THE RAFFLES BULLETIN OF ZOOLOGY 2001 **49**(1): 51-56

FIRST RECORD OF THE DEEP-SEA CARIDEAN SHRIMP GENUS *PSATHYROCARIS* WOOD-MASON AND ALCOCK, 1893 (DECAPODA: PASIPHAEIDAE) FROM TAIWAN

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ABSTRACT. – The deep-sea pasiphaeid genus *Psathyrocaris* Wood-Mason & Alcock, 1893, is reported for the first time in Taiwanese waters and is represented in the region by two species, *P. fragilis* Wood-Mason & Alcock, 1893, and *P. hawaiiensis* Rathbun, 1906. Just two specimens of *P. hawaiiensis* have been previously cited from Hawaii and the Coral Sea while this new record of *P. fragilis* is only the second for the Western Pacific.

KEY WORDS. – *Psathyrocaris*, Pasiphaeidae, deep-sea, Taiwan.

INTRODUCTION

The pasiphaeid genus *Psathyrocaris* Wood-Mason & Alcock, 1893, is a group of deep-sea shrimps (from 315 to 2000m deep) with fragile bodies. They differ from other genera in the family by having a proper rostrum armed dorsally with numerous teeth, the posterior three pereiopods are not reduced or greatly shortened, and the pleopods consist of a very long exopod and a very short endopod (Holthuis, 1993). Five species are generally recognized in this genus (de Man, 1920) of which two, *P. fragilis* Wood-Mason & Alcock, 1893, and *P. infirma* Alcock & Anderson, 1894, are believed to have a world-wide distribution. The other three species *P. plumosa* Alcock & Anderson, 1894, *P. platyopthalmus* Alcock & Anderson, 1894, and *P. hawaiiensis* Rathbun, 1906, have been reported only from the Indo-West Pacific and are poorly known.

Recent collections in Taiwan have obtained many specimens of this genus from the north-eastern coast and close examination of this material shows that two species are present. Most of the specimens belong to the widely distributed *P. fragilis* while seven are of the poorly known species *P. hawaiiensis*. The present report provides description and color photographs for these two uncommon shrimps.

The specimens are deposited at the National Taiwan Ocean University, Keelung (NTOU), the National Museum of Natural Science, Taichu (NMNS), the Muséum national d'Histoire naturelle, Paris (MNHN), the National Museum of Natural History, Smithsonian Institution, Washington D.C. (USNM) and Zoological Reference Collection of the Raffles Museum, National University of Singapore (ZRC). The measurement cl. is the carapace length excluding rostrum. Unless otherwise stated, the figures provided are lateral views.

TAXONOMIC ACCOUNT

Psathyrocaris hawaiiensis Rathbun, 1906
(Figs. 1-2, 4a)

Psathyrocaris hawaiiensis Rathbun, 1906: 928, fig. 79 [type-locality: Hawaii]; Bruce, 1990: 848, figs. 1-5.

Material examined. – N.E. Taiwan, I-Lan County, fishing port at Tai-Shi, commercial trawlers, about 600 m: 28 May 1998, 1 female 13.6 mm (NTOU); 1 Oct 1999, 1 ovig. female 14.4 mm (NTOU); 7 Oct.1999, 1 ovig. female 13. 9 mm and 1 female 13.6 mm (NTOU, transferred to USNM); 15 Oct.1999, 1 ovig. female 14.2 mm (NTOU, transferred to MNHN); 10 Dec.1999, 1 ovig. female 14.0 mm (NTOU, transferred to NMNS); 7 Jan.2000, 1 ovig. female 15.4 mm (NTOU, transferred to ZRC).

Description. – Rostrum, with distinct lateral carina, nearly half as long as carapace, straight but directed upward and extending to distal margin of second antennular segment; dorsal border armed with 12 to at least 15 movable teeth and with 1-2 of them situated posterior to orbit, distal half of ventral border bearing 4-5 small to minute teeth.

Received 27 Apr 2000 Accepted 16 Oct 2000

Postrostral carina absent but with a small tubercle present behind posteriormost dorsal rostral tooth. Carapace without spine on anterior margin but with strong suborbital angle, lateral ridge only distinct at median part, anterior and posterior parts faint. Eye (including stalk) strongly depressed, cornea moderate in size and pigment, without ocellus but bearing rudimentary papilla. Antennular peduncle with second segment about 3 times longer than distal segment. Stylocerite sharply pointed distally and slightly overreaching base of second antennular segment. Scaphocerite somewhat oblique ventrolaterally and about 3 times as long as broad, distolateral tooth far from distal margin of lamella. Basicerite spine well developed and overreaching proximal end of lateral margin of scaphocerite.

Thoracic appendages with maxilliped III having two arthrobranches, pereiopods I to IV each bearing one arthrobranch and one pleurobranch, pereiopod V with only one pleurobranch. Maxilliped III, with exopod longer than half length of endopod, more or less extending to tip of scaphocerite; distal segment about 1.5 times as long as penultimate segment, distal third segment strongly flattened. Pereiopod I , with very long exopod which only slightly shorter than endopod, overreaching scaphocerite by almost half length of fingers, chela with palm slightly more than 3 times as long as broad and fingers about 0.8 times as long as palm, cutting edge of fixed finger minutely pectinate but that of movable finger bluntly serrated, carpus with strong but blunt distodorsal and distoventral angles, merus bearing elongate distodorsal seta-like spine and 1-2 large dorsal movable spines. Pereiopod II just exceeding scaphocerite and with a slightly shorter exopod, chela relatively more slender than that of pereiopod I, palm nearly 3 times as long as broad, fingers about 1.3 times longer than palm and with cutting edges of both fingers distinctly pectinate, carpus with blunt distodorsal angle and bearing strong ventrolateral movable spine, merus with elongate distodorsal seta-like spine and 2 large dorsal movable spines. Pereiopod III, bearing slightly longer exopod, extending to about middle of scaphocerite, dactylus slightly shorter (about 0.85 times) than propodus and falcate, with posterior margin convex and bearings tufts of minute setae, propodus unarmed except for bearing two long distoventral setae, merus bearing 2-4 ventral movable spines while ischium armed with 1-2 ventral movable spines. Pereiopod IV, bearing slightly longer exopod, just failed to reach tip of scaphocerite, dactylus about 0.4 times as long as propodus and slightly falcate, with anterior margin weakly convex and distributed with row of minute setae, merus bearing small distoventral movable spine and 1-2 larger ventral movable spines, ischium armed with 1 long ventral movable spine. Pereiopod V, with exopod 1.5 times longer than endopod, just overreaching base of scaphocerite, dactylus laminar and about 0.4 times as long as propodus, mesial surface densely distributed with long setae, propodus also with mesial surface densely covered with long setae particularly at distal 2/5, merus bearing distoventral movable spine and 1-2 mesial movable spines, ischium armed with long distomesial movable spine.

Abdomen, including pleura, lacking carina or spine, somite VI 2.6-2.9 times as long as height. Pleopods with expod extremely long but endopod very short. Telson as long as abdominal somite VI, bearing 6-7 pairs of dorsolateral spines, posterior margin minutely pointed medially and accompanied by 2 pairs of movable spines (inner pair longer), at least also bearing 1 pair of posterolateral spines. Eggs with eye-spots

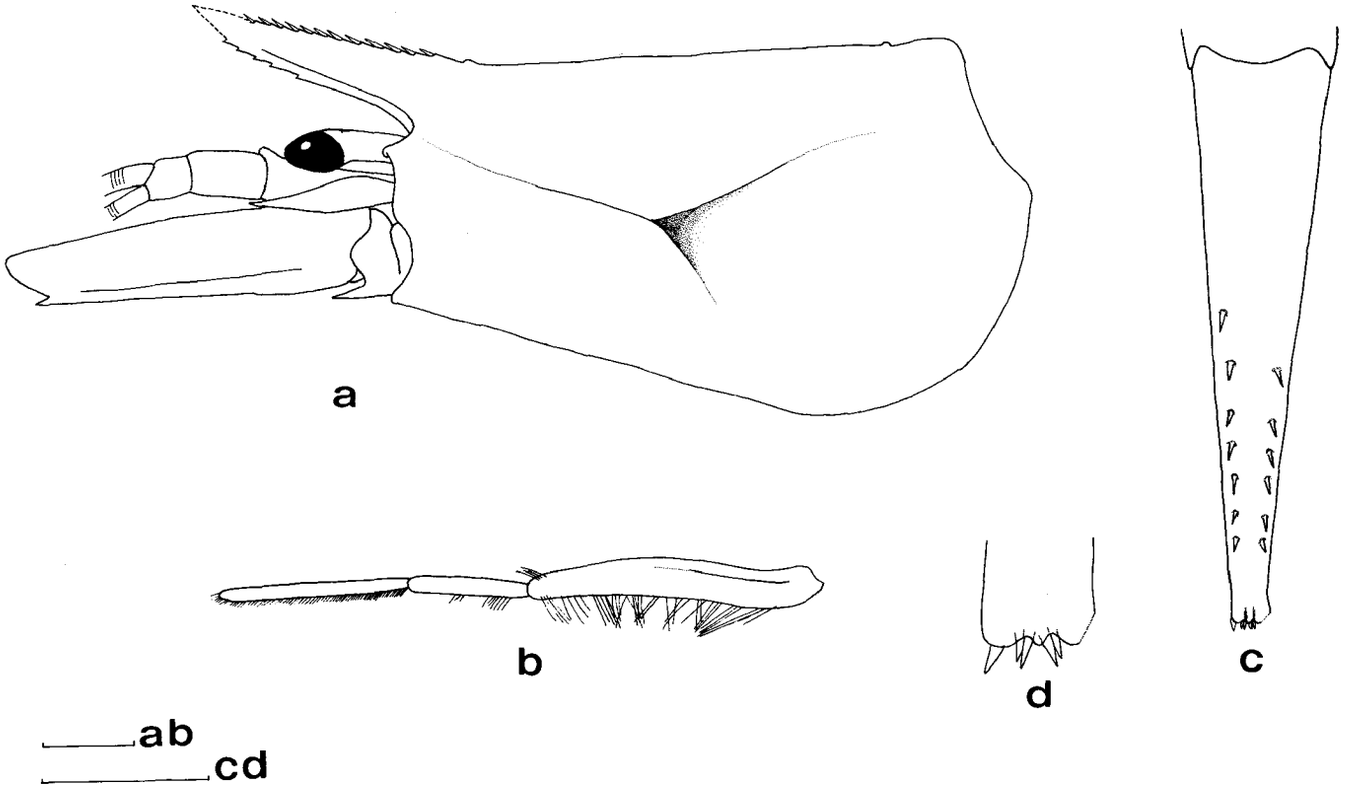

Fig. 1. *Psathyrocaris hawaiiensis* Rathbun, 1906, Taiwan: a. ovig. female 14.4 mm cl, b-d. ovig. female 13.9 mm cl. a. carapace; b. right maxilliped III, ventral view; c. telson, dorsal view; d. tip of telson (slightly damaged), dorsal view. Scale bars: a-c = 2 mm; d = 1mm.

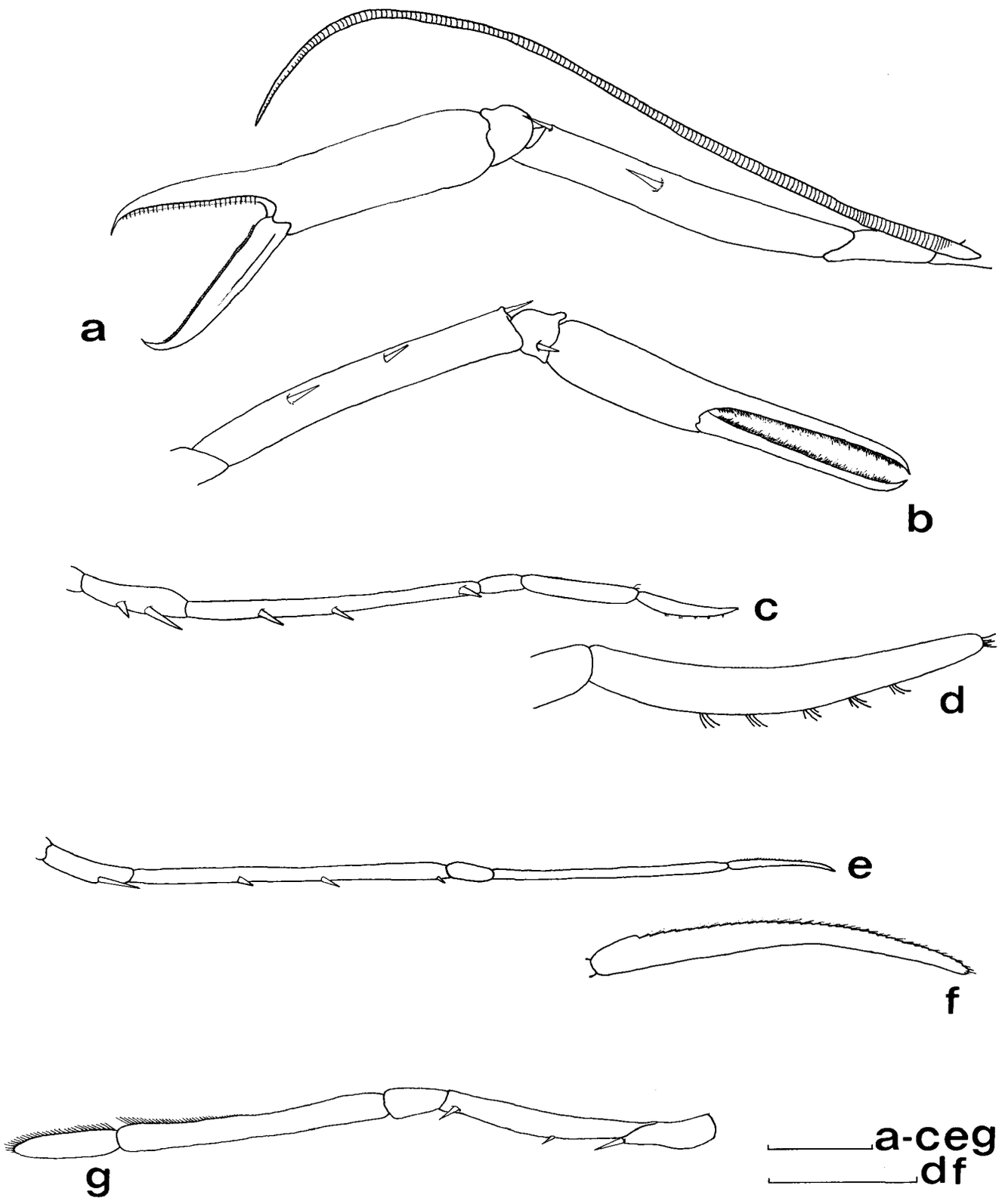

Fig. 2. *Psathyrocaris hawaiiensis* Rathbun, 1906, Taiwan: a-d. female 13.6 mm cl; e-g. ovig. female 13.9 mm cl. a. left pereiopod I with exopod; b. right pereiopod II; c. right pereiopod III; d. dactylus of pereiopod III; e. right pereiopod IV; f. dactylus of pereiopod IV; g. left pereiopod V. Scale bars: a-c, e, g = 2 mm; d, f = 1mm.

few and fragile, suboval and about 2-3 mm in diameter.

Coloration. – Body crimson and with carapace somewhat dark red. Eyes light gray. Eyed eggs dirty yellow.

Size. – The Taiwanese specimens are ranging from 13.6 (ovigerous female) to 15.4 mm cl. The Hawaiian and Coral Sea specimens are 11.5mm cl and 13.0 mm cl (ovigerous), respectively.

Distribution. – Western Pacific and so far only known from Hawaii, N.E. Australia (Coral Sea) and Taiwan, at depths of about 600 to 1602 m.

Remarks. – *P. hawaiiensis* was previously known only from two damaged specimens, one, the type from the Hawaii (Rathbun, 1906) and the other, an ovigerous female from the Coral Sea off northeast Australia (Bruce, 1990). The present series of seven specimens from Taiwan provides more information on this rare species. The Taiwanese material is almost identical with the Coral Sea specimen reported by Bruce (1990), but differs from the Hawaiian type which has the dorsal rostral teeth illustrated as fixed by Rathbun (1906: fig. 79a). A re-examination of the type (USNM 30569, sex unknown, abdomen detached and damaged, with posterior half of telson and all pereiopods except left pereiopod III missing) by Rafael Lemaitre of the USNM reveals that the dorsal rostral teeth (16 in number instead of 17 as stated by Rathbun, 1906) are actually all movable. Therefore, the Taiwanese and Coral Sea material are conspecific with the type.

As noted by Rathbun (1906), *P. hawaiiensis* differs from congeners in having a much longer rostrum and second antennular segment. Actually more substantial differences are present: dorsal rostral teeth all movable (vs. all fixed in congeners), pereiopod I with very long exopod (vs. exopod rudimentary or short), chelae II not particularly long (vs. chelae extremely long and slender), pereiopod III distinctly shorter than pereiopod IV and with falcate dactylus (vs. pereiopod III similar in length and shape with pereiopod IV). It also appears that the telson bears more and larger dorsolateral spines in *P. hawaiiensis*.

Further observations revealed that the pereiopod V of the present species is very similar to that of *P. fragilis* but none of the specimens examined has the dactylus flexed (see "Remarks" of *P. fragilis*). Moreover, the position and shape of the lateral ridge on the carapace in *P. hawaiiensis* is essentially similar to that of *P. fragilis* and only with the two ends becoming weaker. Although the gill formula of *P. hawaiiensis* is the same as that of *P. fragilis*, the gills of the present species are more delicate and smaller.

Psathyrocaris fragilis Wood-Mason & Alcock, 1893
(Figs 3, 4b)

Psathyrocaris fragilis Wood-Mason & Alcock, 1893: 171, pls 10-11 [type-locality: Bay of Bengal]; Crosnier & Forest, 1973: 138, fig. 40 a-d (with complete synonymy before 1973); d'Udekem d'Acoz, 1999: 80 (with synonymy after 1973).

Material examined. – N.E. Taiwan. I-Lan County, fishing port at Tai-Shi, commercial trawlers, about 600 m: 2 Nov.1995,1 male 27.7 mm (NTOU); 27 May 1997, 2 males 23.0 and 27.5 mm, 1 ovig. female 26.7 mm (NTOU, transferred to NMNS); 28 May 1998, 5 females 26.3-28.7 mm (NTOU, transferred to MNHN); 18 Sep.1998, 6 males 22.1-29.5 mm, 2 ovig. females 28.6 and 30.4mm, 1 female 26.2 mm (NTOU, transferred to USNM); 1 Oct.1999, 1 female 17.5 mm (NTOU); 8 Oct.1999, 1 female 25.8 mm (NTOU, transferred to NMNS); 15 Oct.1999, 1 female 17.1 mm (NTOU, transferred to NMNS); Dec.1999, 1 male 25.5 mm, 3 ovig females 23.6-26.5 mm, 1 female 23.0 mm (NTOU); 30 Mar.2000, 1 ovig. female 32.0 mm (NTOU, transferred to ZRC); 12 Apr.2000 1 ovig. female 28.1 mm (NTOU, transferred to ZRC).

Diagnosis. – Rostrum short and deep, horizontal and not exceeding eyes, bearing strong lateral carina and armed with 14-22 small to obsolete dorsal teeth or sometimes merely crenulations (including 6-9 situated posterior to level of orbit), ventral border strongly convex and unarmed or somewhat crenulated. Rostral crest absent but with distinct postrostral carina extending to mid-carapace. Carapace with distinct lateral carina running sinuously from postorbital margin to dorsoposterior margin, also having oblique hepatic carina which abruptly delimited posteriorly. Eyes moderately (more often) to strongly depressed and bearing distinct papilla. Antennular peduncle with distal two segments nearly same length. Stylocerite robust and tapered distally, generally extending to near distal margin of antennular segment II. Basicerite spine short and far from proximal end of lateral margin of scaphocerite. Pereiopod I with exopod rudimentary, chela slender, with palm 6-8 times as long as broad and about 1.5 times longer than fingers, cutting edge of fixed finger minutely pectinate while that of movable finger serrated with blunt spinules, merus bearing distodorsal seta-like spine and 1 dorsal movable spine. Pereiopod II, with exopod half as long as endopod, chela extremely long and slender, with palm 9-11 times as long as broad and more or less as long as fingers, cutting edges of fingers distinctly pectinate, carpus armed with 1 distoventral movable spine while merus bearing distodorsal seta-like spine and 3-4 dorsal movable spines. Pereiopods III and IV long and slender, both bearing long exopods, dactyli very long and rod-like, meri and ischia armed with 0-1 ventral movable spine. Pereiopod V, with exopod longer than endopod, distinctly shorter than pereiopod IV but relatively more robust, dactylus laminar and about 0.4 times as long as propodus, merus armed with 1 distoventral movable spine. Abdomen without spine or carina. Telson, as long as abdominal somite VI, bearing pair of longitudinal ridges and 3-4 pairs of dorsolateral spinules, posterior margin medially pointed and armed with 2 pairs of spines (inner pair larger). Eggs large and few, very oily, suboval and about 2.5-3 mm in diameter, becoming about 5-5.5 mm and very fragile when nearly hatching.

Coloration. – Body crimson and distributed with some dark red dots. Eyes dark grey. Eggs orange-red and gradually becoming grayish white (starting from outer rim of the egg) when near hatching.

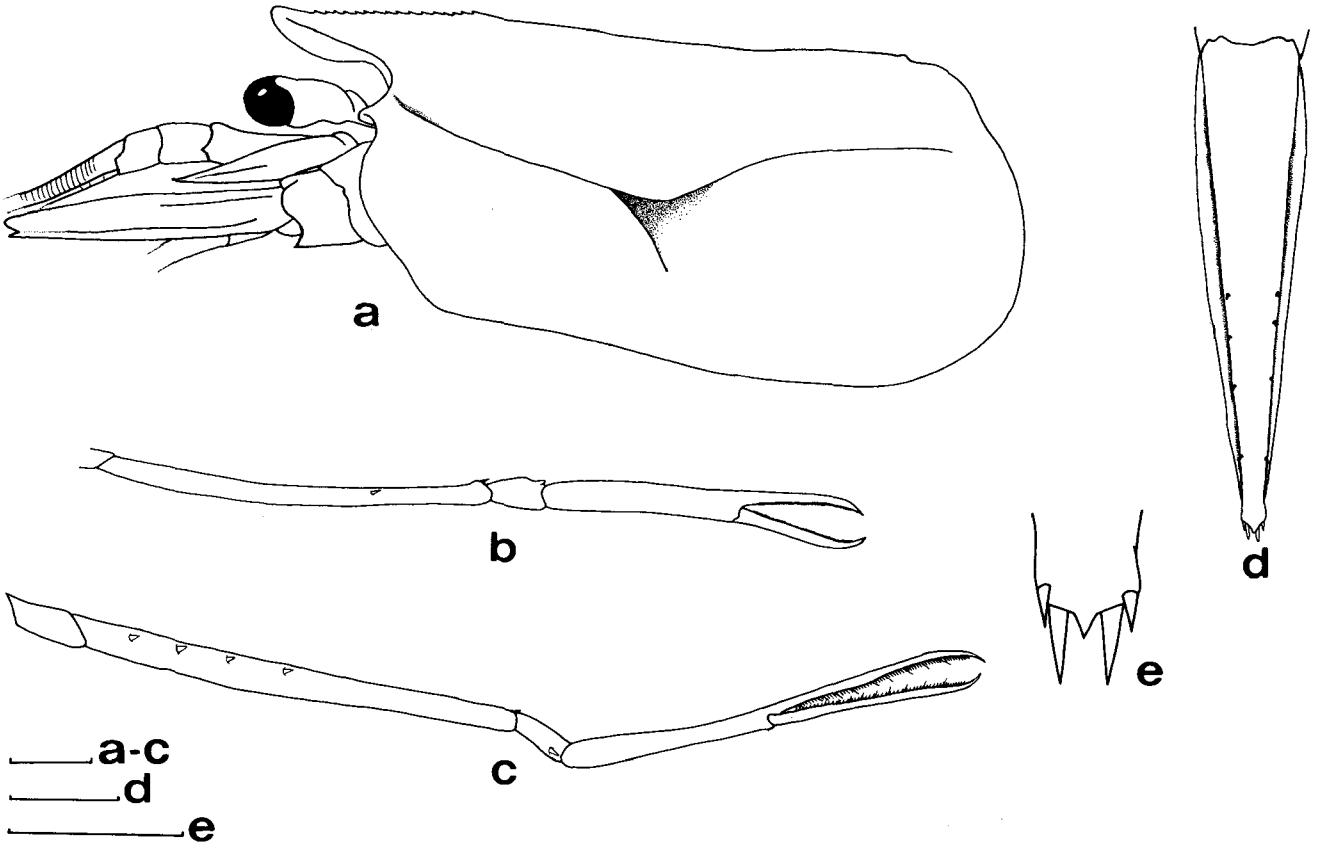

Fig. 3. *Psathyrocaris fragilis* Wood-Mason & Alcock, 1893, Taiwan: a-c. female 17.5 mm cl; d-e. female 25.8 mm cl. a. carapace; b. right pereiopod I; c. right pereiopod II; d. telson, dorsal view; e. tip of telson. Scale bars: a-d = 2 mm; e = 1mm.

Size. – Taiwanese material: largest male 29.5 mm cl and largest female 32.0 mm cl, smallest ovigerous female 23.6 mm cl. Largest size reported from other localities is 25.3 mm cl and with smallest ovigerous female of 22.1 mm cl (Crosnier & Forest, 1973).

Distribution. – Indo-Pacific and Eastern Atlantic from depths of 315 to 1886 m, benthic and sometimes bathypelagic (Crosnier & Forest, 1973; d'Udekem d'Acoz, 1999).

Remarks. – The Taiwanese material agrees well with the detailed original descriptions of this species by Wood-Mason & Alcock (1893) and Alcock (1901). The only discrepancy is the state of the epipod on the maxilliped III. The maxilliped III of the Taiwanese material is identical with that of the figure of the type provided by Wood-Mason & Alcock (1893: pl. XI-fig. 6). However, the so-called "rudimentary epipod" by Wood-Mason & Alcock (1893) and Alcock (1901) is actually an immovable flap-like anterior projection of the coxa and not a true epipod. Furthermore, there was no mention of the spines on the pereiopods by Wood-Mason & Alcock (1893) and Alcock (1901), particularly those on the pereiopods I and II.

Psathyrocaris plumosa and *P. platyopthalmus* described from the Indian Ocean are very similar to *P. fragilis*. According to Alcock (1901), these three species are mainly separated by the body of *P. plumosa* being pubescent while *P. platyopthalmus* having the eyestalks sublaminar and a shorter stylocerite (i.e. only extending to middle of antennular segment II). All the Taiwanese specimens examined have naked bodies and the stylocerite generally reaching near to the distal end (sometimes shorter but at least extending to distal 2/3) of the antennular segment II. Most of the eyes of the Taiwanese material are moderately depressed. Some specimens have the eyes strongly depressed but it is evident that this is due to these fragile specimens being squashed, and there are four specimens having one of the eyes moderately depressed while the other eye is strongly depressed. It is not known whether the sublaminar eyestalk of *P. platyopthalmus* is natural or in fact a damaged eye. On the other hand, Crosnier & Forest (1973) concluded that the Atlantic and Indo-Pacific material should be the same and invalidated the subspecific name *P. fragilis* var. *atlantica* Caullery, 1896. The present specimens from Taiwan are very similar to the eastern Atlantic material described by Crosnier & Forest (1973) except the latter seems to have less dorsal rostral teeth and a larger basicerite spine (see Crosnier & Forest, 1973: fig. 40a).

The present report of *P. fragilis* from Taiwan is the second record of this uncommon shrimp in the Western Pacific. Its previous Western Pacific record was from a single damaged specimen collected by the "Siboga" expedition in the Flores Sea nearly 80 years ago (de Man, 1920). Although *P. fragilis* is not rare in Taiwan, its extremely delicate body results in none of the 28 specimens collected having a complete pereiopod III or IV. According to the Wood-Mason & Alcock (1893), the dactyli of pereiopods III and IV are much longer than the propodi in this species. On the other hand,

Fig. 4. a. *Psathyrocaris hawaiiensis* Rathbun, 1906, ovig. female 14.4 mm cl; b. *P. fragilis* Wood-Mason & Alcock, 1893, female 17.5 mm cl.

the dactylus of the pereiopod V is not always flexed in this species as stated by Alcock (1901), and the Taiwanese material only has five specimens having flexed dactyli. In such a case, the dactylus is flexed mesially and not posteriorly. Since both the mesial surfaces of the dactylus and the distal part of the propodus carry dense setae, the flexed dactylus forms a "hairly" grip with the distal part of the propodus (also see Wood-Mason & Alcock, 1893, Alcock, 1901).

ACKNOWLEDGEMENTS

Grateful acknowledgement is extended to Dr. R. Lemaitre of the National Museum of Natural History, Smithsonian Institution, Washington, D.C. for kindly examining the type of *P. hawaiiensis* for us; and Dr. A. Crosnier of the Muséum national d'Histoire naturelle, Paris for providing us comments on the Taiwanese *Psathyrocaris*. This work is a contribution from a research grant supported by the National Science Council, Taiwan, R.O.C.

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