukovskyi* sp.n. and may indeed be closely related to it. The two most important differences between these two species are the development of the balaeniceps ridge on the male minor chela (poorly marked, without setae in *A. burukovskyi* sp.n. *vs.* well-developed, with balaeniceps setae in *A. villus*) and the armature of the ischium of the third and fourth pereiopods (with a small spiniform seta in *A. burukovskyi* sp.n. *vs*. unarmed in *A. villus*). Most importantly, *A. burukovskyi* sp.n. shares with *A. villus* the presence of unusually thickened setae on the ventromesial side of the penultimate article of the third maxilliped. However, in *A. burukovskyi* sp.n., these setae are limited to the distal part of the article and are long and almost spiniform (Fig. 1F), whilst in *A. villus*, they are shorter, more dense, and occupy almost the entire ventromesial surface [cf. Kim, Abele, 1988: fig. 34d].

Alpheus spinicaudus Lockington, 1878, described very poorly and without illustrations by Lockington [1878], was assigned to the *A. edwardsii* group by Kim and Abele [1988] based on Lockington's brief description of the major cheliped. *Alpheus burukovskyi* sp.n. differs from *A. spinicaudus* by at least three features: (1) major cheliped dactylus articulated vertically or mesio-laterally (*vs*. obliquely in *A. spinicaudatus*); (2) minor chela with fingers subequal to palm (*vs.* half-length of palm in *A. spinicaudatus*); and (3) second pereiopod with first carpal joint longer than second (*vs.* second two-thirds longer than first in *A. spinicaudatus*). *Alpheus burukovskyi* sp.n. shows no particularly close affinities to any of the Indo-West Pacific members of the *A. edwardsii* group [e.g., Coutière, 1905, 1908; De Man, 1911; Banner, 1953; Banner, Banner, 1966, 1982, 1983; Chace, 1988; Anker, 2001, 2010].

Alpheus burukovskyi sp.n. may be the only uniformly reddish coloured species of the *A. edwardsii* group in the eastern Pacific and Atlantic [see Anker et al., 2007b for colour patterns of *A. nuttingi*, *A. galapagensis* and *A. millsae*; Mathews, Anker, 2009, and Anker, 2012 for species of the *A. armillatus* complex and *A. viridari*; Almeida et al., 2013, 2014 for *A. buckupi* and *A. petronioi*; Soledade, Almeida, 2013 for *A. estuariensis*, *A. chacei* and *A. intrinsecus*; Jensen, 1995 for *A. californiensis*; Debelius, 2001 for *A. holthuisi*; A. Anker, pers. observations for all remaining taxa, except for *A. villus*, for which the colour pattern is unknown].

Alpheus zarenkovi **sp.n.**

Figs 4–6.

TYPE MATERIAL. Holotype: ♂ (cl 5.7 mm), MNHN-IU-2014-10169, Pacific side of Panama, Coiba Island, northwestern coast, Bahía de Santa Cruz, estuarine mudflat, under rocks in mud, coll. A. Anker et al., 21.03.2007 [fcn. 07-142A]. Paratypes: all same collection data as for holotype: 1 ov. ♀ (cl 5.2 mm), MNHN-IU-2014-10170, [fcn. 07-142B]; 1 ov. ♀ (cl 5.0 mm), (OUMNH.ZC. 2015-01-095), [fcn. 07-149].

DESCRIPTION. Small-sized species (cl of largest specimen 5.7 mm) of *Alpheus edwardsii* group. Rostrum short, not reaching mid-length of first article of antennular peduncle, conical, subacute distally; rostral carina feebly developed, extending to level of eye base, slightly widening posteriorly; adrostral furrows very shallow; orbital hoods moderately swollen, rounded, unarmed (Fig. 4A, B). Pterygostomial angle rounded (Fig. 4B); cardiac notch well-developed.

Abdominal somites with ventrally rounded pleura. Telson relatively broad, subrectangular, about twice as long as wide, with slightly convex lateral margins, latter tapering distally; dorsal surface with two pairs of stout spiniform setae both distinctly removed from lat-

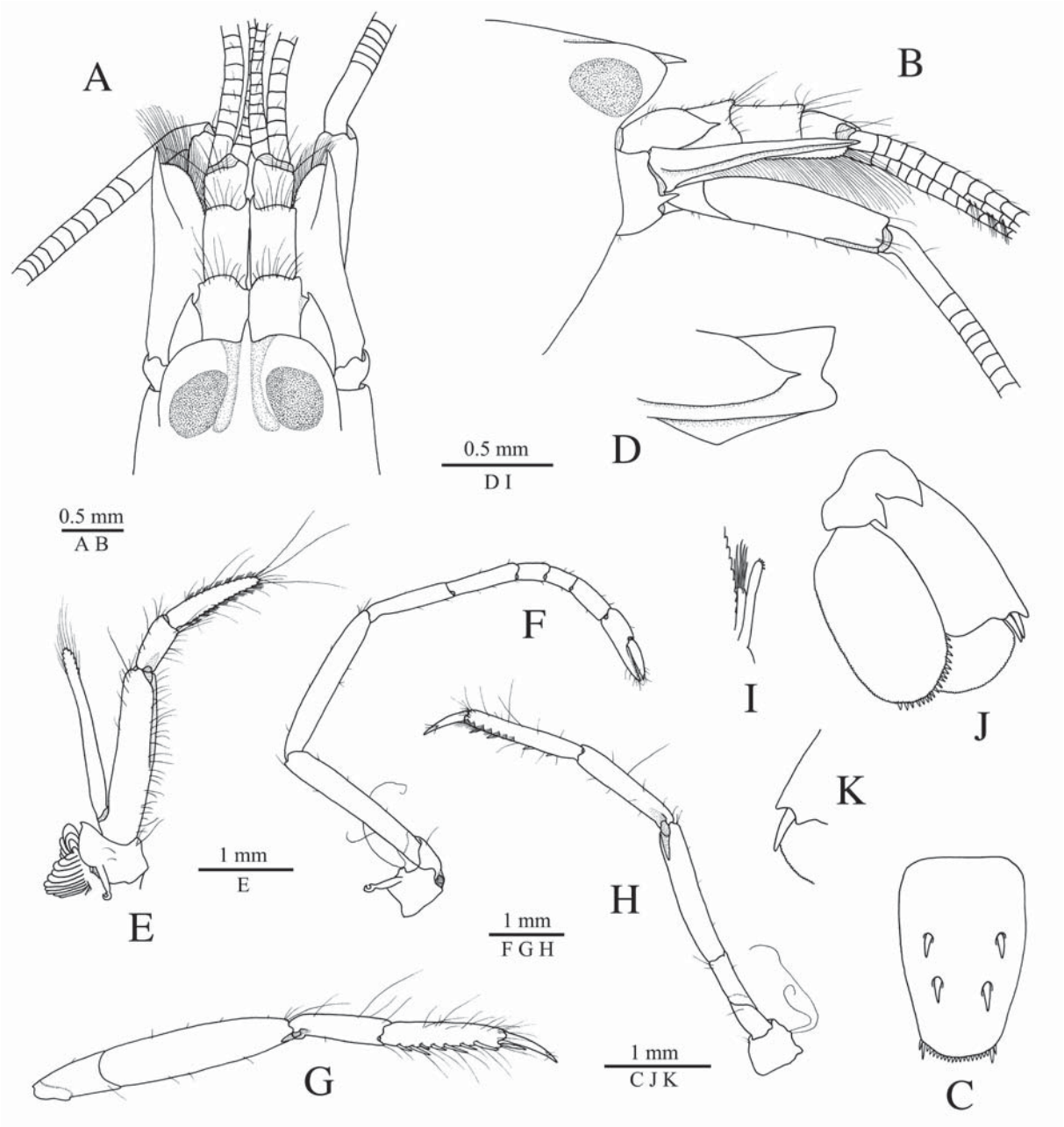

Fig. 4. *Alpheus zarenkovi* sp.n.: holotype, ♂ (cl 5.7 mm) (MNHN-IU-2014-10169) from Coiba Island, Pacific side of Panama: A — frontal region, dorsal view; B — same, lateral view; C — telson, dorsal view; D — first article of antennular peduncle, ventromesial carina, lateral view; E — third maxilliped, lateral view; F — second pereiopod, lateral view; G — third pereiopod, lateral view; H — fifth pereiopod, lateral view; I — second pleopod, appendices masculina and interna, ventral view; J — right uropod, dorsal view; K — left uropod, distolateral spiniform seta, dorsal view.

Рис. 4. *Alpheus zarenkovi* sp.n.: голотип, ♂ (cl 5.7 mm) (MNHN-IU-2014-10169) с о. Коиба, тихоокеанское побережье Панамы: A — фронтальный отдел, дорсальный вид; B — то же, латеральный вид; C — тельсон, дорсальный вид; D — 1-й членик стебелька антеннул, вентромезиальный гребень, латеральный вид; E — максилипед 3-й пары, латеральный вид; F — переопод 2-й пары, латеральный вид; G — переопод 3-й пары, латеральный вид; H — переопод 5-й пары, латеральный вид; I — плеопод 2-й пары, отростки мужской и внутренний, вентральный вид; J — правый уропод, дорсальный вид; K — левый уропод, дистолатеральные шиповидные щетинки, дорсальный вид.

eral margins, first pair situated distinctly anterior to telson mid-length, second pair situated at about 0.6–0.7 of telson length; posterior margin broadly rounded, each posterolateral angle with pair of small spiniform setae, lateral much shorter than mesial, margin between mesial spiniform setae with row of minute spiniform setae (Fig. 4C).

Antennular peduncle with second article short, about 1.7 times as long as wide; stylocerite not reaching distal margin of first article, with acute tip; mesioven-

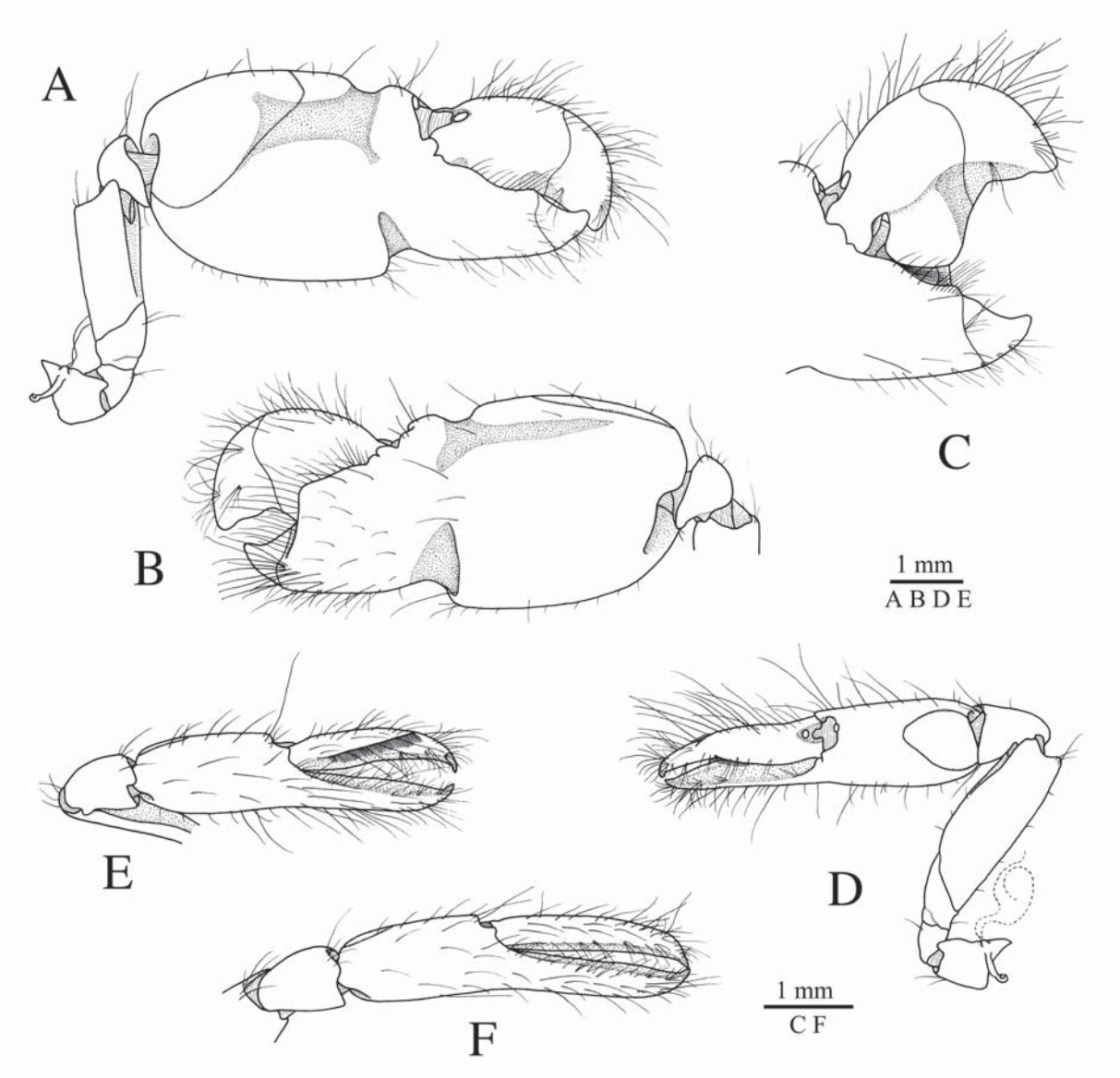

Fig. 5. *Alpheus zarenkovi* sp.n.: holotype, ♂ (cl 5.7 mm) (MNHN-IU-2014-10169) [A–E] and paratype, ovigerous ♀ (cl 5.2 mm) (OUMNH.ZC. 2015-01-095) [F] from Coiba Island, Pacific side of Panama: A — right (major) cheliped, lateral view; B — right (major) chela, mesial view; C — same, fingers opened, lateral view; D — left (minor) cheliped, lateral view; E — left (minor) chela, mesial view; F — same, mesial view.

Рис. 5. *Alpheus zarenkovi* sp.n.: голотип, ♂ (cl 5.7 мм) (MNHN-IU-2014-10169) [A–E] паратип, яйценосная ♀ (cl 5.2 mm) (OUMNH.ZC. 2015-01-095) [F] с о. Коиба, тихоокеанское побережье Панамы: A — правая (большая) хелипеда, латеральный вид; B — правая (большая) клешня, мезиальный вид; C — то же, пальцы клешни раскрыты; латеральный вид; D — левая (меньшая) хелипела, латеральный вид; E — левая (меньшая) клешня, мезиальный вид; F — то же, мезиальный вид.

tral carina with low, very broad, triangular tooth, without anterior point (Fig. 4A, B, D). Antenna with basicerite bearing sharp distoventral tooth; scaphocerite relatively long, with almost unnoticeably concave lateral margin and well-developed blade, latter not overreaching strong distolateral tooth; carpocerite reaching distinctly beyond scaphocerite and also exceeding end of antennular peduncle (Fig. 4A, B).

Mouthparts typical for genus in external observation. Third maxilliped slender, pediform; coxa with distally subacute lateral plate; antepenultimate article slightly flattened ventrolaterally; penultimate article about twice as long as wide, mesioventral surface without particularly thickened setae; ultimate article with rows of short serrulate setae and very long simple setae distally, without spiniform setae; arthrobranch well developed (Fig. 4E).

Major cheliped similar in both sexes, typically larger and with slightly different proportions in males; ischium very short, merus moderately stout, about 2.4 times as long as wide, blunt distodorsally, without distomesial tooth; carpus very short, cup-shaped; chela

with palm about 1.6 times as long as fingers, distodorsal margin with broad transverse groove extending onto lateral surface and then posteriorly beyond linea impressa, and into mesial surface and then posteriorly, almost reaching linea impressa; dorsal shoulder not overhanging, rounded, sloping smoothly into transverse groove; ventral margin with deep, broad transverse groove, ventral shoulder not protruding anteriorly, rounded; dactylus slightly overreaching pollex, with stout, broad plunger, latter furnished with stamen-shaped sensillae (Fig. 5A–C).

Male minor cheliped much smaller and slightly less robust than major cheliped; ischium very short; merus rather stout, about 2.6 times as long as wide, blunt distodorsally, without distomesial tooth; carpus short, cup-shaped; chela with palm subequal to fingers, smooth, without transverse or longitudinal grooves, without shoulders; fingers subequal in length; dactylus slightly broadened laterally, lateral and mesial surfaces with longitudinal ridge furnished with thick balaeniceps setae (Fig. 5D, E). Female minor cheliped with ischium, merus and carpus similar to those of male minor cheliped; chela with fingers longer than palm, simple, without balaeniceps setae (Fig. 5F).

Second pereiopod slender; ischium and merus subequal in length; carpus with five joints, their ratio approximately equal to 3/2.7/1/1/1.5; chela as long as second carpal segment (Fig. 4F). Third pereiopod moderately slender; ischium without spiniform seta on ventrolateral surface; merus about four times as long as wide, slightly inflated, unarmed; carpus about half length of merus, much more slender, unarmed; propodus significantly longer than carpus but shorter than merus, ventral margin with irregularly inserted, stout spiniform setae, including two near dactylar base; dactylus about half length of propodus, fairly slender, conical, simple (Fig. 4G). Fourth pereiopod generally similar to third, slightly more slender. Fifth pereiopod much more slender than third and fourth; ischium unarmed; merus not inflated, about 5.5 times as long as wide; carpus 0.9 length of merus; propodus with setal rows on ventrolateral surface, starting from about half-length of article and increasing in length distally, and with several spiniform setae on ventromesial surface; dactylus conical, simple, slightly shorter and more curved than that of third pereiopod (Fig. 4H).

Male second pleopod with appendix masculina much shorter than appendix interna, with stiff setae apically (Fig. 4I). Uropod with lateral lobe of protopod ending in acute point; exopod and endopod broad, rounded distally; diaeresis of exopod slightly sinuous, lateral portion with broadly subtriangular lobe adjacent to stout distolateral spiniform seta, aberrantly with two spiniform setae (Fig. 4J, K).

COLOURATION. Carapace uniform reddish brown to bluish or greenish grey; abdomen pale yellow-grey with broad transverse bands of brown or greenish grey; antennular and antennal peduncles reddish-brownish to reddish green; chelipeds orange brown to dark olive-brown mesially; second to fifth pereiopods reddish; telson dark brown or grey, uropod with darker greyish brown endopod and paler reddish exopod (Fig. 6).

ETYMOLOGY. It is a great honour for us to name this new species after Dr. Nikolai A. Zarenkov (M.V. Lomonosov Moscow State University) for his important contribution to the taxonomic knowledge of decapod crustaceans.

TYPE LOCALITY. Bahía de Santa Cruz, Isla Coiba (Coiba Island), Panama.

DISTRIBUTION. Presently known only from the type locality on Coiba Island, on the Pacific side of Panama.

ECOLOGY. All specimens were collected by sieving muddy water under large rocks, partly immerged in mud, in a shallow bay near the entrance of an estuary, not far from mangroves.

REMARKS. *Alpheus zarenkovi* sp.n., like the previous species, belongs to the *A. edwardsii* species group. Among the American members of this group, *A. zarenkovi* sp.n. is characterised by the combination of the following morphological features: (1) rostral carina low, posteriorly widening, short, not extending beyond level of eye base; (2) second article of the antennular peduncle distinctly longer than wide; (3) third maxilliped with slender, not particularly broadened antepenultimate article, and without noticeably thickened or villiform setae on the penultimate article; (4) distomesial margin of the cheliped merus unarmed; (5) minor chela of males with balaeniceps setae on dactylus, simple in females; (6) ischium of the third and fourth pereiopods unarmed; (7) merus of the third and fourth pereiopods unarmed distoventrally; (8) dactylus of the third to fifth pereiopods non-spatulate, subconical. The features (4), (7) and (8) are shared with *A. burukovskyi* sp.n., the two species differing in the features (1), (2), (3), (5), and (6) (see above). In life, *A. burukovskyi* sp.n. and *A. zarenkovi* sp.n. can be easily told apart by their colour patterns (cf. Figs. 3, 6).

Only a few other American species of the *A. edwardsii* group are characterised by the cheliped merus unarmed distomesially; the male minor chela bearing a ridge with balaeniceps setae; and the third to fifth pereiopods with a non-spatulate, subconical dactylus (features (3), (4) and (7) above, respectively). These species are *A. heterochaelis* and *A. petronioi* (both WA), *A. californiensis*, *A. lacertosus*, *A. distinctus*, *A. firmus* and *A. villus* (all EP). Among these species, *A. heterochaelis*, *A. petronioi* and *A. villus* may be more closely related to *A. zarenkovi* sp.n. based on the overall morphological similarity.

Alpheus zarenkovi sp.n. differs from *A. heterochaelis* and *A. petronioi* by the unarmed ischium of the third and fourth pereiopods (*vs.* armed with a small spiniform seta in *A. heterochaelis* and *A. petronioi*); from *A. heterochaelis* also by the shorter second article of the antennular peduncle (about 1.6 times as long as wide in *A. zarenkovi* sp.n. *vs.* almost twice as long as wide in *A. heterochaelis*); and from *A. petronioi* also by the proportions of the carpal articles of the second pereiopod, with the first article noticeably longer than the second

Fig. 6. *Alpheus zarenkovi* sp.n.: holotype, male (cl 5.7 mm) (MNHN-IU-2014-10169) [above] and paratype, ovigerous female (cl 5.2 mm) (MNHN-IU-2014-10170) [below] from Coiba Island, Pacific side of Panama, dorsal views in life. Photographer: A. Anker.

Рис. 6. *Alpheus zarenkovi* sp.n.: голотип, самец (cl 5.7 мм) (MNHN-IU-2014-10169) [верхнее фото] и паратип, яйценосная самка (cl 5.2 mm) (MNHN-IU-2014-10170) [нижнее фото] с о. Коиба, тихоокеанское побережье Панамы, дорсальный вид. Фотограф: А. Анкер.

in *A. zarenkovi* sp.n. (*vs*. subequal to the second in *A. petronioi*) [cf. Hendrix, 1971; Almeida et al., 2014]. The new species can be easily separated from *A. californiensis*, *A. lacertosus* and *A. distinctus* by the less defined, gradually sloping dorsal shoulder of the major chela (*vs*. almost perpendicularly sloping in *A. californiensis*, *A. lacertosus* and *A. distinctus*); the absence of a ventral shoulder in the male minor chela (very obvious in *A. californiensis*, *A. lacertosus* and *A. distinctus*); the unarmed ischium of the third and fourth pereiopods (*vs*. armed with a stout spiniform seta in *A. californiensis*, *A. lacertosus* and *A. distinctus*); and from *A. californiensis* also by the smoothly flattening postrostral area (*vs.* much more sharply delimited in *A. californiensis*) [cf. Kim, Abele, 1988]. The three most obvious differences between *A. zarenkovi* sp.n. and *A. firmus* are the dactylus of the male minor chela (laterally not expanded in *A. zarenkovi* sp.n. *vs.* greatly expanded in *A. firmus*); the armature of the ischium of the third and fourth pereiopods (unarmed in *A. zarenkovi* sp.n. *vs.* armed with a small spiniform seta in *A. firmus*); and the length of the penultimate article of the third maxilliped (hardly twice as long as wide in *A. zarenkovi* sp.n. *vs*. more than three times as long as wide in *A. firmus*) [cf. Kim, Abele, 1988]. *Alpheus zarenkovi* sp.n. may be separated from *A. villus* by the absence of a dense field of thickened setae on the penultimate article of the third maxilliped (present in *A. villus*); the absence of ventral shoulder on the male minor chela (present, although very slight, in *A. villus*); the broader and ventrally less protruding ventromesial carina of the first article of the antennular peduncle; and the shorter second article of the antennular peduncle (about 1.6 times as long as wide in *A. zarenkovi* sp.n. *vs.* almost twice as long as wide in *A. villus*).

All other American or amphi-Atlantic species of the *Alpheus edwardsii* group differ in at least three obvious morphological characters from *A. zarenkovi* sp.n., such as the merus distomesially armed with a stout sharp tooth (e.g., *A. buckupi*, *A. armillatus* and *A. nuttingi* species complexes, *A. holthuisi*, *A. intrinsecus*); the male minor chela without balaeniceps setae (e.g., *A. armilla-*

tus and *A. nuttingi* species complexes, *A. viridari*, *A. mazatlanicus*, *A. pacificus*, *A. colombiensis*, *A. estuariensis*); the dactyli of the third to fifth pereiopod distinctly broadened, subspatulate (e.g., *A. colombiensis*, *A. estuariensis*, *A. latus*, *A. pontederiae*); the antepenultimate article of the third maxilliped distinctly broadened, operculate (*A. chacei*, *A. antepaenultimus*); the mesial margin of orbital hoods with strong sharp teeth (*A. intrinsecus*); the dorsal and ventral shoulders of the major chela acutely projecting (*A. intrinsecus*); the merus of the third pereiopod armed with a distomesial tooth (*A. intrinsecus*, *A. schmitti*, *A. umbo*). Many of them also differ from *A. zarenkovi* sp.n. in the colour pattern (see above for references) and ecology.

The poorly described *Alpheus spinicaudus* Lockington, 1878 is distinguishable from *A. zarenkovi* sp.n. by the same features as *A. burukovskyi* sp.n. (see above). *Alpheus zarenkovi* sp.n. is also morphologically similar to several Indo-West Pacific species, e.g., those related to the *A. lobidens* De Haan, 1849 species complex. However, all of them possess minor chelipeds with a better developed balaeniceps condition in males; the distomesial margin of the cheliped merus is produced into a sharp tooth; and the ischium of the third and fourth pereiopods is typically armed with a stout spiniform seta [see Banner, Banner, 1982; Chace, 1988 and references therein].

ACKNOWLEDGEMENTS. The material reported in this study was collected with the collecting permits issued by the Autoridad Nacional del Ambiente (ANAM) through the Smithsonian Tropical Research Institute (STRI). The trip to Coiba Island was organised by Javier Jara and Eyda Gomez (STRI), with the financial support of STRI and Nancy Knowlton (National Museum of Natural History, Smithsonian Institution). AA and PP are grateful to Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) of the Ministry of Education of the Brazilian Government, for providing financial support in the form of a postdoctoral and a MSc. scholarship, respectively. Both authors are also grateful to Marcos D.S. Tavares (MZUSP) for providing laboratory space and equipment to accomplish this study. The original manuscript was reviewed by Zdenek Ďuriš (University of Ostrava).

References

Almeida A.O., Terossi M., Araújo-Silva C.L., Mantelatto F.L. 2013. Description of *Alpheus buckupi* spec. nov., a new amphi-Atlantic snapping shrimp (Caridea: Alpheidae), based on morphological and molecular data // Zootaxa. Vol.3652. P.437–452.

Almeida A.O., Terossi M., Mantelatto F.L. 2014. Morphology and DNA analyses reveal a new cryptic snapping shrimp of the *Alpheus heterochaelis* Say, 1818 (Decapoda: Alpheidae) species complex from the western Atlantic // Zoosystema. Vol.36. P.53–71.

Anker A. 2001. Two new species of snapping shrimps from the Indo-Pacific, with remarks on colour patterns and sibling species in Alpheidae (Crustacea: Caridea) // Raffles Bulletin of Zoology. Vol.49. P.57–72.

Anker A. 2010. On two snapping shrimps, *Alpheus baccheti* n. sp. and *A. coetivensis* Coutière from the Tuamotu Islands // Zootaxa. Vol.2492. P.49–62.

Anker A. 2012. Revision of the western Atlantic members of the *Alpheus armillatus* H. Milne Edwards, 1837 species complex (Decapoda, Alpheidae), with description of seven new species // Zootaxa. Vol.3386. P.1–109.

Anker A., Hurt C., Knowlton N. 2007a. Three transisthmian snapping shrimps (Crustacea: Decapoda: Alpheidae: *Alpheus*) associated with innkeeper worms (Echiura: Thalassematidae) in Panama // Zootaxa. Vol.1626. P.1–23.

Anker A., Hurt C., Knowlton N. 2007b. Revision of the *Alpheus nuttingi* (Schmitt) complex (Crustacea: Decapoda: Alpheidae), with description of a new species from the tropical eastern Pacific // Zootaxa. Vol.1577. P.41–60.

Anker A., Hurt C., Knowlton N. 2008a. Revision of the *Alpheus cristulifrons* species complex (Crustacea: Decapoda: Alpheidae), with description of a new species from the tropical eastern Atlantic // Journal of the Marine Biological Association of the United Kingdom. Vol.88. P.543–562.

Anker A., Hurt C., Knowlton N. 2008b. Revision of the *Alpheus websteri* Kingsley, 1880 species complex (Crustacea: Decapoda: Alpheidae), with revalidation of *A. arenensis* (Chace, 1937) // Zootaxa. Vol.1694. P.51–68.

Anker A., Hurt C., Knowlton N. 2009. Description of cryptic taxa within the *Alpheus bouvieri* A. Milne-Edwards, 1878 and *A. hebes* Kim and Abele, 1988 species complexes (Crustacea: Decapoda: Alpheidae) // Zootaxa. Vol.2153. P.1–23.

Anker A., Pachelle P.P.G. 2013. Re-examination of the eastern Pacific and Atlantic material of *Alpheus malleator* Dana, 1852, with the description of *Alpheus wonkimi* sp. nov. (Crustacea: Decapoda: Alpheidae) // Zootaxa. Vol.3637. P.412–431.

Armstrong J.C. 1949. New Caridea from the Dominican Republic // American Museum Novitates. Vol.1410. P.1–27.

Audouin V. 1826. Explication sommaire des planches de crustacés de l'Égypte et de la Syrie, publiées par Jules-César Savigny, Membre de l'Institut; offrant un exposé des caractères naturels des genres avec la distinction des espèces. Animaux invertébrés // Description de l'Égypte ou receuil des observations et des recherches qui ont été faites en Égypte pendant l'expédition de l'Armée Française, publié par les ordres de sa Majesté l'Empereur Napoléon le Grand. Paris: Imperiale. P.77–98.

Banner A.H. 1953. The Crangonidae, or snapping shrimp, of Hawaii // Pacific Science. Vol.7. P.3–147.

Banner A.H., Banner D.M. 1966. The alpheid shrimp of Thailand // The Siam Society Monograph Series. Vol.3. P.1–168.

Banner A.H., Banner D.M. 1983. An annotated checklist of the alpheid shrimp from the western Indian Ocean // Travaux et Documents de l'ORSTOM. Vol.158. P.1–164.

Banner D.M., Banner A.H. 1982. The alpheid shrimp of Australia. Part III: The remaining alpheids, principally the genus *Alpheus*, and the family Ogyrididae // Records of the Australian Museum. Vol.34. P.1–357.

Bracken-Grissom H.D., Felder D.L. 2014. Provisional revision of American snapping shrimp allied to *Alpheus floridanus* Kingsley, 1878 (Crustacea: Decapoda: Alpheidae) with notes on *A. floridanus africanus* // Zootaxa. Vol.3895. P.451–491.

Carvacho A. 1979. Les crevettes carides de la mangrove guadeloupéenne // Bulletin du Muséum National d'Histoire naturelle (4), section A, Zoologie, Biologie et Écologie animales. Vol.1. P.445–470.

Chace F.A, .Jr. 1972. The shrimps of the Smithsonian-Bredin Caribbean expeditions with a summary of the West Indian shallow-water species (Crustacea: Decapoda: Natantia) // Smithsonian Contributions to Zoology. Vol.98. P.1–179.

Chace F.A.,Jr. 1988. The caridean shrimps (Crustacea: Decapoda) of the *Albatross* Philippine Expedition, 1907–1910, Part 5: Family Alpheidae // Smithsonian Contributions to Zoology. Vol.466. P.1–99.

Christoffersen M.L. 1984. The Western Atlantic snapping shrimps related to *Alpheus heterochaelis* Say (Crustacea, Caridea) with the description of a new species // Papéis Avulsos de Zoologia. Vol.35. P.189–208.

Coutière H. 1905. Les Alpheidae // Gardiner J.S. (ed.). The Fauna and Geography of the Maldive and Laccadive Archipelagoes.

Being the account of the work carried on and of the Collections made by an Expedition during the years 1899 and 1900. Cambridge: University Press. P.852–921.

Coutière H. 1908. Sur quelques nouvelles espèces d'Alpheidae // Bulletin de la Société Philomathique de Paris. 9e sér. T.10. P.191–216.

Crosnier A., Forest J. 1966. Crustacés Décapodes: Alpheidae // Campagnes de la Calypso dans le Golfe de Guinée et aux Iles Principe, São Tomé et Annobon (1956), et Campagne aux Iles du Cap Vert (1959). Part 19: Résultats Scientifiques des Campagnes de la Calypso 7(27). Annales de l'Institut Océanographique de Monaco. Vol.44. P.199–314.

Dana J.D. 1852. Conspectus Crustaceorum &c. Conspectus of the Crustacea of the Exploring Expedition under Capt. C. Wilkes, U.S.N. Macroura // Proceedings of the Academy of Natural Sciences of Philadelphia. Vol.1852 P.10–29.

De Haan W. 1833–1850. Crustacea // von Siebold P.F. (ed.). Fauna Japonica sive Descriptio Animalium, quae in Itinere per Japoniam, Jussu et Auspiciis Superiorum, qui Summum in India Batava Imperium Tenent, Suspecto, Annis 1823–1830 Collegit, Notis, Observationibus et Adumbrationibus Illustravit. Lugduni-Batavorum. P.i–xxxi, ix–xvi, 1–243.

De Man J.G. 1911. The Decapoda of the Siboga Expedition. Part II. Family Alpheidae // Siboga Expeditie. Vol.39a. P.133–465.

Debelius H. 2001. Crustacea guide of the world. Shrimps. Crabs. Lobsters. Mantis shrimps. Amphipods. Frankfurt: IKAN Unterwasserarchiv. 321 pp.

Fabricius J.C. 1798. Supplementum Entomologiae Systematicae. Hafniae: Proft et Storch. 572 p.

Hendrix G.Y. 1971. A systematic study of the genus *Alpheus* (Crustacea: Decapoda: Alpheidae) in South Florida. Florida: University of Miami, Coral Gables. PhD thesis. 184 pp.

Holmes S.J. 1900. Synopsis of California stalk-eyed Crustacea. // Occasional Papers of the California Academy of Sciences. Vol.7. P.1–262.

Jensen G.C. 1995. Pacific coast crabs and shrimps. California: Sea Challengers. 87 pp.

Kim W., Abele L.G. 1988. The snapping shrimp genus *Alpheus* from the Eastern Pacific (Decapoda: Caridea: Alpheidae) // Smithsonian Contributions to Zoology. Vol.454. P.1–119.

Lockington W.N. 1878. Remarks on some new Alphei, with a synopsis of the North-American species // The Annals and Magazine of Natural History. 5 sér. T.1. P.465–480.

Mathews L.M., Anker A. 2009. Molecular phylogeny reveals extensive ancient and ongoing radiations in a snapping shrimp species complex (Crustacea, Alpheidae, *Alpheus armillatus*) // Molecular Phylogenetics and Evolution. Vol.50. P.268–281.

Milne Edwards H. 1833 (1834–1840). Histoire naturelle des crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux. Paris: Librairie Encyclopédique de Roret. P.1–468, 1–532, 1–638, 1–32.

Rafinesque C.S. 1815. Analyse de la Nature ou tableau de l'Univers et des corps organisés. Palerme. 224 p.

Ribeiro A. 1964. Sobre uma espécie nova de *Alpheus* Fabricius, 1798 do Arquipélago de Cabo Verde, *Alpheus holthuisi* n. sp. // Notas Mimeografadas do Centro de Biologiá Piscatória, Lisboa. Vol.42. P.1–14.

Ríos R. 1992. Camarones carídeos del Golfo de California. VI. Alpheidae del estuario de Mulegé y de Bahía Concepción, Baja California Sur, México (Crustacea: Caridea) // Proceedings of the San Diego Society of Natural History. Vol.14. P.1–13.

Rochebrune A.T., de. 1883. Diagnoses d'arthropodes nouveaux propres à la Sénégambie // Bulletin de la Société Philomathique de Paris. 7 sér. T.7. P.167–182.

Say T. 1818. An account of the Crustacea of the United States, part 5 // Journal of the Academy of Natural Sciences at Philadelphia. Vol.1. P.235–253.

Schmitt W.L. 1924. Report on the Macrura, Anomura and Stomatopoda collected by the Barbados-Antigua Expedition from the University of Iowa in 1918 // University of Iowa Studies of Natural History. Vol.10. P.65–99.

Sivertsen E. 1933. The Norwegian Zoological Expedition to the Galapagos Islands 1925, conducted by Alf Wollebaek. VII. Littoral Crustacea Decapoda from the Galapagos Islands // Meddelelser fra det Zoologiske Museum, Oslo. Vol.38. P.1–23.

Soledade G.O., Almeida A.O. 2013. Snapping shrimps of the genus *Alpheus* Fabricius, 1798 from Brazil (Caridea: Alpheidae): updated checklist and key for identification // Nauplius. Vol.21. P.89–122.

Spence Bate C. 1888. Report on the Crustacea Macrura collected by the Challenger during the years 1873–76 // Report on the Scientific Results of the Voyage of H.M.S. "Challenger" during the years 1873–76. Vol.24. P.i–xc, 1–942.

Wicksten M.K. 1983. A monograph on the shallow water caridean shrimps of the Gulf of California, Mexico // Alan Hancock Monographs in Marine Biology. Vol.13. P.1–59.

Wicksten M.K. 1988. A new snapping shrimp from the Pacific coast of Colombia (Decapoda, Caridea, Alpheidae) // Crustaceana. Vol.54. P.1–4.

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