

Description of a new species of *Richalpheus* Anker and Jeng, 2006 (Crustacea: Decapoda: Alpheidae) from the Red Sea

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Abstract

Richalpheus dahabensis n. sp. is described from a single female specimen collected at a depth of 10–13 m from the mound of the callianassid mudshrimp, *Glypturus* sp., in the shallow lagoon near Dahab, Egyptian Red Sea. The new species differs from the type species, *R. palmeri* Anker and Jeng, 2006, by the absence of the fossa/tooth system on the pollex of the major chela. The diagnosis of *Richalpheus* is emended to accommodate the new species. The two possible pathways for the evolution of the fossa/tooth system within the leptalpheoid lineage are discussed.

Keywords: Alpheidae, *Richalpheus*, infaunal shrimp, new species, Callianassidae, commensalisms, fossa-tooth system, Indo-West Pacific, Red Sea.

Introduction

The alpheid shrimp genus *Richalpheus* Anker and Jeng, 2006 was established for the peculiar infaunal shrimp, *Richalpheus palmeri* Anker and Jeng, 2006, from Panglao, Philippines (Anker and Jeng 2006). *Richalpheus* is closely related to *Leptalpheus* Williams, 1965 (*sensu lato*), *Fenneralpheus* Felder and Manning, 1986, and *Amphibetaeus* Coutière, 1896 (see Williams 1965; Felder and Manning 1986; Dworschak and Coelho 1999; Anker and Jeng 2006; Anker et al. 2006a). These four genera share the presence of strongly asymmetrical chelipeds that are carried flexed when not in use (in the major cheliped, merus being fitted into a ventral depression of the palm); the general shape of the minor cheliped and third to fifth pereopods; the absence of orbital teeth (and often the rostrum as well); and the diaeresis being deeply incised and bearing a large tooth near the mesial margin of the exopod. Within the Alpheidae, they form a morphologically well defined and likely monophyletic leptalpheoid lineage (see Anker et al. 2006b). *Richalpheus* differs from *Leptalpheus*, *Fenneralpheus*, and *Amphibetaeus* by the absence of strap-like epipods on the

third maxilliped and first to fourth pereopods and the presence of tufts of dense stiff setae on the chela of the second pereopod (Anker and Jeng 2006). Most if not all leptalpheoids live as commensals in burrows of larger crustaceans (mostly thalassinideans), although hosts of *Richalpheus palmeri* and *Fenneralpheus chacei* Felder and Manning, 1986 remain to be determined.

In October 2005, while scuba diving in the shallow lagoon near Dahab, Egypt, in the Gulf of Aqaba, northern Red Sea, one of us (P.C.D.) collected a single specimen of an infaunal leptalpheoid shrimp by using a bait suction pump ("yabby pump") on the mound of a large mudshrimp, *Glypturus* sp. (Thalassinidea, Callianassidae). The alpheid specimen was initially identified as "*Leptalpheus* sp.", but after more thorough inspection was found to represent an undescribed species of the morphologically similar *Richalpheus*. The new species is described and illustrated below. The generic diagnosis of *Richalpheus* is slightly emended to accommodate the new species.

Material and methods

The single specimen was collected by scuba diving and with the aid of a bait suction pump (yabby pump), and was preserved in >98% propylene glycol. Drawings were made under a dissection microscope equipped with a camera lucida. The carapace length (CL) and the total length (TL) were measured along the mid-dorsal line from the anterior margin of the carapace to the posterior margin of the carapace and telson, respectively. The holotype is deposited in the Naturhistorisches Museum in Wien, Vienna, Austria (NHMW). The other abbreviations used in the text are: P, pereopod; Mxp, maxilliped.

Taxonomy

Richalpheus Anker and Jeng, 2006

Revised diagnosis

Carapace glabrous, with anterolateral suture; branchiostegial margin with pronounced ventral lip and with rounded notch; cardiac notch well developed. Frontal margin without rostrum or orbital teeth. Pterygostomial angle rounded. Eyes concealed in dorsal and lateral view; anteromesial margin of eyestalk bluntly projecting. Antennular peduncle robust, first segment with ventromesial tooth; stylocerite appressed, distally blunt; second segment longer than wide; lateral antennular flagellum with very short accessory ramus. Antenna with basicerite moderately robust; carpocerite overreaching scaphocerite. Mouthparts typical for family; mandible with two-segmented palp; first maxilliped with elongate palp and expanded caridean lobe; second maxilliped with elongate epipod. Third maxilliped pediform, lateral plate produced, distally acute; tip of ultimate segment unarmed. First pereopods (chelipeds) enlarged, very unequal in size, asymmetrical in shape, carried flexed; major cheliped with basis and ischium unarmed; merus slender, unarmed, ventral surface depressed; carpus short, cup-shaped; chela moderately large, subcylindrical; palm depressed longitudinally on ventromesial side, linea impressa absent; adhesive discs present; pollex with very shallow proximal depression or with shallow central fossa; dactylus unarmed or with flat bulge fitting into central fossa on pollex; no additional teeth on dactylus or pollex. Second pereopod with four-segmented carpus; chela simple, with dense rows of stiff setae. Third pereopod with unarmed ischium and merus, carpus

with distal spine on ventral margin; propodus with spines on ventral margin, dactylus simple, conical. Fifth pereopod with unarmed propodus, distally bearing well developed brush of setae. Sixth pleomere with more or less distinct articulated plate at posteroventral angle. Uropod with unarmed protopod; exopod distally truncate, diaeresis with deep incision and triangular tooth near mesial margin of exopod. Telson with two pairs of dorsal spines and two pairs of posterolateral spines; posterior margin rounded; anal tubercles present. Gill/exopod formula: 5 pleurobranches (P1–5), 1 arthrobranch (Mxp3), 0 podobranch, 2 lobe-like epipods (Mxp1–2), 0 strap-like epipods = mastigobranchs, 0 sets of setobranchs, 3 exopods (Mxp1–3).

Type species

Richalpheus palmeri Anker and Dworschak, 2006.

Other species included

Richalpheus dahabensis n. sp. (see below).

Distribution

Indo-West Pacific: presently known only from the Philippines and Egyptian Red Sea.

***Richalpheus dahabensis* n. sp.**

(Figures 1–3)

Material

Holotype: female, CL 4.6 mm, TL 16.8 mm, NHMW 21600, Egypt, Red Sea, Dahab, Laguna, 13 m, bait suction pump, from mound of *Glypturus* sp., coll. P. C. Dworschak, 31 October 2005.

Description

Body moderately elongate and slender, slightly compressed laterally, glabrous. Carapace with inconspicuous suture proximal to base of antenna (Figure 1B). Frontal margin broadly rounded, rostrum and orbital teeth absent (Figure 1A). Pterygostomial angle rounded, not protruding (Figure 1B). Cardiac notch deep (Figure 1E). Eyes juxtaposed, completely covered by carapace, not visible in dorsal or lateral view (Figure 1A, B), anteromesial process feebly developed, cornea relatively small.

Antennular peduncle relatively slender, elongate (Figure 1A), dorsoventally somewhat flattened (Figure 1B); first segment about three times as long as wide; dorsomesial carina with row of slender spiniform setae (Figure 1C); ventromesial carina of first segment with strong acute tooth (Figure 1D); stylocerite appressed, with blunt tip reaching slightly past mid-length of first segment (Figure 1A); second segment slightly shorter than visible portion of first segment; lateral flagellum biramous, secondary ramus short, with several groups of aesthetascs (Figure 1B).

Antenna with stout basicerite distally bearing small subacute ventrolateral tooth (Figure 1B); scaphocerite oval-shaped, anterior margin of blade not protruding beyond

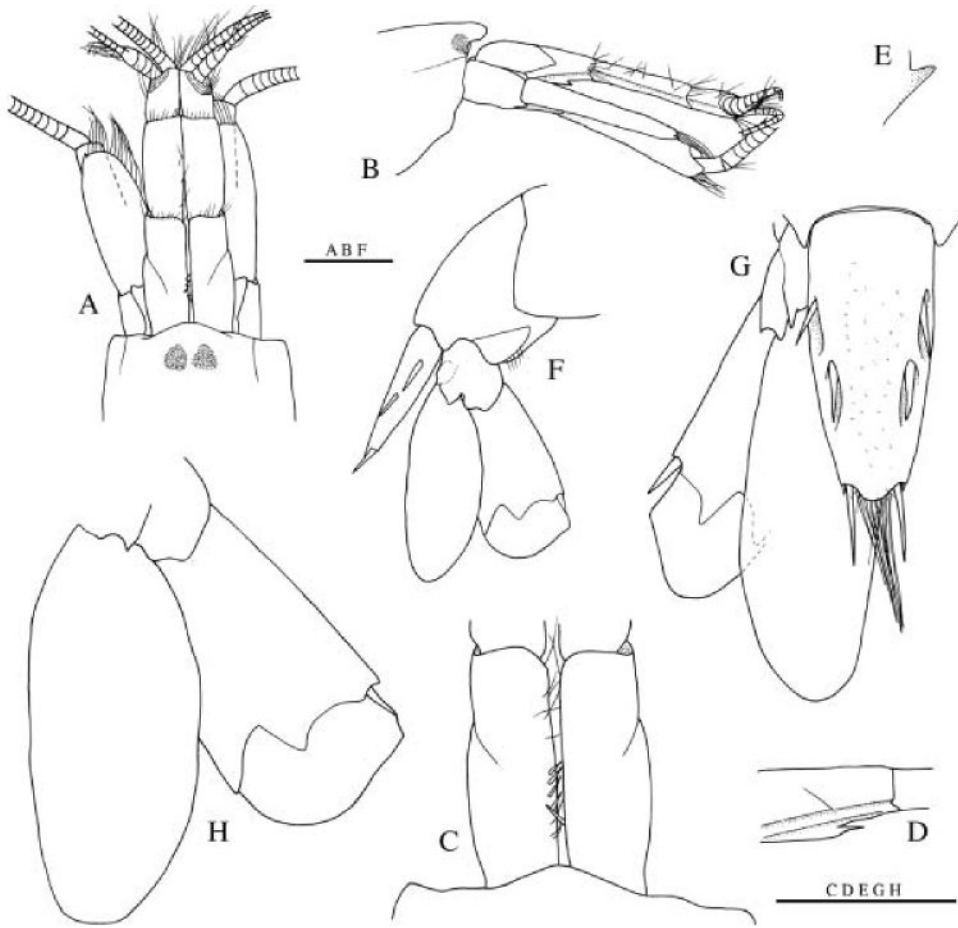


Figure 1. *Richalpheus dahabensis* n. sp., female holotype (NHMW 21600). (A, B) Frontal region, dorsal and lateral view, respectively; (C) same, frontal margin of carapace and first segments of antennular peduncles, dorsal view; (D) right antennule, tooth on ventromesial carina of first segment, lateral view; (E) right cardiac notch, lateral view; (F) sixth pleomere and tail fan, right lateral view; (G) telson and left uropod, dorsal view; (H) right uropod, dorsal view. Scale bars: 1 mm.

distolateral tooth, latter minute, subacute, not separated from blade by incision (Figure 1A); carpocerite elongate, moderately robust, slightly overreaching distolateral tooth of scaphocerite, in full extension reaching at most to mid-length of third segment of antennular peduncle (Figure 1A, B).

Mouthparts typical for genus. Mandible (Figure 2A) with bisegmented palp; molar process comparatively small; incisor process with six teeth. Maxillule (Figure 2B) with bilobed palp, both lobes distally with one seta. Maxilla (Figure 2C) with dorsal endite deeply incised; scaphognathite relatively broad. First maxilliped (Figure 2D) with expanded endopod (palp) and caridean lobe; epipod ear-shaped. Second maxilliped (Figure 2E) with elongate epipod; propodus without distinct transverse suture. Third maxilliped (Figure 2F) relatively slender; coxa with large, ear-shaped lateral plate, distally subacutely produced; exopod elongate, with some flexible setae on posterior margin, overreaching distal margin of antepenultimate segment; antepenultimate segment with oblique basal suture near

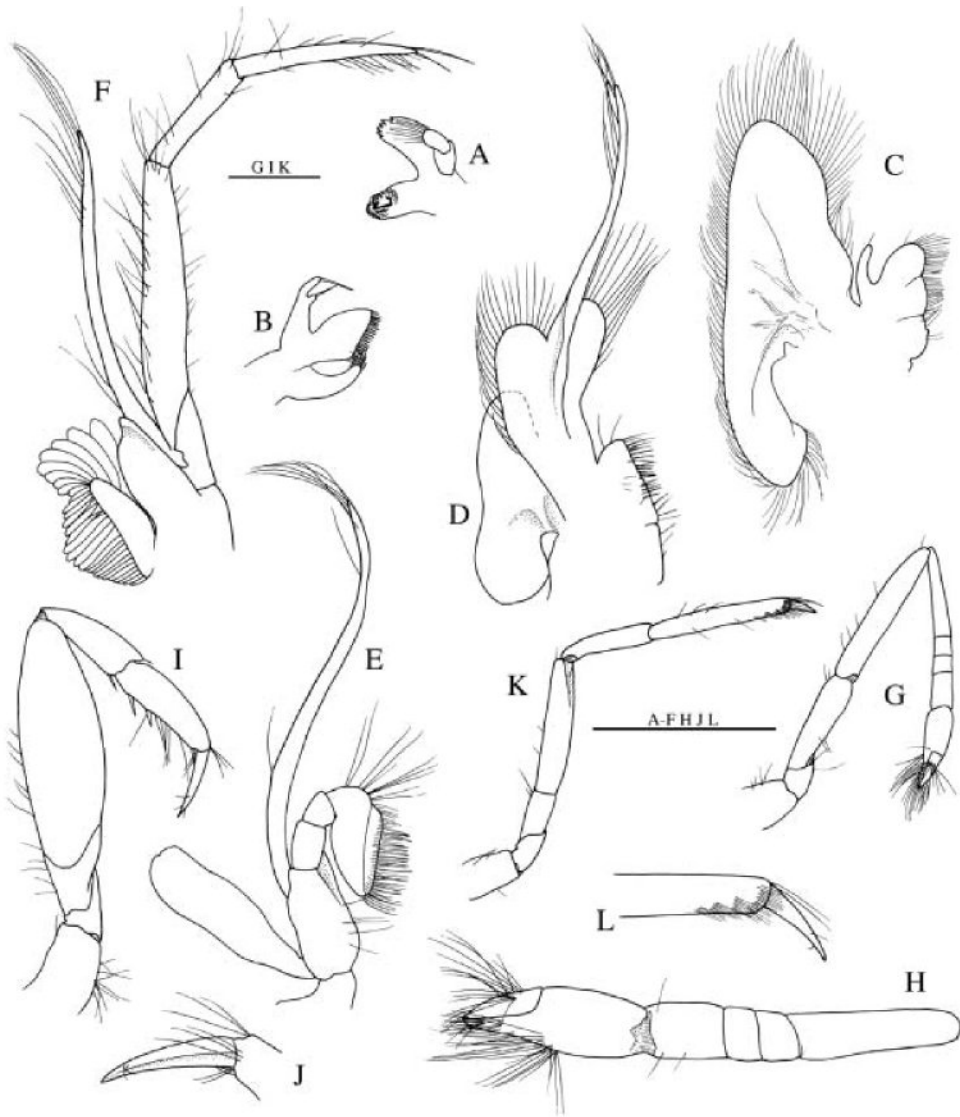


Figure 2. *Richalpheus dahabensis* n. sp., female holotype (NHMW 21600). (A) Right mandible, mesial view; (B) right maxillule, lateral view; (C) right maxilla, lateral view; (D) right first maxilliped, lateral view; (E) right second maxilliped, lateral view; (F) right third maxilliped, lateral view; (G) right second pereopod, lateral view; (H) same, detail of carpus and chela; (I) right third pereopod, lateral view; (J) same, detail of dactylus, mesial view; (K) right fifth pereopod, lateral view; (L) same, detail of distal propodus and dactylus. Scale bars: 1 mm.

insertion of exopod; penultimate segment almost four times as long as wide; ultimate segment distally tapering, with scarce rows or tufts of setae, some elongate, tip unarmed; arthrobranch large.

First pereopods (chelipeds) very asymmetrical in shape and unequal in size (Figure 3), carried flexed ventromesially. Major cheliped (Figure 3A, B) with short unarmed ischium; merus moderately elongate, ventrally slightly depressed, with smooth margins, distally without teeth; carpus very short, plate-shaped (Figure 3A, B); chela enlarged,

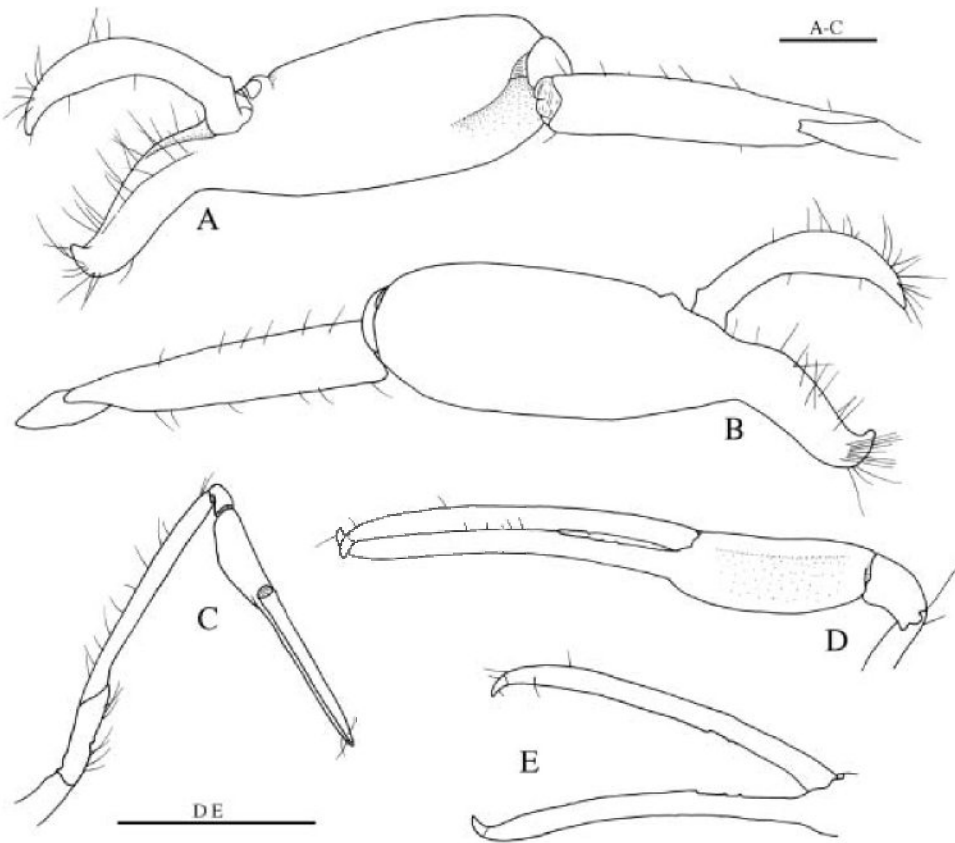


Figure 3. *Richalpheus dahabensis* n. sp., female holotype (NHMW 21600). (A, B) Left (major) cheliped, mesial and lateral view, respectively; (C) right (minor) cheliped, lateral view; (D) same, carpus and chela, mesial view; (E) same, chela fingers opened. Scale bars: 1 mm.

subcylindrical, smooth; palm depressed ventromesially (Figure 3A) with transverse constriction on distodistal margin (Figure 3A, B); linea impressa absent; adhesive discs conspicuous (Figure 3A); fingers slightly turned mesially, about three-quarters length of palm; dactylus relatively slender, distally curved, cutting edge unarmed (Figure 3A, B); pollex with deep sinus proximally (Figure 3B), tip strongly curved upwards, cutting edge unarmed (Figure 3A, B), proximal portion shallowly depressed (Figure 3A).

Minor cheliped (Figure 3C–E) much smaller than major cheliped, slender; ischium elongate, unarmed; merus elongate, slender, ventrally flattened, margins smooth; carpus very small, cup-shaped (Figure 3C); chela flattened ventromesially (Figure 3D); fingers about twice as long as palm (Figure 3D), finger tips strongly curved distally, crossing (Figure 3D); cutting edges of pollex and dactylus mostly straight, except for, respectively, three and two small, irregular teeth in proximal half (Figure 3E).

Second pereiopod relatively short, moderately slender (Figure 2G); ischium about three-quarters length of merus; carpus four-segmented, segment ratio approximately 4/1/1/2 (Figure 2G); chela with fingers shorter than palm; distoventral portion of palm, pollex and dactylus with dense rows or tufts of setae (Figure 2G, H). Third pereiopod robust (Figure 2I), flattened mesially; ischium unarmed; merus about three times as long as wide; ventral

and dorsal margins convex, unarmed; carpus much shorter and more slender than merus, with slender distoventral spiniform seta; propodus as long as carpus, with two spiniform setae on ventral margin and one distal spiniform seta near articulation with dactylus (Figure 2I); dactylus more than half propodus length, simple, feebly curved, somewhat flattened on one side (almost subspatulate; Figure 2J). Fourth pereopod generally similar to third pereopod. Fifth pereopod shorter and much more slender than third and fourth pereopods (Figure 2K); ischium unarmed; merus at least four times as long as wide, with straight margins; carpus shorter than merus, unarmed; propodus as long as merus, without spiniform setae on ventral margin, distally with four rows of setae (Figure 2L); dactylus similar to that of third and fourth pereopods, slightly more curved (Figure 2L).

First to fifth pleomeres with rounded posteroventral angles; sixth pleomere with posteroventral angle separated from rest of pleomere by complete suture, forming feebly articulated plate (Figure 1F); preanal plate with median groove, posteriorly rounded. Female second pleopod with slender appendix masculina; male second pleopod unknown.

Uropods distinctly exceeding telson (Figure 1G); lateral lobe of protopod (sympodite) distally with two blunt or subacute lobes (Figure 1G, H); endopod distinctly longer than exopod; exopod posterolaterally truncate, subrectangular (Figure 1G, H); diaeresis laterally sinuous, mesially deeply incised and with large triangular tooth near mesial margin of exopod (Figure 1G, H); distolateral spiniform seta slender, not reaching distal margin of exopod (Figure 1H).

Telson moderately slender, about twice as long as wide at base, distally tapering (Figure 1G); dorsal surface pitted, with two pairs of strong slender spiniform setae inserted in deep pits, first pair situated close to lateral margin, anterior to mid-length of telson, second pair situated at some distance from lateral margin, posterior to mid-length of telson (Figure 1G); posterior margin rounded medially, with two pairs of posterolateral spiniform setae, lateral very short, mesial at least seven times longer, slender (Figure 1G); margin between mesial spiniform setae with at least seven (probably eight) setae; anal tubercles present, moderately developed. Gill/exopod formula typical for genus: 5 pleurobranchs (P1–5), 0 podobranch, 1 arthrobranch (Mxp3), 0 mastigobranchs (strap-like epipods), 0 setobranchs, 3 exopods (Mxp1–3).

Size

The holotype is 4.6 mm CL and 16.8 mm TL.

Colour pattern

Pale whitish, semitransparent.

Etymology

The specific name refers to the type locality, Dahab, Egypt.

Type locality

Dahab, Gulf of Aqaba, Red Sea, Egypt.

Distribution

Presently known only from the type locality in the northern Red Sea.

Habitat

Subtidal sandy bottom with few coral patches, depth 10–13 m, in burrow of the callianassid mudshrimp, *Glypturus* sp. Burrows of *Glypturus* can be recognized by characteristic volcano-shaped mounds (with a diameter of 10 cm or more, sometimes with a small hole or a shallow crater on the top), and nearby funnels (more than 10 cm in diameter at surface, more than 10 cm deep). The host was not collected, but the most likely candidate is *G. laurae* (de Saint Laurent, 1984) [according to Sakai (1999) *G. laurae* is a junior synonym of *G. armatus* (A. Milne Edwards, 1870), an opinion with which we do not agree].

Remarks

Richalpheus dahabensis n. sp. differs from *R. palmeri*, the type species and the only other species of *Richalpheus*, by the absence of a shallow fossa on the pollex of the major chela (cf. Figure 3A and Anker and Jeng 2006, Figure 4h); the more slender tooth on the mesioventral carina of the first segment of the antennular peduncle (cf. Figure 1D and Anker and Jeng 2006, Figure 2d); the somewhat shorter merus of the third pereopod: less than three times as long as wide (at widest point) in *R. dahabensis* n. sp. versus at least three and a half times in *R. palmeri* (cf. Figure 2I and Anker and Jeng 2006, Figure 6a); the longer exopod and penultimate segment of the third maxilliped (cf. Figure 2F and Anker and Jeng 2006, Figure 3f); and the distolateral tooth of scaphocerite being much smaller and not having a deep incision separating it from the blade, as in *R. palmeri* (cf. Figure 1A and Anker and Jeng 2006, Figure 2a, f). Furthermore, *R. dahabensis* n. sp. appears to have a more distinct articulated plate on the sixth pleomere (see Figure 1F) than does *R. palmeri*, which has only an inconspicuous suture separating the posteroventral angle from the rest of the pleomere (cf. Anker and Jeng 2006, Figure 2g).

Discussion

Anker et al. (2006b) provided the only exhaustive phylogenetic treatment of the Alpheidae. *Richalpheus palmeri* (described at about the same time in 2006) was not included in this analysis, although in a short note added in the proof Anker et al. (2006b) stated that *Richalpheus* plainly belongs to the leptalpheoid lineage, together with *Amphibetaeus*, *Leptalpheus*, and *Fenneralpheus* (clade ALF in Anker et al. 2006b).

The combination of morphological characters of *R. palmeri* and *R. dahabensis* n. sp. corroborates the position of *Richalpheus* within the ALF clade (see Anker et al. 2006b). However, the incomplete set of characters for *Amphibetaeus jousseamei*, a species not collected again since its original description, with only the major cheliped remaining as lectotype (see Anker and Jeng, 2006; Anker et al. 2006b), and the morphological diversity within *Leptalpheus sensu lato* (Anker et al. 2006a; A. Anker, personal observation), make it difficult to propose a more resolved topography of the clade ALF. Three most likely possibilities are: (1) *Richalpheus* and *Amphibetaeus* as sister genera opposed to the sister genera *Fenneralpheus* and *Leptalpheus*; (2) *Amphibetaeus* forming a sister clade to all the remaining three leptalpheoid genera, with *Richalpheus* forming a sister clade to the *Fenneralpheus–Leptalpheus* clade; (3) *Amphibetaeus* forming a sister clade to all the remaining three leptalpheoid genera, with *Richalpheus* embedded somewhere within the *Fenneralpheus–Leptalpheus* clade. Only a formal cladistic treatment of the clade ALF, based on morphological and/or molecular characters, may elucidate the position of *Richalpheus* within the ALF clade.

Coutière's (1899) observations of the behaviour of *Amphibetaeus jousseaumei* (Coutière, 1896) suggest that the fossa/tooth system on the major chela is most probably non-functional; at least, these shrimps do not produce an audible snap, unlike the true snapping shrimps (mostly species of *Alpheus* Fabricius, 1798 and *Synalpheus* Bate, 1888). The presence of an apparently non-functional fossa/tooth system on the major chela of *Amphibetaeus jousseaumei* and *Richalpheus palmeri*, and its absence in *Richalpheus dahabensis* n. sp., suggest at least two possible evolutionary scenarios. The first is that the fossa/tooth system evolved independently in two related leptalpheoid lineages: in *Amphibetaeus* and within *Richalpheus* (in *R. palmeri*). This hypothesis is supported by some structural differences between the fossa/tooth systems of *A. jousseaumei* and *R. palmeri* (Anker and Jeng 2006). The other, in our opinion less likely, scenario is that the fossa/tooth system evolved once in the common ancestor of *Amphibetaeus* and *Richalpheus*, and became secondarily reduced in *R. dahabensis* n. sp. (and eventually also in *Fenneralpheus* and *Leptalpheus*). For a more detailed discussion of alpheid tooth/fossa systems and their evolution see Anker et al. (2006b).

The above comparison between *R. dahabensis* n. sp. and *R. palmeri* raises some doubts about the development of the articulated plate on the sixth pleomere as a character of generic importance. The presence or absence of this plate has been widely used in alpheid generic diagnoses since Coutière's studies (e.g. Holthuis 1993). It is true that in the vast majority of the currently recognized alpheid genera, the presence or absence of this plate is clear and consistent (A. Anker, personal observation). However, in *Richalpheus*, as well as in two other genera, *Nennalpheus* Banner and Banner, 1981 and *Salmonaeus* Holthuis, 1955, the development (or at least the external distinctiveness) of the articulated plate appears to be variable (Banner and Banner 1981; A. Anker, personal observation). Furthermore, according to Anker et al. (2006b), this plate appears to have evolved multiple times within the Alpheidae and may have been the subject of reversals (fused again with the rest of the pleomere).

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