A redescription of *Parabetaeus culliereti* Coutière and status of the genus *Neopalpheopsis* Banner (Decapoda: Caridea: Alpheidae)

Keiichi Nomura and Arthur Anker

Abstract.—*Parabetaeus culliereti* Coutière, 1896, the type species of the genus *Parabetaeus* Coutière, 1896, is redescribed and illustrated based on recently collected specimens from southern Japan and Papua New Guinea, and the taxonomic status of the genus *Parabetaeus* Coutière is clarified. *Parabetaeus culliereti* appears to exhibit large variation in the development of the rostrum and orbital teeth. This type of variation has not been previously reported in the family Alpheidae. As a result, the genus *Neopalpheopsis* Banner, 1953 is synonymized with *Parabetaeus*, and a new combination, *Parabetaeus euryone* (De Man, 1910) is proposed. Differences between *P. culliereti* and *P. euryone* are also discussed.

Introduction

The monotypic alpheid genus *Parabetaeus* Coutière, 1896 was established for *Parabetaeus culliereti* Coutière, 1896, based on an incomplete specimen from Tahiti, which lacked both first pereiopods. The genus *Parabetaeus* is closely related to *Neopalpheopsis* Banner, 1953 but the rostrum is not developed in *Parabetaeus*. Therefore, Banner & Banner (1985) strongly suspected that *Parabetaeus* might be a senior synonym of *Neopalpheopsis*, and also that *P. culliereti* might be a senior synonym of *N. euryone* (De Man, 1910). They suggested that the type of *P. culliereti* might be genetically deformed. However, as there are no subsequent record of *P. culliereti* since the original description, the true taxonomic status of this genus and species has remained unclear. Despite our efforts, the holotype could not be located, although Forest (in Banner & Banner, 1985: p.38) suggested that the holotype might be deposited in the University of Lyon.

Recently, several specimens which closely agree with the original description of *P. culliereti* were collected from southern Japan and Papua New Guinea. These specimens made it possible to reevaluate this poorly known species and to compare it with *Neopalpheopsis euryone*. In this study, we redescribe *P. culliereti*, and discuss the taxonomic status of the two genera, *Parabetaeus* and *Neopalpheopsis*.

Specimens are deposited in the Koninklijk Belgisch Instituut voor Natuurwetenschappen (KBIN), and the Museum National d’Histoire Naturelle, Paris (MNHN), National Fisheries University, Shimonoseki (NFU), and Natural History Museum and Institute, Chiba (CBM). The carapace length (CL), measured from the frontal margin to the posterodorsal margin of the carapace, is used as a standard measurement.

The following specimens of *Neopalpheopsis euryone* were used for comparison with *Parabetaeus culliereti*: 1 female (CBM-ZC 5725, CL 4.8), Nakamoto, Kuro-shima, southern Ryukyus, Japan, 16 April 1987, reef flat, intertidal, coll. K. Nomura; 1 female (MNHN-Na. 13633, CL 5.1), Yakabi-jima, Kerama Group, central Ryukyus, 24 April 1994, 10 m deep, coll. K. Nomura; 1 female (NFU 530-2-2320, ca. CL 5.0), Ahra, Kume-jima, central Ryukyus, 14 June 1995, reef flat, inter-

Systematics

Parabetaeus culieriiti Coutière, 1896
Figs. 1–4

[New Japanese name: Henge-teppouebi]

Parabetaeus culieriiti Coutière, 1896: 383
[Type locality: Papeete, Tahiti]; 1899: 69, 247, 259, 310, figs. 16, 298, 316, 317, 390, 392; Holthuis, 1993: 208, fig. 204; Nomura et al., 1996: 7.


Redescription.—Body (Fig. 1A) not especially compressed or elongated. Carapace (Fig. 1A) smooth, without distinct carina or groove; pterygostomial angle rounded, not produced anteriorly; cardiac notch present. Rostrum (Figs. 1B, 3A–E) usually absent, sometimes present as blunt projection; orbital teeth (Figs. 1B, 3A–E) variable from absent to acutely pointed in various degrees; frontal margin variable from nearly straight to con- cave.

Abdominal somites (Fig. 1A) smooth and rounded dorsally, pleura of fourth to sixth somites pointed postero-ventrally; sixth somite 0.4 times as long as carapace, with articulated triangular flap posteroventrally; postero-lateral process acute or subacute. Telson (Fig. 1C) 2.5–3.3 times length of anterior width, and about half length of carapace; dorsal surface with 2 pairs of dorso-lateral spines, anterior pair situated approximately at mid-length of telson; posterior margin ending in sharply pointed, triangular projection; each side of median projection with 2 spines, mesial spine 3–4 times longer than lateral spine, overreaching tip of median projection.

Eyes (Fig. 1A, B) concealed in dorsal view, partially exposed in lateral and frontal views. Corneas well developed, occupying most of supero-anterior portion of eyestalks.

Antennular peduncle (Fig. 1B, D) stout, about half length of carapace, reaching nearly to distal margin of scaphocerite. First segment with strong tooth on ventromesial ridge; stylocerite acutely pointed, reaching 0.5–0.9 length of second segment. Second segment 0.8–1.2 times as long as visible part of first segment; third segment subequal in length to visible part of first segment. Lateral flagellum (Fig. 1A) about 1.5 times as long as carapace, biramous, proximally fused for 3–4 articles; aesthetasc bearing branch composed of about 10 articles; mesial flagellum slightly longer than lateral flagellum.

Antenna (Fig. 1A, E) with basicerite bearing strong ventrolateral tooth, reaching or not reaching distal margin of first segment of antennular peduncle; anterodorsal margin produced in small, blunt process. Scaphocerite about 2.0 times as long as wide, with well developed blade; lateral margin slightly convex, distolateral tooth not reaching distal margin of blade. Carpocerite subcylindrical,
Fig. 1. *Parabetaeus culliereti* Coutière, female (CBM-ZC 5728, CL 5.9): A, habitus, lateral; B, anterior part of carapace and cephalic appendages, dorsal; C, telson and right uropods, dorsal, setae omitted; D, antennular peduncle, ventral, setae omitted; E, scaphocerite, dorsal, setae omitted; F, right third maxilliped; G, right first pereiopod, dorsal; H, same, merus and ischium, ventral; I, same, fingers, ventral; J, left first chela, dorsal.
shorter than scaphocerite, about 3 times as long as wide, reaching about mid length of third segment of antennular pedunule. Flagellum approximately equal to total body length.

Mouthparts as usual for family. Mandible with incisor process bearing 7–8 teeth; palp 2-articulated. Maxillule with bilobed palp, mesial lobe bearing 1 long apical bristle; distal endite suboval, with row of small spines and stiff setae on mesial margin; proximal endite slender, with 3 spiniform setae distally. Maxilla with short palp; distal endite bilobed; proximal endite composed of single small lobe. First maxilliped with long, slender palp, over-reaching distal margin of distal endite; exopod long, with caridean lobe proximally, epipod large, almost as large as endite, slightly bilobed. Third maxilliped (Fig. 1F) slender, slightly overreaching distal margin of antennular peduncle; ultimate segment about 10 times as long as wide, tapering distally, tip with 3 short spines; penultimate segment 0.6 times as long as ultimate segment; antepenultimate segment 1.8 times as long as ultimate segment; exopod well developed, reaching to distal margin of antepenultimate segment; epipod with terminal hook; epipodial plate acute distally; arthrobranch present.

First pereiopods (Fig. 1G–J) equal or subequal, usually carried extended with dactylus in lateral position. Dactylus subequal in length to palm, terminating in acute tip; lateral surface with scattered long setae and few tufts of setae distally, dorsal surface with row of short setae adjacent to cutting edge; cutting edge serrated with about 20 teeth. Carpus short, cup-shaped, almost as long as wide. Merus about 6.0 times as long as wide; ventral surface excavated, ventromesial and ventrolateral margins each with acute distal tooth. Ischium short, without teeth, spines or depressions.

Second pereiopod (Fig. 2A) slender; chela about 3 times as long as wide; fingers slightly gaping, about twice as long as palm, with tufts of long setae at distal third; tips acute, cutting edges entire; palm sub-cylindrical, without setae; carpus with 5 articles, first article 5–6 times as long as second, slightly longer than distal 4 articles combined; ischium and merus unarmad.

Posterior three pairs of pereiopods (Figs. 1A, 2B–E) slender. Third pereiopod (Fig. 2B, C) with dactylus simple, slightly curved, about 0.3 times as long as propodus, 5–7 times as long as proximal width. Propodus 11–16 times as long as wide, slightly longer than carpus; flexor margin with 4–6 spines arranged in single row and 2 distal spines. Carpus unarmad. Merus 7–10 times as long as wide, lateral surface 2–4 spines. Ischium 3–6 times as long as distal width, ventral surface with 1 or 2 spines.

Fourth pereiopod (Fig. 2D) similar to third pereiopod in shape, slightly shorter; flexor surface of propodus with 3–5 spines and 2 distal spines; merus with 1–3 ventral spines; ischium with 2 ventral spines. Fifth pereiopod (Fig. 2E) as long as third pereiopod; flexor surface of propodus with 5–7 spines and 2 distal spines, and about 10 tufts of short setae; merus with 0–3 ventral spines; ischium short, about half length of ischium of third pereiopod, with 0–1 ventral spine.

Branchial formula summarized in Table 1.

Female first pleopod (Fig. 2F) with endopod reduced, tapering distally. Male first pleopod similar to that of female; second pleopod (Fig. 2G) with appendix
Fig. 2. Parabetaeus culliereti Coutière, A–G, female (CBM-ZC 5728, CL 5.9); H–I, male (CBM-ZC 5729, CL 6.3): A, right second cheliped, lateral; B, right third pereiopod, lateral; C, same, dactylius and distal part of propodus, mesial; D, right fourth pereiopod, lateral; E, right fifth pereiopod, lateral; F, first pleopod, setae omitted; G, second pleopod, setae of endopod and exopod omitted; H, left first (major) chela, dorsal; I, right first (minor) chela, dorsal.
masculina and interna; appendix masculina slightly longer than appendix interna, and about 0.3 times as long as endopod.

Uropod (Fig. 1C) not reaching tip of telson; protopod with 2 acute posterodorsal processes; exopod slightly longer than endopod, bearing 1 large movable spine situated mesial to postero-lateral tooth; diaeresis unarmed.

Variation.—*Parabetaeus culliereti* exhibits a large variation in the development of the rostrum and orbital teeth. According to the original description and subsequent illustrations (Coutière, 1896, 1899), the orbital teeth arise from the anterolateral margins of the carapace, while the margin between the orbital teeth is nearly straight (Fig. 3A). In 3 out of the 6 specimens collected from Japan and Papua New Guinea, the orbital teeth are developed as in the type specimen, and the frontal margin is slightly concave (Fig. 3B). On the other hand, in 2 specimens from Japan, the orbital teeth are not developed at all, and the entire frontal margin is almost straight (Fig. 3D, E). Furthermore, 1 specimen from Papua New Guinea, has a weak triangular rostrum between well developed orbital teeth (Fig. 3C).

This species also exhibits slight sexual dimorphism in morphology of the chelae of the first pair of pereiopods. Females and the small male (CL 3.4 mm) have equal or subequal chelipeds, the

Table 1. Branchial formula of *Parabetaeus culliereti* Coutière.

<table>
<thead>
<tr>
<th>Maxillipeds</th>
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<tr>
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<td>Epipod</td>
<td>+</td>
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<td>Exopod</td>
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h: hook-like epipod
chela being more slender than in the large male, being about 0.8 times as long as carapace. The large male (CL 6.3 mm) has unequal chelipeds, with the left cheliped larger than the right; the chelae are about 1.1 times as long as carapace. The armature of the cutting edges is also variable, and the following two forms are recognized. Female and small male form (Fig. 1G, J): the cutting edge of the dactylus is generally smooth and forms a thin plate, with one or multiple teeth proximal to the tip; the cutting edge of the fixed finger is serrated with 15–25 teeth. Large male form (Fig. 2H, I): the major chela of the cutting edge of the dactylus is armed with one large tooth at midlength and bears a thin plate only proximally; the cutting edge of the fixed finger is armed with a small tooth only on the proximal third, bearing one large tooth in the distal third, a concavity is present at about midlength corresponding to the tooth on the opposing margin of dactylus; the minor chela is similar to that of the female and small male form.

Eggs.—One ovigerous female (CBMZC 5727) brooded about 20 non-eyed eggs of the diameter of 0.44–0.45 x 0.34–0.38 mm. The ovary of this individual was full of the mature eggs (Fig. 4B).

Coloration.—Body transparent or milky white dorsally with transverse red band on each abdominal somite (Fig. 4A, B). Chela of first pereiopod and antennular peduncle sometimes reddish. Color intensity of red band is variable from brilliant red to pale red.

Habitat.—The Japanese and Papua New Guinea specimens were collected in shallow coral reefs from the intertidal zone down to 15 m deep, under dead coral or among broken corals.

Distribution.—Papeete, Tahiti (type locality); southern Japan and northern coastline of Papua New Guinea (present study).

Remarks.—The shape of the frontal margin of the carapace, including the development of the rostrum and orbital teeth, has been considered as an important and stable diagnostic character at the generic level in the family Alpheidae (Chace, 1988; Holthuis, 1993). However, a large infraspecific variation in the development of the rostrum and the orbital region was observed in Parabetaeus cullieri. Such variation has not been reported in other species of alpheids, except for deformed individuals (see Banner & Banner (1985) for Synalpheus streptodactylus and S. iocasta).

The present specimens agree well with the original description and subsequent illustrations of Parabetaeus cullieri by Coutière (1896, 1899) except for the shape of the frontal margin of the carapace. Nevertheless, as demonstrated above, the observed variation in the frontal margin is near continuous, and there is little doubt that all the examined specimens belong to P. cullieri.

Discussion

Status of the genus Neoalpheopsis and N. euryone

The genus Neoalpheopsis was established by Banner (1953) with N. hiatti Banner, 1953 as the type species. Banner (1953) cited only the presence of a projecting rostrum by which Neoalpheopsis can be separated from Parabetaeus. Subsequently, the generic status of Neoalpheopsis was retained for the alpheids that seemingly differed from Parabetaeus in the presence of a distinct rostrum by Banner & Banner (1985), Chace (1988) and Holthuis (1993), although Banner & Banner (1985) suggested that the two genera might be synonymous, and even that the P. cullieri and N. euryone (De Man, 1910) (=senior subjective synonym of N. hiatti; see Banner and Banner, 1985) might be conspecific. As shown by the specimens in the present study, the development of the rostrum is variable from completely absent
Fig. 4. *Parabetaeus culliereti* Coutière (A, B) and *P. euryone* (De Man) (C), dorsal: A, *P. culliereti*, female (CBM-ZC 5728, CL 5.9); B, *P. culliereti*, ovigerous female (CBM-ZC 5727, CL 6.6); C, *P. euryone*, female (MNHN-Na-13633, CL 5.1).
Table 2. Comparison of the morphological characters, habitat and color pattern of two species of *Parabetaeus*.

<table>
<thead>
<tr>
<th>Species / Catalog No.</th>
<th>Locality</th>
<th>Sex</th>
<th>C L (mm)</th>
<th>Rostrum</th>
<th>Orbital teeth</th>
<th>No. of teeth on cutting edge of fixed finger of 1st pereiopod</th>
<th>No. of spines of posterior 3 pereiopods</th>
<th>Ratio of length to width of telson</th>
<th>Habitat</th>
<th>Coloration</th>
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1) Information on the holotype of *Parabetaeus cullieri* was derived from the figures of Coutière, 1899
2) PNG: Papua New Guinea
to weakly projecting in *P. culliereti*. Thus, the presence of the rostrum is not a reliable character to separate *Neopalpheopsis* from *Parabetaeus*. We have compared all available specimens of *P. culliereti* with the four specimens (see "Introduction") referable to the description of *N. euryone* and described as *Alpheopsis? euryone* by De Man (1910, 1911). This comparison has confirmed that there are no differences, of generic significance, between the two species. Therefore, we place *Neopalpheopsis* in the synonymy of *Parabetaeus*, and propose a new combination, *Parabetaeus euryone*, for De Man's (1910) taxon.

As mentioned above, Banner & Banner (1985) suggested that *Neopalpheopsis euryone* might be a junior synonym of *Parabetaeus culliereti*. Indeed these two species are very similar in morphology, habitat and coloration (Figs. 3, 4; Table 2). However, morphological comparison has revealed the presence of some minor but consistent differences which warrant specific status for the two taxa. Namely, the rostrum, if present, seems to be less prominent in *P. culliereti* than in *P. euryone*. In larger females, the cutting margin of the fixed finger of the first pereiopod is armed with more numerous teeth in *P. culliereti* than in *P. euryone* (more than 20 versus less than 13). Also in females, the telson is slightly longer in *P. culliereti* than in *P. euryone* (average ratio of length to width is 2.9 in the former versus 2.6 in the latter species).

Banner & Banner (1985) concluded that *Neopalpheopsis hiatti* Banner, 1953 and *Alpheopsis hummelincki* Schmitt, 1936 are junior synonym of *N. euryone*, and Chace (1988) also concurred with this opinion. However, this synonymization remains questionable. Although it is undoubtedly that *N. hiatti* and *A. hummelincki* belong to the genus *Parabetaeus*, the systematic position of these species should be carefully examined again.

**Redefinition of the genus Parabetaeus**

**Parabetaeus** Coutière, 1896  
[New Japanese name: Henge-teppouebi-zoku]


Emended diagnosis.—Body not markedly compressed, nor elongate. Carapace smooth, without distinct dorsal carina or groove; frontal margin variable, orbital teeth developed or lacking; rostrum present or absent; pterygostomian angle rounded. Sixth abdominal somite with articulated triangular plate. Telson ending in acute, triangular projection. Eyes concealed in dorsal view, partially exposed in lateral and frontal views. Mandible with incisor and molar processes, palp 2-articulated. Third maxilliped pediform, not expanded, distally armed with short spines. First pereiopods usually equal or subequal, carried extended with dactylus in lateral or dorsolateral position; cutting edges of fingers usually serrated, without snapping mechanism. Carpus of second pereiopod divided into 5 articles. Third to fifth pereiopods with simple dactyl. Epipods present on at least first three pereiopods. Second male pleopod with appendices masculina and interna. Exopod of uropod with lateral spine, diaeresis unarmed.

Species included.—*Parabetaeus culliereti* Coutière, 1896; *Parabetaeus euryone* (De Man, 1910), new combination.

Remarks.—The family Alpheidae presently includes 34 genera (Holthuis, 1993; Miyazaki, 1997; Wicksten, 1999; Anker & Iliffe, 2000, De Grave & Anker, 2000). Of these genera, the genus *Parabetaeus* is
closely related to six genera: *Alpheopsis* Coutière, 1896, *Betaeus* Dana, 1852, *Fenneralpheus* Felder & Manning, 1986, *Leptalpheus* Williams, 1965, *Metabetaeus* Borradaile, 1899, and *Nennalpheus* Banner & Banner, 1981. *Parabetaeus* shares the following characteristics: (1) the presence of an articulated plate on the sixth abdominal somite, (2) the presence of the hooked epipods on at least two anterior pereiopods, and (3) the eyes completely covered in dorsal view. *Parabetaeus* is distinguished from the these genera by the features of the first pereiopods and telson. The first chelipeds of *Betaeus* and *Nennalpheus* have inverted chela, with the dactylus situated in the ventral position. The first pereiopods of *Fenneralpheus* and *Leptalpheus* are extremely unequal and very different in shape from those of *Parabetaeus*. *Metabetaeus* bears an elongated, cylindrical carpus of the first pereiopod, while the carpus is cup-shaped and rather short in *Parabetaeus*. Furthermore, *Metabetaeus* is characterized by a peculiar black spot of the incisor process of mandible. *Alpheopsis* shows greatest affinity to *Parabetaeus*, however, the latter genus can be easily separated from the former by the presence of the triangular projection of the telson.

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**Literature Cited**


De Man, J. G., 1910. Diagnoses of new species


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