

**PRESENCE OF THE ALPHEID SHRIMP GENUS *POTAMALPHEOPS* POWELL, 1979
(CRUSTACEA: DECAPODA: CARIDEA) IN SOUTH ASIA,
WITH DESCRIPTION OF A NEW SPECIES FROM SRI LANKA**

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ABSTRACT.— A new species of the alpheid shrimp genus *Potamalpheops* Powell, 1979, is described on the basis of a single male specimen collected in a brackish water stream, 6 km from the sea, in southern Sri Lanka. *Potamalpheops galle*, new species, differs from all other species of the genus by a combination of several features, and appears to be closest to the South-East Asian species *P. amnicus* Yeo & Ng, 1997, *P. miyai* Yeo & Ng, 1997 and *P. palawanensis* Cai & Anker, 2004. The new species is the first record of *Potamalpheops* in South Asia and constitutes an important link between two major radiation zones of this genus, West Africa and South-East Asia/Australia.

KEY WORDS.— *Potamalpheops*, Alpheidae, Sri Lanka, South Asia, brackish waters, Tethyan distribution.

INTRODUCTION

The alpheid genus *Potamalpheops* was established by Powell (1979) for three West African species: *P. pylorus* Powell, 1979, the type species, *P. haugi* (Coutière, 1906) and *P. monodi* (Sollaud, 1932). The presence of a fourth West African species was mentioned (Powell, 1979: addendum); however, this species remains undescribed. In West Africa the range of *Potamalpheops* stretches from Senegal to Gabon (Coutière, 1906; Sollaud, 1932; Gordon, 1956; Powell, 1976, 1979; Anker, 2001), with all four species occurring in the Niger Delta region in Nigeria. Subsequently members of this genus were found in other parts of the world: *P. stygicola* (Hobbs, 1973) in southern Mexico (Hobbs, 1973); *P. hanleyi* Bruce, 1991 and *P. darwiniensis* Bruce, 1993 in northern Australia (Bruce, 1991, 1993); *P. pininsulae* Bruce & Iliffe, 1992 in New Caledonia (Bruce & Iliffe, 1992; Anker, 2001); *P. amnicus* Yeo & Ng, 1997 in southern peninsular Malaysia and Singapore (Yeo & Ng, 1997); *P. miyai* Yeo & Ng, 1997 in western Indonesia and Philippines (Yeo & Ng, 1997; Cai, in prep.); *P. tigger* Yeo & Ng, 1997 in Singapore and northern Australia (Yeo & Ng, 1997; Anker, 2003); *P. johnsoni* Anker, 2003 in Singapore (Anker, 2003) and most recently *P. palawanensis* Cai & Anker, 2004 in Palawan (Cai & Anker, 2004). The habitats of *Potamalpheops* species range from freshwater streams and brackish tidally influenced portions of rivers to mangroves and peat flats, and also include freshwater and anchialine caves.

In 1996 M. M. Bahir (Wildlife Heritage Trust, Sri Lanka) collected a single, complete male specimen of *Potamalpheops* in a brackish water stream in southern Sri Lanka. This specimen is the first record of this genus in South Asia, the

nearest localities being situated in the southern Malaysian state of Johor and Singapore (Yeo & Ng, 1997). Furthermore, this specimen differs in several subtle features from all previously known species and represents a new species, which is described herein.

MATERIAL AND METHODS

The carapace length (CL) and total length (TL) are given in mm and were measured from the tip of the rostrum to the posterior margin of the carapace (CL) or the posterior margin of the telson (TL). Other abbreviations used in the text: P – pereopod; Mxp – maxilliped. The type specimen is deposited in the Zoological Reference Collection, Raffles Museum of Biodiversity Research, National University of Singapore (ZRC). Specimens of the following species were used for comparison and remain deposited in the Muséum National d’Histoire Naturelle, Paris, France (MNHN) and the National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A. (USNM): *Potamalpheops pininsulae* Bruce & Iliffe, 1992: 2 specimens, Pindai caves, New Caledonia (MNHN); *P. palawanensis* Cai & Anker, 2004: 2 specimens, St. Paul Cave, Palawan (MNHN); *P. johnsoni* Anker, 2003: 1 specimen, Mandai Kechil, Singapore (MNHN); *P. amnicus* Yeo & Ng, 1997: 1 specimen, Sungai Kahang, Johor, S Malaysia (MNHN); *P. tigger* Yeo & Ng, 1997: 4 specimens, Lim Chu Kang, Singapore (MNHN); *P. monodi* (Sollaud, 1932): 3 specimens, Porto-Novo, Benin (MNHN); *P. pylorus* Powell, 1979: 1 specimen, Port Harcourt, Nigeria (MNHN); *P. stygicola* (Hobbs, 1973), 1 specimen (paratype), Oaxaca, Mexico (USNM).

TAXONOMY

FAMILY ALPHEIDAE RAFINESQUE

Genus *Potamalpheops* Powell, 1979*Potamalpheops galle*, new species
(Fig. 1)

Material examined. – Holotype - male, CL 3.15, TL 11.1, ZRC 2004.0673, SW Sri Lanka: Lelkada near Dodangoda, Galle District, Gin River basin, 6 km from the sea, altitude 5 m, 06°08'N 80°10'E, brackish water, 0.5–1 m deep, stream bank with vegetation and leaf debris, coll. M.M. Bahir, 21 Mar.1996.

Description. – Carapace smooth, glabrous, laterally with two distinct longitudinal-oblique grooves, one anterior and one posterior (Fig. 1a). Rostrum triangular, broad at base, only slightly exceeding distal margin of cornea (Fig. 1c, d), distally acute, without setae. Extra-corneal teeth well developed, acute, infra-corneal region broadly rounded, produced anteriorly (Figs. 1a, b). Pterygostomial angle very slightly projecting anteriorly, rounded, with a few simple (non-plumose) setae (Fig. 1a). Eyes largely exposed in dorsal and lateral views; cornea well pigmented, occupying most of eyestalk except for mesial and antero-mesial portions, antero-mesial margin with small angular projection (Fig. 1d), without setae. Ocellar beak visible in dorsal view, with black spot (Fig. 1c).

Antennular peduncles slender, second article slightly longer than visible portion of first in dorsal view (Fig. 1c); first segment with distal margin not toothed, dorsal margin with small spines (Figs. 1b, e); stylocerite acute, reaching slightly beyond distal margin of first segment (Figs. 1c, e); ventro-mesial carina with well developed, subacute tooth as illustrated (Fig. 1f); lateral flagellum lacking on both sides. Antenna with basicerite bearing acute ventro-lateral tooth (Fig. 1b); scaphocerite not reaching distal margin of antennular peduncle, disto-lateral spine robust (Fig. 1c), anterior margin convex, not exceeding disto-lateral spine; carpocerite short, with distal margin reaching to about 4/5 of scaphocerite (Fig. 1b); flagellum (broken) slender.

Mouthparts typical for *Potamalpheops*. Mandible with incisor process bearing six triangular acute teeth, two central teeth largest; molar process with circular rows of setae and conspicuous tubercle. Maxillule with endopod bilobed, dorsal lobe without setae, ventral lobe with single very thick seta. Maxilla with scaphognathite rather narrow; dorsal lacinia with small incision; endopod (palp) slender, not setose. First maxilliped with caridean lobe on exopod moderately developed; endopod (palp) bearing distally long, thick plumose setae; epipod rounded-triangular. Second maxilliped without specific features, with epipod elongated. Third maxilliped slender; coxal lateral plate ear-shaped, distally subacute, covering base of exopod; tip of ultimate segment distally with at least two small spines; arthrobranch present, well developed.

First chelipeds (Figs. 1g–i) symmetrical in shape, equal in size, not particularly enlarged compared to second pereopod; ischium elongated; merus slightly longer than ischium and carpus; carpus cylindrical, distally slightly widening, ventro-mesially with at least five rows of grooming setae (Fig. 1h); chela subcylindrical, longer than carpus, fingers slightly shorter than palm (Fig. 1i), with scattered tufts of setae; finger tips bidentate (Fig. 1i'), cutting edges unarmed.

Second pereopod slender (Fig. 1j); ischium and merus subequal in length, slender; carpus five-articulated, ratio of carpal articles approximately equal to (from proximal to distal): 3–1–1.2–1.2–2 (Fig. 1j); chela simple, longer than distal carpal article, subequal to first carpal article; fingers longer than palm. Third pereopod slender (Fig. 1k); ischium armed with one spine; merus armed with two spines (Fig. 1k); carpus unarmed, distally with strong seta; propodus armed with six minute spines on ventral margin, including one distal spine (Fig. 1k); dactylus about 0.4 length of propodus, simple, slender, gradually and slightly curving distally, furnished with fine setae (Fig. 1k). Fourth pereopod similar to third pereopod. Fifth pereopod generally similar to third and fourth pereopods, but with different proportions of articles (Fig. 1l); ischium and merus each armed with one spine; propodus with two-three minute spines on ventral margin and at least rows of grooming setae, distal setae longest (Fig. 1l).

Abdominal segments with postero-ventral angles rounded, fifth segment with postero-ventral angle angular, not acutely produced (Fig. 1n); sixth segment postero-ventrally with triangular articulated flap (Fig. 1n); posterior margin sub-rectangular with minute subacute tooth (Fig. 1n'). Second pleopod with appendix masculina twice as long as appendix interna (Fig. 1m), distally with four slender spines (Fig. 1m'). Uropodal exopod with diaeresis finely toothed for about 3/4 of its length between insertion of lateral spine and abrupt incision (Fig. 1o), with around 19–20 very small triangular acute or subacute teeth (Fig. 1o'); lateral spine strong. Telson relatively broad, sub-rectangular, slightly tapering distally (Fig. 1p), with two pairs of dorsal spines situated as illustrated (Fig. 1p); posterior margin of telson medially rounded, with at each angle two strong postero-lateral spines, mesial slightly longer than lateral (Fig. 1p); anal tubercles absent.

Gill formula typical for genus: 5 pleurobranches (P1–P5); 0 podobranch; 1 arthrobranch (Mxp3); 2 lobe-shaped epipods (Mxp1 and Mxp2); 5 strap-like epipods (mastigobranchs, Mxp3 + P1–P4); 5 sets of setobranchs (P1–P5), 3 exopods (Mxp1–Mxp3). Colour in life unknown.

Etymology. – The new species is named after the old Sri Lankan port city of Galle situated near the type locality.

Habitat. – The single specimen was collected 0.5–1 m deep in a stream, along a bank with vegetation and leaf debris. The water condition was noted as brackish (M. M. Bahir, pers. comm.). The stream belongs to the Gin River basin system, and is situated 6 km from the sea at 5 m above sea level. The only other decapod inhabiting this stream was the atyid shrimp

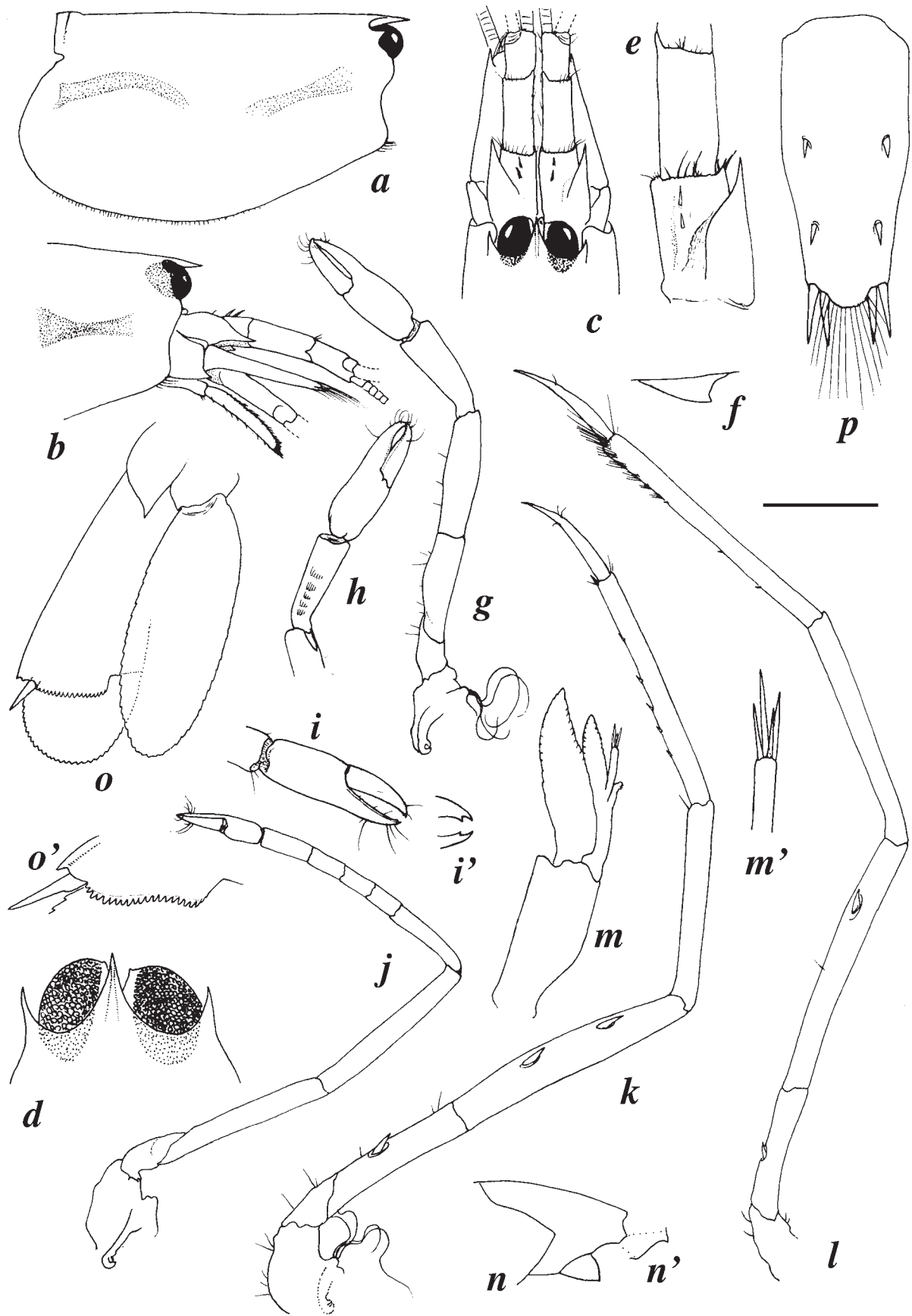


Fig. 1. *Potamalpheops galle*, new species, a – carapace, lateral view; b – frontal region, lateral view; c – same, dorsal view; d – detail of rostrum, orbital teeth and eyestalks; e – antennule, basal segments, dorsal view; f – same, mesio-ventral tooth of first segment; g – first pereiopod (cheliped); h – same, mesial view of chela and carpus; i – same, chela, i' – detail of bidentate tips; j – second pereiopod; k – third pereiopod; l – fifth pereiopod; m – second pleopod, m' – detail of appendix masculina; n – posterior fifth and sixth abdominal segments, n' – detail of posterior margin of sixth segment; o – uropod, o' – detail of diaeresis; p – telson. Scales: 1 mm (a-c, m), 0.5 mm (d-l, n, o); figures i', m', n', o' drawn without scale.

Table 1. All presently known records of *Potamalpheops* with brief summary of ecology.

Species	Locality	Habitat	Reference
<i>P. amnicus</i>	- Singapore: Central Catchment Area - S Malaysia: S Johor: Kota Tinggi	Freshwater streams free of tidal influence	- Yeo & Ng, 1997
<i>P. darwiniensis</i>	- Australia: Northern Territory: Darwin	Mangrove creeks, marine water	- Bruce, 1993
<i>P. galle</i> , new species	- Sri Lanka: Galle District	Streams with tidal influence, brackish water	- Present study
<i>P. hanleyi</i>	- Australia: Northern Territory: Darwin	Mangrove creeks, marine water	- Bruce, 1991
<i>P. haugi</i>	- Gabon: Ogdoué River - Nigeria: Niger Delta	Rivers and streams upstream of tidal limit	- Coutière, 1906 - Powell, 1979
<i>P. johnsoni</i>	- Singapore: Sungei Buloh, Lim Chu Kang	Mangroves, marine and brackish water	- Anker, 2003
<i>P. miyai</i>	- W Indonesia: Pulau Bintan - Philippines: Mindanao	Mangroves, marine and brackish water	- Yeo & Ng, 1997 - Cai & Anker, 2004
<i>P. monodi</i>	- Senegal: Néma - Sierra Leone: Murray Town - Benin: Porto-Novo - Nigeria: Niger Delta - Cameroon: Manoka Bay	Mangrove creeks and peat forests, brackish and tidal influenced freshwater streams	- Gordon, 1956 - Powell, 1979 - Anker, 2001 - Powell, 1976, 1979 - Sollaud, 1932
<i>P. palawanensis</i>	- Philippines: Palawan: St. Paul caves	Anchialine limestone caves, brackish or oligohaline water, tidal influence	- Cai & Anker, 2004
<i>P. pininsulae</i>	- New Caledonia: Pindai Peninsula - New Caledonia: Isle of Pines	Anchialine limestone caves, brackish water, tidal influence	- Anker, 2001; Cai & Anker, 2004 - Bruce & Iliffe, 1992
<i>P. pylorus</i>	- Nigeria: Port Harcourt	Mangrove creeks and mangrove peat flats, also in transition zone between oligohaline and freshwater	- Powell, 1979
<i>P. stygicola</i>	- S Mexico: Oaxaca: Cueva del Nacimiento and Cueva Gabriel	Freshwater caves	- Hobbs, 1973, 1983; Mejía-Ortiz et al., 2003
<i>P. tigger</i>	- Singapore: Sungei Buloh, Lim Chu Kang - Australia: Northern Territory: Darwin	Mangroves, marine or brackish water	- Yeo & Ng, 1997; Anker, 2003 - Anker, 2003
<i>P. sp.</i>	- Nigeria: New Calabar River	Streams, transition zone between oligohaline and freshwater	- Powell, 1979 (addendum)

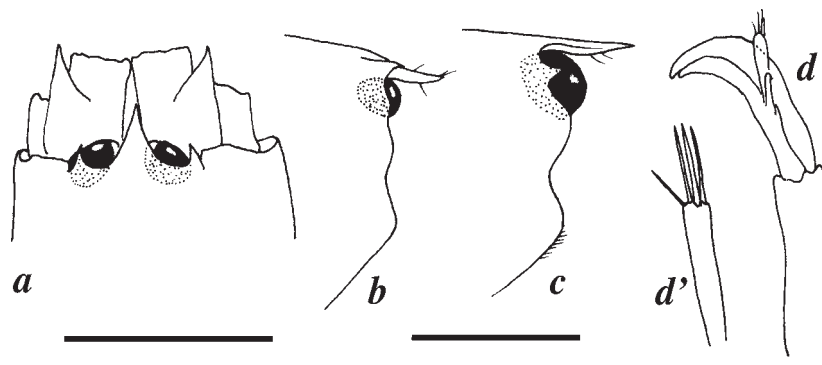


Fig. 2. *Potamalpheops amnicus* Yeo & Ng, 1997 (a, b) and *P. palawanensis* Cai & Anker, 2004 (c, d): a, b - male from Sungai Kahang, Johor, Malaysia (MNHN), frontal region in dorsal (a) and lateral (b) view showing a relatively long rostrum (cf. Yeo & Ng, 1997: fig. 1a, b); c - ovigerous female from St. Paul cave, Palawan (MNHN), frontal region showing a relatively short rostrum (cf. Cai & Anker, 2004: fig. 15A); d - male from the same locality (MNHN), second pleopod, d' - detail of appendix masculina. Scales: left - 1 mm (a-c), right: 0.5 mm (d); figure d' drawn without scale.

Caridina costai De Silva (M. M. Bahir, pers. comm.), which is believed to be a synonym of *Caridina simoni simoni* Bouvier, 1904 (see Benzie & De Silva, 1984). Ovigerous females of this species have relatively large eggs and live mostly in freshwater habitats. The presence of *C. costai* (*C. s. simoni*) could indicate indirectly that the stream where *P. galle*, new species, was collected was only feebly brackish.

Distribution. – Presently known only from the type locality, Lelkada, Galle District, southwestern Sri Lanka.

Remarks. – *Potamalpheops galle*, new species, belongs to *P. monodi* (Sollaud, 1932) group, characterized by two pairs of disto-lateral spines on the posterior margin of the telson. Within this group it can be usefully contrasted with species with a medium to long rostrum; slender, unspecialized chelipeds; and normally developed pigmented cornea: *P. miyai* from Indonesia and the Philippines, *P. amnicus* from southern Malaysia and Singapore, *P. palawanensis* from Palawan, *P. hanleyi* from northern Australia and *P. monodi* from West Africa. The new species differs from all these species by the presence of conspicuous grooves on the lateral sides of the carapace, although these grooves are indicated or feebly marked in some species, e.g., *P. pininsulae* or *P. palawanensis* (Anker, pers. obs.). The only other species bearing well marked (although slightly differently arranged) grooves is *P. stygicola* from southern Mexico (Hobbs, 1973, 1983). However, this stygobitic species can be easily separated by the poor pigmentation of the eyes (cf. Hobbs, 1973: fig. 1b) and the uniquely incised (V-shaped) diaeresis (Hobbs, 1983: fig. 1a).

Besides the absence of well developed grooves on the carapace all above-mentioned species differ from *P. galle*, new species, by a combination of several other features. *Potamalpheops miyai* appears to be closely related to *P. galle*, new species, but differs from the new species in the absence of a spine on the ischium of the fifth pereopod (cf. Yeo & Ng, 1997: fig. 4i), the non-protruding mesio-anterior margin of the eyestalks (cf. idem.: fig. 3b) and the shorter and stouter carpal segments of the second pereopod (cf. idem.: fig. 4c). *Potamalpheops amnicus*, differs from *P. galle*, new species, by the shape of the uropodal diaeresis (cf. Yeo & Ng, 1997: fig. 1e), the presence of small setae on the anterior margin of the eyestalks (cf. idem.: fig. 1b), the absence of a spine on the merus and the ischium of the fifth pereopod (cf. idem.: fig. 2i) and especially by the conspicuously elongated appendix masculina (cf. idem.: fig. 1h). The stygophilic *P. palawanensis* can be separated from the Sri Lankan species by its much longer rostrum (cf. Cai & Anker, 2004: fig. 15A, B), slightly narrower telson (cf. idem.: fig. 15C), much more slender dactyli on the walking legs (cf. idem.: fig. 16D, E) and the antero-mesial margin of the eyestalks non-protruding beyond the cornea (cf. idem.: fig. 15B). *Potamalpheops hanleyi* can be easily distinguished from the new species by its much more robust chelipeds (cf. Bruce, 1991: fig. 4A, B), the proportions of the carpal

segments of the second pereopod (cf. idem.: fig. 4C) and the more robust walking legs (cf. idem.: fig. 4F). Finally, *P. monodi* differs from the Sri Lankan species by the very different proportions of the carpal segments in the second pereopod (cf. Gordon, 1956: fig. 14), the lower number of teeth in the uropodal diaeresis (cf. idem.: fig. 20) and the presence of numerous conspicuous setae on the anterior margin of the eyestalks (cf. Sollaud, 1932: fig. 1; Gordon, 1956: fig. 1). The fourth, still undescribed West African species was briefly described as “morphologically less specialized” than any of the other three African species (Powell, 1979: addendum, p. 150); this species also could be related to *P. galle*, new species.

The remaining six species of *Potamalpheops*, namely *P. pylorus* and *P. haugi* from West Africa, *P. darwiniensis* from northern Australia, *P. tigger* from Singapore and northern Australia, *P. johnsoni* from Singapore, and *P. pininsulae* from New Caledonia, are more distantly related to *P. galle*, new species, differing from the latter in a number of characters, including the development of the chelipeds (*P. pylorus*, *P. haugi*, *P. darwiniensis*) or in the shape and length of the rostrum (*P. tigger*, *P. johnsoni* and *P. pininsulae*). The minute dorsal spines on the first segment of the antennular peduncle (Fig. 1e) are not characteristic of *P. galle*, new species. These spines or spine-like setae are present in some other species, e.g., *P. johnsoni* and *P. pininsulae* (pers. obs.). However, as they are not very conspicuous, these spines may be easily overlooked and have not been illustrated or mentioned in previous descriptions.

The rostrum of *P. amnicus* and *P. palawanensis* shows some variation in length (Fig. 2a–c), approaching the condition found in *P. galle*, new species. A more significant variation of the rostrum length and shape exists in *P. pininsulae* (Bruce & Iliffe, 1992), *P. tigger* and *P. johnsoni* (Anker, 2003). Furthermore, both *P. pininsulae* and *P. johnsoni* appear to be highly variable in the development of the ventral rostral teeth, which may be present in number of one to three or absent (Bruce & Iliffe, 1992; Anker, 2003). The previously unnoted variation in *P. amnicus* and *P. palawanensis* appears to be slight, but demonstrates once more that the rostrum in *Potamalpheops* species is not always a reliable taxonomic character.

The appendix masculina of *P. palawanensis* was previously unknown, as both type specimens of this species are females (Cai & Anker, 2004). Therefore, I take the opportunity to illustrate the second pleopod and the appendix masculina of the first known male of *P. palawanensis* (Figs. 2d, d’). The appendix masculina of most species of the genus, including *P. galle*, new species, and *P. palawanensis*, is furnished with spines on the tip (Figs. 1m’, 2d’). The only exception is *P. pininsulae*, in which the spines are present on the tip but also along the margins of the appendix masculina (Bruce & Iliffe, 1992: fig. 31). In *P. amnicus* the appendix masculina is conspicuously elongated, reaching far beyond the distal margin of the endopod (Yeo & Ng, 1997: fig. 1h).

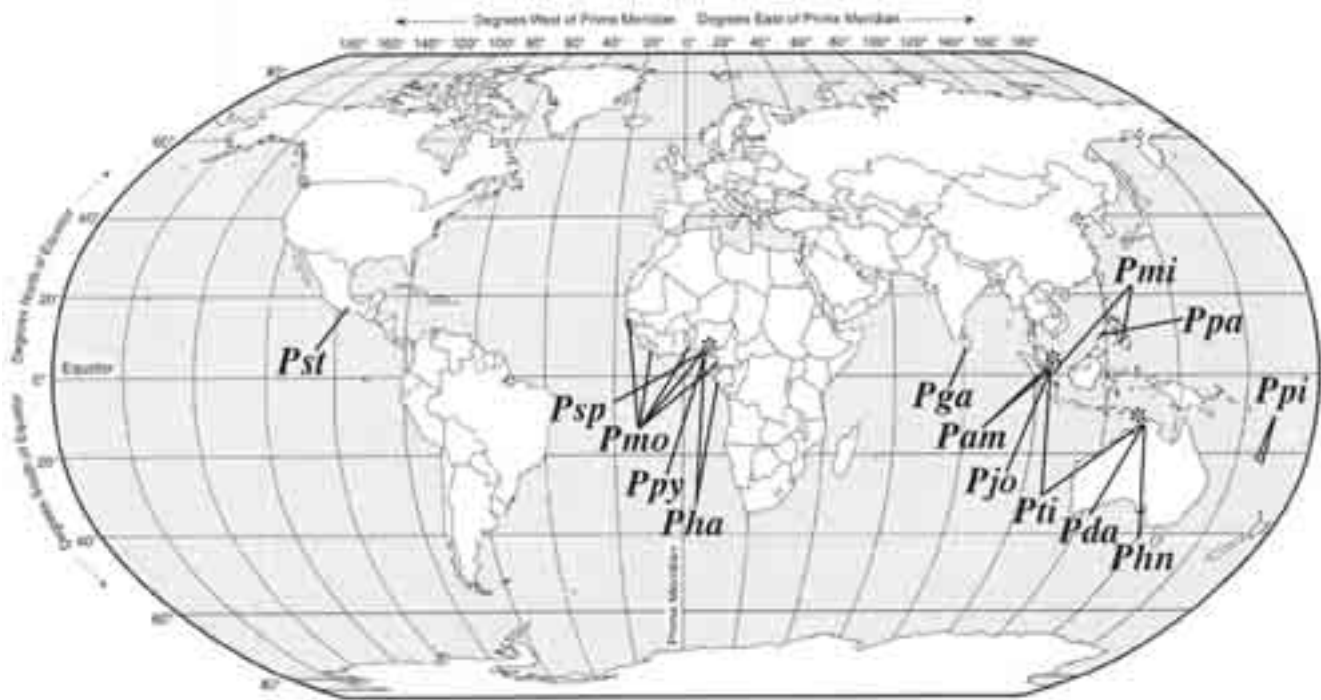


Fig. 3. Distribution of 14 presently known *Potamalpheops* species: **Pam** – *P. amnicus*; **Pda** – *P. darwiniensis*; **Pga** – *P. galle*, n. sp.; **Pha** – *P. haugi*; **Phn** – *P. hanleyi*; **Pjo** – *P. johnsoni*; **Pmi** – *P. miyai*; **Pmo** – *P. monodi*; **Ppa** – *P. palawanensis*; **Ppi** – *P. pininsulae*; **Ppy** – *P. pylorus*; **Psp** – *Potamalpheops* sp. (Powell, 1979); **Pst** – *P. stygicola*; **Pti** – *P. tigger*. * indicates regions with the presently highest diversity of *Potamalpheops* (at least 3 species): the Niger delta in Nigeria, Singapore, and Darwin in Northern Territory, Australia.

DISCUSSION

With the present new species the genus *Potamalpheops* contains 14 species and appears to have a disjunct worldwide distribution (Table 1, Fig. 3). The finding of *P. galle*, new species, in Sri Lanka extends the distribution of this genus from Southeast Asia to South Asia. The genus appears to have radiated in two major zones: in tropical South-East Asia and Australia with seven species, and in tropical West Africa with four species, one of which remains undescribed. Bruce (1991) suggested a former Tethyan distribution and an Upper Cretaceous origin (80–90 my) of the genus. Since *P. galle*, new species, appears to be morphologically (and possibly phylogenetically) closer to some South-Asian species, it is possible that it originated from the same ancient stock as the modern Southeast Asian and Australian species. With respect to its ecology, *P. galle*, new species, belongs to a group of species living in tidally influenced freshwater or brackish-water habitats, which also includes *P. monodi* and the stygophilic *P. palawanensis*. The ancestors of the present species were possibly shallow water marine or brackish water species, from the same lineage as today's mangrove species *P. miyai*, *P. tigger* or *P. hanleyi*. A phylogenetic hypothesis for the genus *Potamalpheops* (Anker, in prep.) would enable a more solid evolutionary interpretation of biogeographical and ecological features.

Other caridean genera with disjunct worldwide distributions, e.g., the atyid genera *Typhlatya* Creaser and *Antecaridina* Edmondson and the barbouriid genus *Parhippolyte* Borra-

daile, are restricted to “refugial” habitats, such as caves and land-locked anchialine pools. In contrast to the modern species of these presumably very old genera, most recent species of *Potamalpheops* are epigeal, although confined to “stressful” habitats (e.g., mangroves, streams with or without tidal influence, and caves).

All presently known records of *Potamalpheops* species and the ecology of each species are summarized in the Table 1. It can safely be assumed that the present knowledge of *Potamalpheops* is far from being complete. The major reason is that *Potamalpheops* spp., are rarely if ever collected. Most species are very small (less than 15 mm TL), inconspicuous in colour and cryptic in habits, and therefore, may easily be overlooked even by an experienced collector. Some of the described species presently restricted to the type locality may have a much wider distribution range. Furthermore, new species may be discovered in other parts of the Indo-Pacific in the future.

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