

THREE ISOPOD PARASITES (BOPYRIDAE: PSEUDIONINAE), INCLUDING TWO NEW SPECIES, OF HERMIT CRABS FROM THE SOUTH CHINA SEA

Jianmei An

School of Life Science, Shanxi Normal University, Linfen, 041004, China
Email: anjianmei@hotmail.com (Correspondence author)

Xinzheng Li

Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China

John C. Markham

Arch Cape Marine Laboratory, Arch Cape, Oregon 97102-0133, U.S.A.

ABSTRACT. — Three bopyrid species belonging to two genera infesting hermit crabs from the South China Sea are reported. This is the first record of the genus *Pagurion* Shiino, 1933, in Chinese waters, where it is represented by two species: *Pagurion tuberculata* Shiino, 1933, infesting *Dardanus aspersus* (Berthold, 1846), and *Pagurion arrosor* n. sp., infesting *Dardanus arrosor* (Herbst, 1796). The female of *Pagurion arrosor* differs from that of *P. tuberculata* in the structure of its barbula, pleopods, and terminal pleomere. The first Chinese record of the genus *Pseudionella* Shiino, 1949, is *P. spiropaguri* n. sp. found infesting *Spiropagurus profundorum* Alcock, 1905, *S. spiriger* (De Haan, 1849), and *Spiropagurus* sp. *Pseudionella spiropaguri* is contrasted with the other four previously described species of the genus.

KEY WORDS. — Bopyridae, *Pagurion*, *Pseudionella*, new species, new records, hermit crabs, South China Sea

INTRODUCTION

Recent examination of material of five species of hermit crabs from the South China Sea deposited in the Marine Biological Museum of the Chinese Academy of Sciences in the Institute of Oceanology, Chinese Academy of Sciences, in Qingdao, revealed specimens of three bopyrid species, two (one a new record for China, one new to science) in the genus *Pagurion* Shiino, 1933, and the third, also new to science, in *Pseudionella* Shiino, 1949. This is the first record of bopyrid infestation of the pagurid hermit crab species *Spiropagurus profundorum* Alcock, 1905, and *S. spiriger* (De Haan, 1849).

MATERIAL AND METHODS

Material for this study was collected by the China-Vietnam Joint Comprehensive Oceanographic Survey from Beibu Gulf (Gulf of Tonkin) (1959–1960, 1962), which is deposited in the Marine Biological Museum of the Chinese Academy of Sciences (MBMCAS) in the Institute of Oceanology, Chinese Academy of Sciences, in Qingdao (IOCAS). The specimens were observed and drawn using a Zeiss Stemi SV Apo microscope. Males studied by scanning electron microscope were fixed in 2.5% glutaraldehyde in 0.2 M Millonig's

phosphate buffer at pH 7.4 for 1.5 h and postfixed in 1% osmium tetroxide in 0.2 M Millonig's buffer for 1 h, then dehydrated through a graded series of ethanol, followed by critical point drying. After sputter coating with colloidal gold, the specimens were examined with a KYKY2800B scanning electron microscope. CIEA: C=Crustacea; I=Isopoda; E=Epicaridea; A=Anomura.

SYSTEMATICS

Order Isopoda Latreille, 1817

Family Bopyridae Rafinesque-Schmaltz, 1815

Subfamily Pseudioninae Codreanu, 1967

Genus *Pagurion* Shiino, 1933

Type-species. — *Pagurion tuberculata* Shiino, 1933.

***Pagurion tuberculata* Shiino, 1933**

(Fig. 1)

Pagurion tuberculata Shiino, 1933: 254–256; fig. 2 [type locality: Tanabe Bay, Japan; infesting *Pagurus watasei* Terao, 1913 (= *Dardanus scutellatus* H. Milne Edwards, 1848)]. Shiino, 1972:

7. Harada, 1991: 201. Saito et al., 2000: 36. Markham, 2003: 72. Madad, 2008: 2, 5, 6, 17, 33–34, 48, 51, 86, 87; fig. 9 [Batangas, Philippines; infesting *Clibanarius gaimardii* (H. Milne Edwards, 1848)] [= *Calcinus gaimardii* (H. Milne Edwards, 1848)], *Calcinus minutus* Buitendijk, 1937] and *Dardanus lagopodes* (Forsskål, 1775)]. Markham, 2010: 151, 152; tab. 1, 156–158; figs. 6, 7 [Queensland, Australia; infesting *Dardanus arrosor* (Herbst, 1796)]. McDermott et al., 2010: 8; tab. 1.

Material examined. — Infesting *Dardanus aspersus* (Berthold, 1846), 1♀, CIEA600401, 1♂, CIEA600402, South China Sea, Stn 6004, 23°30'N, 117°30'E, 39 m, coll. Huiliang Chen, 24 Apr.1960.

Remarks. — Of the five specimens of *Dardanus aspersus* (Berthold, 1846) examined, only one was infested with *Pagurion tuberculata*. This, the fourth record of *P. tuberculata*, is the first from China. The present specimens match the description of *P. tuberculata* by Shiino (1933) thus: 1) slight distortion of body; 2) non-extended smoothly rounded head bearing thin frontal lamina across all of anterior margin; 3) heavy tuberculation of oostegites and pleopods; 4) extensive setation of maxillipedal palp; 5) deeply digitate fringes on barbula and interior ridge of first oostegite; and 6) distinctive lateral coverage of final one or two pleomeres

by preceding pleomeres. The present female differs from those of *P. tuberculata* recorded from Queensland, Australia, by Markham (2010) thus: eyes present, posterolateral point rounded, left first three and right first four pereomeres with prominent dorsolateral bosses (Fig. 1A). In contrast, the females from Australia lacked eyes, had sharp posterolateral points, and only the left and right first two pereomeres bearing dorsolateral bosses (Markham, 2010). In both the present females and those from Australia, the maxillipedal palp (Fig. 1D, E) articulates fully. Shiino's (1933) description of the type female did not mention the palp. In the present specimen, the first oostegite ends in a round posterolateral point (Fig. 1G, H), more similar to that of the type than to those from Australia.

All known male specimens, namely the present specimen, Australian specimens and Shiino's type male, have short heads about half as broad as the first pereomeres, sides of pereon nearly parallel, dactyli of pereopods of the first two or three pairs (Fig. 1R–U) much larger than those of the following pereopods and five pairs of flaplike pleopods. In the present male and Shiino's type male, the final two pleomeres are separated, in contrast with the partial fusion

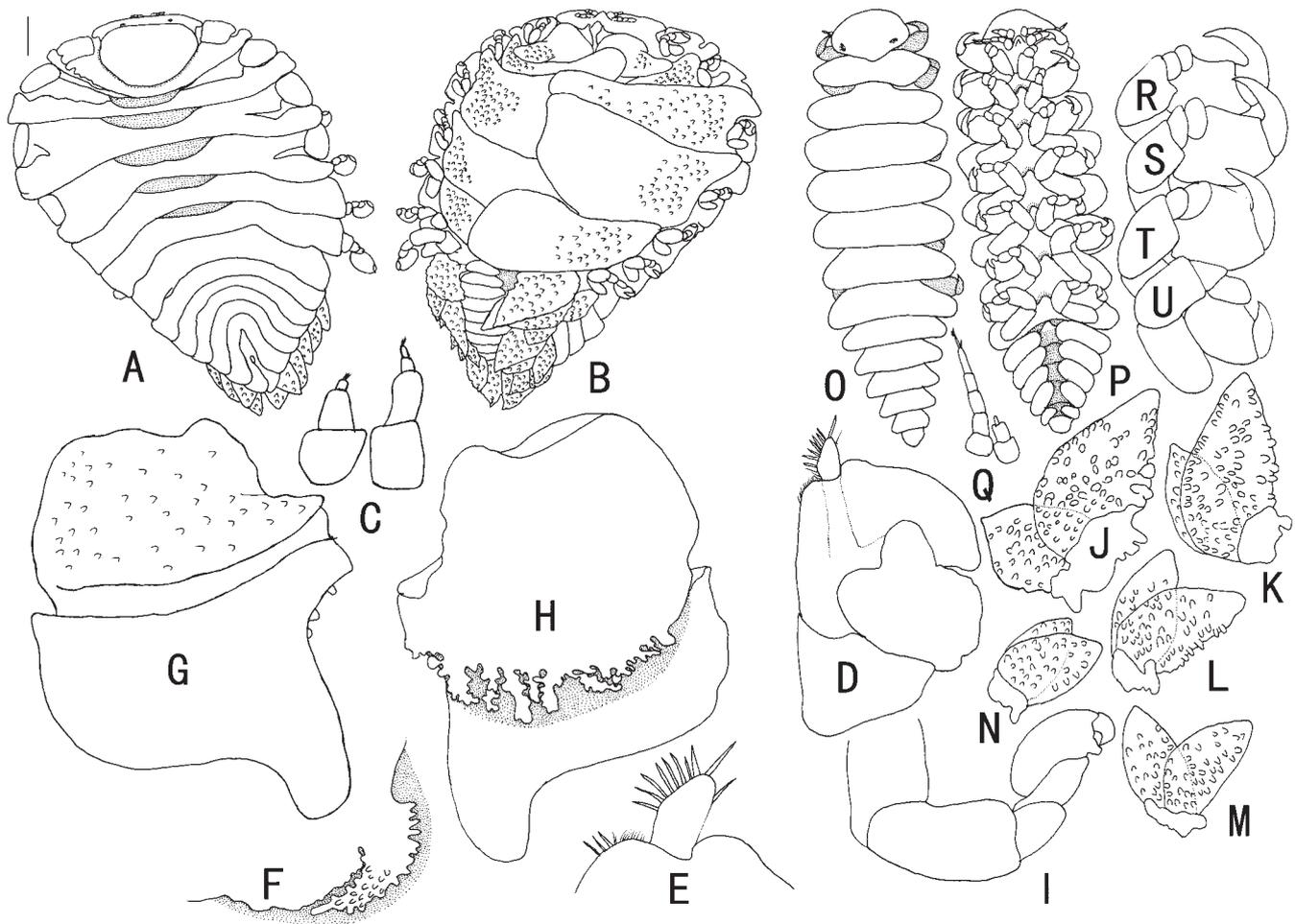


Fig. 1. *Pagurion tuberculata* Shiino, 1933: A–N, female, CIEA600401; O–U, male, CIEA600402. A, Dorsal view; B, ventral view; C, left antennae; D, left maxilliped; E, palp of same; F, left side of barbula; G, left oostegite 1, external view; H, same, internal view; I, left pereopod 7; J, left pleopod 1; K, left pleopod 2; L, left pleopod 3; M, left pleopod 4; N, left pleopod 5; O, dorsal view; P, ventral view; Q, right antennae; R, left pereopod 1; S, left pereopod 2; T, left pereopod 3; U, left pereopod 4. Scale bar = 1 mm (A, B), 0.13 mm (C, E, Q–U), 0.27 mm (D, F–H), 0.22 mm (I), 0.57 mm (J–N), 0.36 mm (O, P).

of the final two pleomeres of the Australian male. Madad (2008) presented the only SEM images prior to the present work showing that the male from the Philippines bore minute tubercles on articles of the pereopods. The shape of the pleopods of the present male is more similar to that of Madad's (2008) Philippine specimen than other known specimens of the species.

All reported hosts of *Pagurion tuberculata*, including this record, belong to the Diogenidae, in the genera *Dardanus* and *Calcinus*. Although the geographic range of *P. tuberculata* seems extensive, it is evidently never common. The sample from Australia (Markham, 2010) consisted of two pairs, while the present material and the other two known collections were all of single pairs. The previously known distribution and hosts of *Pagurion tuberculata* are summarised in the synonymy above. This is the first record of bopyrid infestation of *Dardanus aspersus*, a member of the genus most commonly recorded to host *P. tuberculata* elsewhere.

***Pagurion arrosor*, new species**

(Fig. 2)

Material examined. — Infesting *Dardanus arrosor* (Herbst, 1796). South China Sea, Stn 6238, 20°00'N, 108°00'E, 83 m, Fengshan Xu, coll. 27 Feb.1958: 1 ♀, holotype, CIEA623801; 1 ♂, allotype, CIEA623802.

Description of holotype female (Fig. 2A–K). — Length 13.01 mm, maximal width (across third pereomere) 10.16 mm, head length 2.42 mm, head width 3.39 mm, pleon length 3.27 mm, distortion 8°. All body regions and segments distinct. No pigmentation (Fig. 2A, B).

Head subelliptical, without frontal lamina, anterior edge with deep semicircular notch. Eyes absent. Antennae of 4 and 5 articles, respectively (Fig. 2C), without setae; basal articles of second antennae greatly expanded. Maxilliped (Fig. 2D, E) with prominent articulating palp bearing many setae on

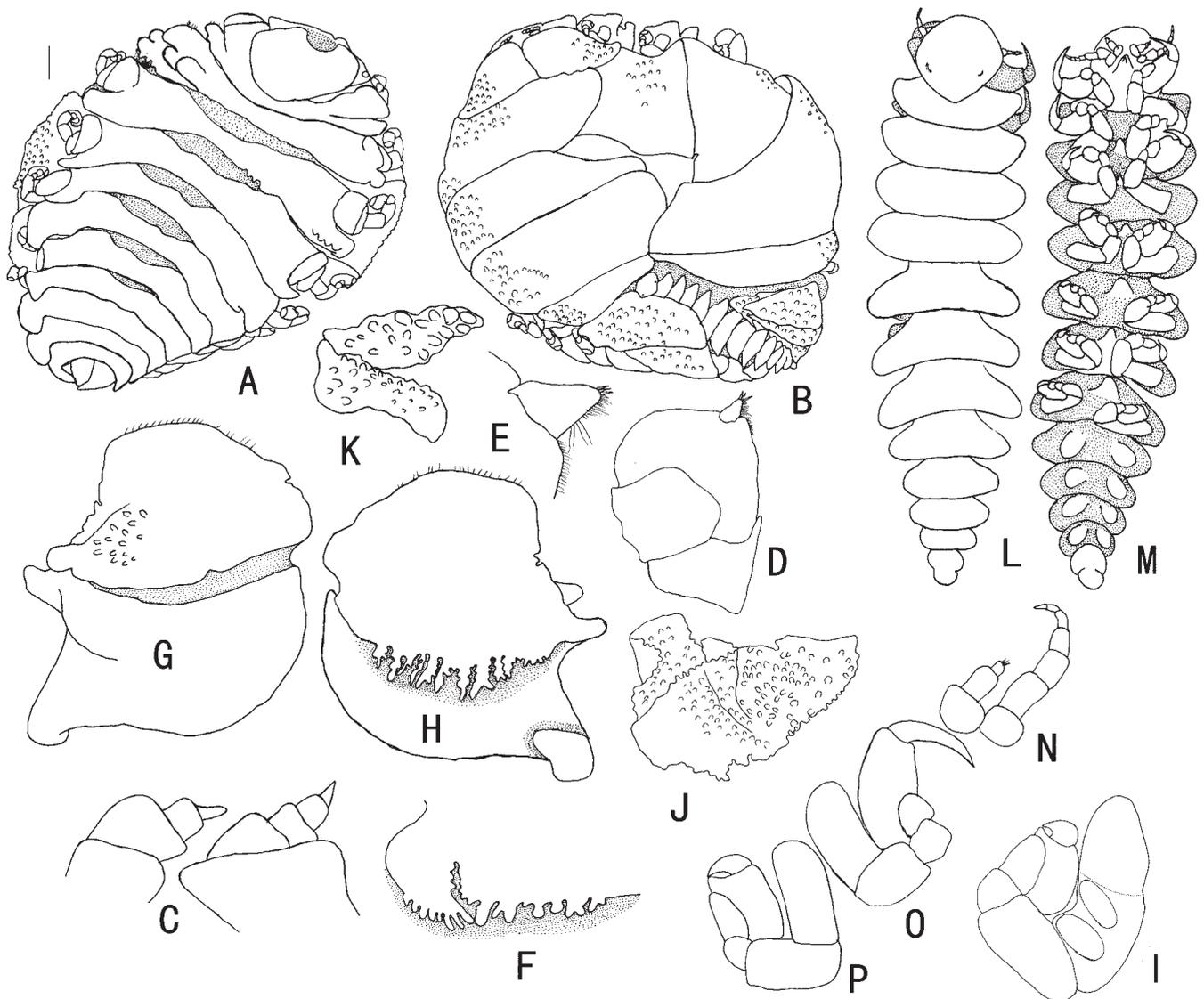


Fig. 2. *Pagurion arrosor* n. sp: A–K, holotype female, CIEA623801; L–P, allotype male, CIEA623802. A, Dorsal view; B, ventral view; C, left antennae; D, left maxilliped, external view; E, palp of same; F, left side of barbula; G, left oostegite 1, external view; H, left oostegite 1, internal view; I, left pereopod 1; J, left pleopod 1; K, left pleopod 5; L, dorsal view; M, ventral view; N, left antennae; O, right pereopod 1; P, pereopod 6. Scale bar = 1 mm (A, B), 0.13 mm (C, E), 0.57 mm (D), 0.31 mm (F), 0.44 mm (G, H), 0.22 mm (I), 0.67 mm (J), 0.50 mm (K), 0.36 mm (L, M), 0.12 mm (N–P).

margin, some medial setae longer than others; anteromedial margin of maxilliped bearing shorter setae. Barbula (Fig. 2F) with one large digitate projection on each side, many small projections near middle region.

Pereomeres distinct, third one broadest; coxal plates on right sides of pereomeres 1–4 and left sides of pereomeres 1–5; slight medial depressions along anterior margins of pereomeres 3–7. Brood pouch completely enclosed by oostegites (Fig. 2B). Anterior segment of oostegite 1 (Fig. 2G, H) with anteriorly setose margin and patch of tubercles on external surface near lateral margin, internal ridge bearing many irregularly digitate projections, short bluntly rounded falcate posterolateral point with large swelling on inner surface. Pereopods all of about same size, dactyli reduced, bases with large round tubercles (Fig. 2I)

Pleon of 6 pleomeres, first four produced into small lateral plates. Large foliate tuberculate biramous pleopods (Fig. 2J, K) on pleomeres 1–4 almost completely covering ventral surface of pleon. Pleomere 5 with slender triangular lateral plates and biramous pleopods. Short terminal (sixth) pleomere reflexed under fifth pleomere, without lateral plates. No uropods.

Description of allotype male (Fig. 2L–P). — Length 4.93 mm, maximal width (across pereomere 7) 1.79 mm, head length 0.80 mm, head width 0.90 mm, pleonal length 1.95 mm. All body segments except last two pleomeres distinct. Sides of body nearly parallel medially and smoothly tapered posteriorly. Minute black eyes, but no other pigment (Fig. 2L, M).

Head almost circular, bearing small eyes near posterior edge, posterior margin broadly “V” shaped and embedded into first pereomere. Antennae of 3 and 7, articles respectively, both sparsely setose distally (Fig. 2N). Second antenna much longer than first antenna, extended far beyond margin of head and visible in dorsal view (Fig. 2L, M).

Pereomeres almost equally wide, seventh pereomere slightly broadest, their margins broadly rounded and notched anterolaterally. Small midventral projections on pereomeres 2–7 (Fig. 2M). Pereopods 1–2 larger than others, dactyli of first two pereopods much larger and more sharply pointed and propodi somewhat larger than those of posterior pereopods, other articles all of about same size (Fig. 2O, P).

Pleon of 6 pleomeres, each narrower than that before it, without midventral projections. Pleomeres 1–4 distinct, pleomeres 5–6 fused dorsally but with segmentation indicated by lateral indentations and partial ventral suture. Four pairs of oval flaplike uniramous pleopods lying against surface of pleomeres. No fifth pleopods or uropods.

Etymology. — The specific name *arrosor*, a Latin noun used in apposition, means “sponger” or “one who lives at the expense of another.” It has been selected because it is the species name of the new species’ host, *Dardanus arrosor*

(Herbst, 1796). The word *arrosor* can also mean “parasite,” so its selection seems more appropriate here than in the original use for the host species.

Remarks. — *Pagurion arrosor*, n. sp. is distinguished from its only known congener, *P. tuberculata* Shiino, 1933, thus: Female: Frontal lamina of head, absent in the new species (Fig. 2A), well developed in *P. tuberculata* (Shiino, 1933: fig. 2A). Antennae 1 and 2 of 4 and 5 articles, respectively, in *P. arrosor* (Fig. 2C), of 3 and 4 articles in *P. tuberculata* (Shiino, 1933: fig. 2L). Pleomere 6 obscure in *P. arrosor* (Fig. 2A), distinct in *P. tuberculata* (Shiino, 1933: fig. 2A). In males, the last two pleomeres of *P. arrosor* are somewhat fused (Fig. 2L), while those of *P. tuberculata* are distinctly separated.

Distribution and hosts. — South China Sea, infesting *Dardanus arrosor* (Herbst). *D. arrosor* has been reported to host two other pseudionine (branchial) bopyrid species, *Asymmetrione dardani* Bourdon, 1968 in Morocco (Bourdon, 1968) and *Pagurion tuberculata* (discussed above) in Australia and one athelgine (abdominal) species, *Parathelges carolii* Codreanu, 1968 in Italy (Codreanu, 1968).

Genus *Pseudionella* Shiino, 1949

Type-species. — By monotypy, *Pseudionella attenuata*, Shiino, 1949.

Pseudionella spiropaguri, new species

(Figs. 3, 4)

Material examined. — Infesting *Spiropagurus profundorum* Alcock, 1905. South China Sea, Stn 6106, 20°30'N, 112°00'E, 72 m, 20 Apr.1959, coll. Xiutong Ma, 1♀, holotype, CIEA610601, 1♂, allotype, CIEA610602. Paratypes: South China Sea, Stn 6091, 20°30'N, 112°30'E, 78 m, 9 Feb.1960, coll., Jingzuo Qu, 1♀, CIEA609101, 1♂, CIEA609102. South China Sea, Stn 6048, 21°00'N, 114°30'E, 79.6 m, 9 Jan.1960, coll., Baoling Wu, 1♀, CIEA604801, 4♂♂ (immature), CIEA604802.

Other materials examined. — Infesting *Spiropagurus spiriger* (De Haan, 1849). South China Sea, Stn 6230, 18°45'N, 108°15'E, 49 m, 17 Apr.1959, coll., Fengshan Xu, 1♀, CIEA623001, 1♂, CIEA623002.

Infesting *Spiropagurus* sp. South China Sea, Stn 6078, 20°30'N, 113°00'E, 88 m, 8 Apr.1960, coll., Zhican Tang, 1♀, CIEA607801, 1♂, CIEA607802. South China Sea, Stn 6091, 20°30'N, 112°30'E, 74 m, 22 Oct.1959, coll., Jingzuo Qu, 1♀, CIEA609103; 1♂, CIEA609104. South China Sea, Stn 6066, 20°30'N, 113°30'E, 89 m, 25 Apr.1959, coll., Fuzeng Sun, 1♀, CIEA606601, 1♂, CIEA606602.

Description of holotype female (CIEA610601) (Fig. 3A–L). — Length 6.74 mm, maximal width 4.48 mm across pereomere 3, head length 1.46 mm, head width 1.70 mm, pleon length 1.98 mm. Body distortion 31°, dextral. All body regions and segments distinct. No pigmentation (Fig. 3A, B).

Head (Fig. 3A) wider than long and roughly heart-shaped behind frontal lamina, extending slightly around anterolateral curves of head. Eyes absent. Antennae reduced. Maxilliped (Fig. 3C) smoothly rounded anteriorly with non-articulating palp displaced from medial margin, sparse setae on inner side of palp; plectron short and sharply pointed, extending anteriorly medial to anterior article. Barbula (Fig. 3D) with three pairs of lateral projections on each side, outer one simple, inner two bifid, and many small projections medially.

Pereon broadest across pereomere 3 (Fig. 3A). Narrow coxal plates and round dorsolateral bosses on both sides of pereomeres 1–4. Oostegites incompletely enclosing brood pouch (Fig. 3B). Outer surfaces of oostegites 2–5 tuberculate. First oostegite (Fig. 3E, F) with slightly larger anterior article, deep groove separating it from posterior article externally; internal ridge without any projections, posterolateral point curled inwardly. All pereopods (Fig. 3G, H) visible in dorsal view, similar in structure but larger posteriorly, all with minute dactyli.

Pleon of 6 pleomeres, all bearing prominent lateral plates, first three bearing biramous pleopods (Fig. 3I–K), last three with uniramous pleopods and uropods (Fig. 3L). Ventral surface of pleon lined with tuberculae. Prominent anal cone between widely separated uropods, with them creating trifid posterior margin.

Description of allotype male (CIEA610602) (Fig. 3M, N). — Length 2.14 mm, maximal width, across pereomere 4, 0.99 mm, head length 0.37 mm, head width 0.56 mm, pereonal length 1.27 mm. All body regions and segments distinctly separated (Fig. 3M, N).

Head (Fig. 3M) suboval, its convexly curved posterior margin slightly embedded in first pereomere. Small round dark eyes near posterolateral corners. Antennae of 3 and 4 articles, respectively.

Pereon widest across pereomere 4, tapering smoothly anteriorly and posteriorly, all pereomeres laterally separated

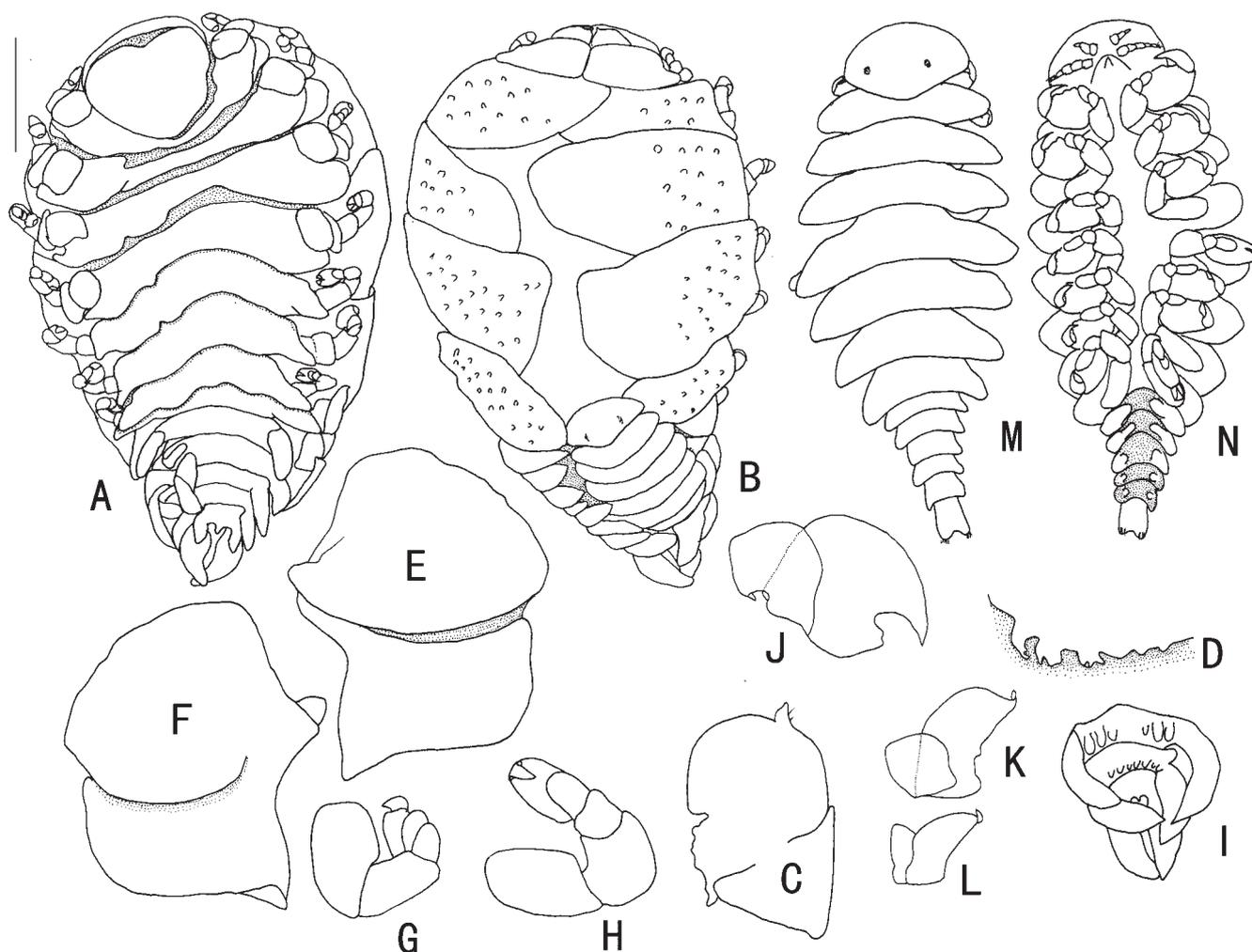


Fig. 3. *Pseudionella spiropaguri* n. sp.: A–L, holotype female, CIEA610601; M, N, allotype male, CIEA610602. A, dorsal view; B, ventral view; C, right maxilliped, external view; D, right side of barbula; E, right oostegite 1, external view; F, right oostegite 1, internal view; G, right pereopod 1; H, right pereopod 6; I, right pleopod 1; J, right pleopod 2; K, right pleopod 3; L, pleon, ventral view; M, dorsal view; N, ventral view. Scale bar = 1 mm (A, B), 0.57 mm (C–F), 0.34 mm (G, H), 1.20 mm (I–L), 0.46 mm (M, N).

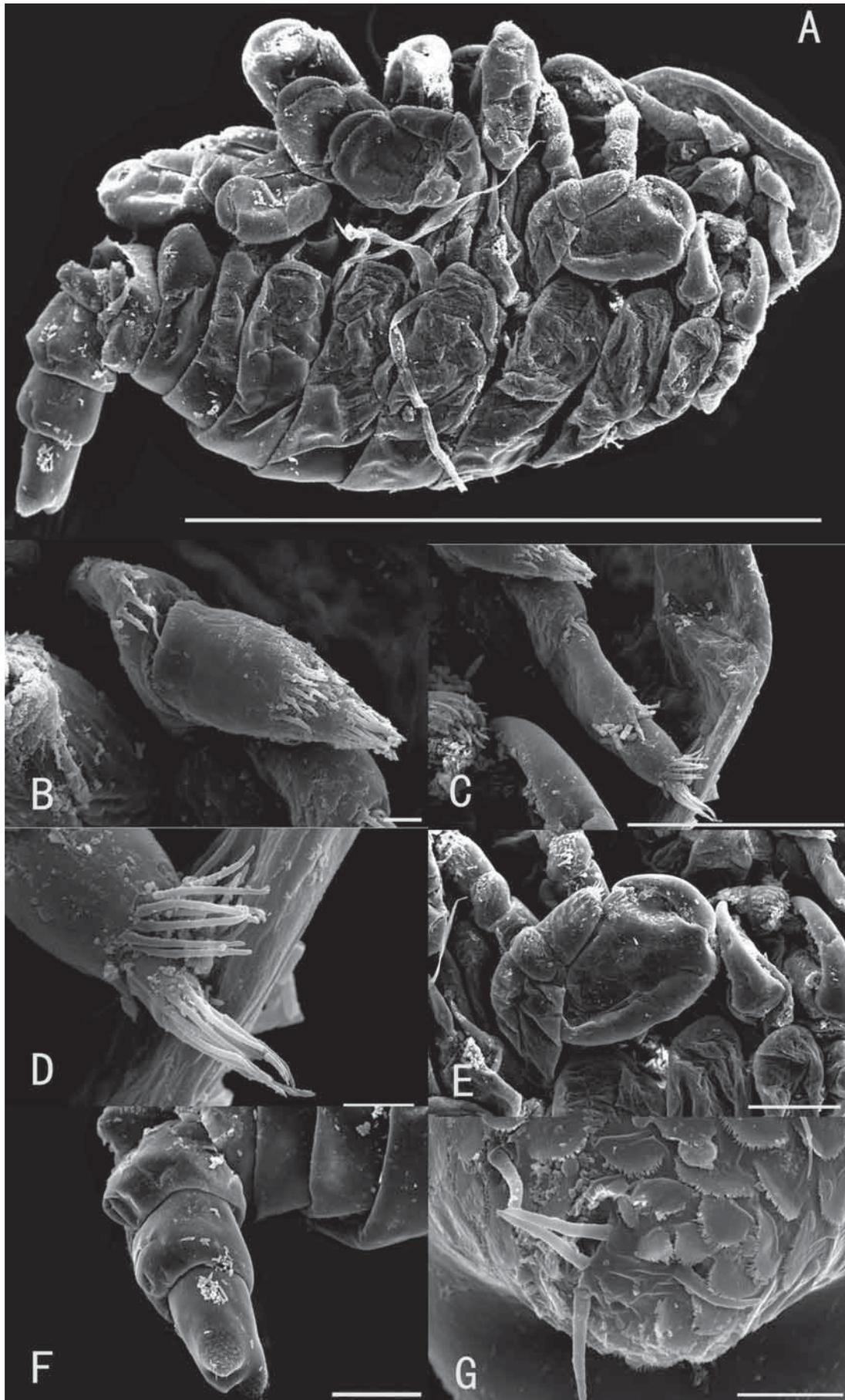


Fig. 4. *Pseudionella spiropaguri* n. sp., SEM micrographs of paratype male, CIEA623002: A, ventral view; B, left antennae 1; C, left antennae 2; D, distal portion of antennae 2; E, pereopods 3; F, pleon, lateral view; G, end of pleon. Scale bar = 1 mm (A), 10 μ m (B, D, G), 100 μ m (C, E, F).

Table 1. Distribution of described species of *Pseudionella* Shiino, 1949.

Species	Location	Host species	Reference
<i>P. akuaku</i> Boyko & Williams, 2001	Easter Island	<i>Calcinus imperialis</i> Whitelegge, 1901	Boyko & Williams, 2001
<i>P. attenuata</i> Shiino, 1949	Seto, Japan	<i>Pagurus</i> sp.	Shiino, 1949
<i>P. deflexa</i> Bourdon, 1979	Off Brazil	<i>P. criniticornis</i> (Dana, 1852)	Bourdon, 1979
	Bahamas	<i>P. brevidactylus</i> (Stimpson, 1859)	Boyko & Williams, 2001
<i>P. markhami</i> (Adkison & Heard, 1978)	North Carolina, USA	<i>P. annulipes</i> (Stimpson, 1860)	Adkison & Heard, 1978
	Magdalena, Colombia	<i>P. brevidactylus</i> (Stimpson, 1859)	Markham, 1988
	Magdalena, Colombia	<i>Pagurus stimpsoni</i> (A. Milne-Edwards & Bouvier, 1893)	Markham, 1988
<i>P. markhami</i> (Adkison & Heard, 1978)	Venezuela	<i>Iridopagurus iris</i> (A. Milne-Edwards, 1880)	Markham, 1978
	South China Sea	<i>Spiropagurus</i> spp.	This paper

by deep anterolateral notches. No midventral projections. Pereopods 1–3 larger than others and with much longer dactyli and somewhat broader propodi (Fig. 3N).

Pleon abruptly narrower than pereon, tapering smoothly posteriorly. First pleomere shortest, sixth longest. Five pairs of uniramous flaplike pleopods (Fig. 3N) extending medially, progressively smaller posteriorly. Sixth pleomere produced into triangular uropods bearing sparse setae posteriorly.

Further details as shown in SEM examination of paratype male (CIEA623002) (Fig. 4).

Antennae and antennules with distal setae on all articles, most on distal article (Fig. 4B–D). Pereopods (Fig. 4E) with minute setae on distal margins of carpi, propodi depressed along margins meeting dactyli. Posterior pleopods (Fig. 4F) reduced to tubercles. Posterior projections of terminal pleomere (Fig. 4G) ornamented with many minute plates with finely dentate edges among setae. These details should be part of the general description of the male, not a separate section.

Notes on other paratypic material. — The paratype females and males conform well to the principal types except for minor details. One female (CIEA609101) is slightly decayed, so some details of its morphology are obscured. It is somewhat longer than the holotype. Four immature cryptoniscus males (CIEA604802) were attached to the pleon of a single female (CIEA604801).

Etymology. — The specific name, *spiropaguri*, is the genitive form of the genus name of its host hermit crab, *Spiropagurus*.

Distribution and hosts. — South China Sea, China, Infesting *Spiropagurus profundorum* Alcock, 1905 and *S. spiriger* (De Haan, 1849).

Remarks. — Characters which *Pseudionella spiropaguri*, new species, shares with other members of the genus *Pseudionella* are in the female: Head relatively large, markedly broader than long, with squarish anterior corners, completely embedded

in first pereomere, with very short frontal lamina extending completely across front; maxilliped with no palp or small non-articulating palp placed on front margin some distance from anteromedial corner; plectron extending medially beyond margin of anterior article. Pereopods long and slender, most extending beyond margins of pereomeres; oostegites completely covering brood pouch, oostegite 1 lacking ornamentation on internal ridge. Pleon of 6 pleomeres; five pairs of foliate biramous pleopods; uniramous pleopods of structure similar to that of pleopodal rami. Its male is like that of its congeners thus: Head much broader than long, extending well out from broader first pereomere. Pereon smoothly tapered anteriorly and posteriorly from pereomeres 3 and 4; pereomeres all distinct and slightly to greatly separated anterolaterally; pereopods almost completely covering ventral surface of pereon but not extending beyond its margins; dactyli longer and propodi broader on anterior pereopods than on posterior ones. Pleon abruptly narrower than last pereomere, extending far posteriorly, of 6 pleomeres; five pairs of uniramous flaplike pleopods; uropods absent to considerably extended posterior triangles with anal cone between.

So far, four species have been described as members of the genus *Pseudionella*. One of those, *P. pyriforma* Shiino, 1958, from Japan (Shino, 1958) was transferred to the genus *Bopyrissa* Nierstrasz & Brender à Brandis, 1931, by Bourdon (1979) and so is not considered here. On the other hand, the species *Pseudasymmetrione markhami* Adkison & Heard, 1978, the type and sole species of its genus described by Adkison & Heard (1978) was transferred to *Pseudionella* when Boyko & Williams (2001) incorporated *Pseudasymmetrione* into *Pseudionella*. With the addition of *P. spiropaguri*, there are now five species in the genus, whose occurrence Table 1 summarises. Noteworthy are the facts that the genus is very widespread across the world's oceans, that only two of the species have been collected more than once, and that *Pseudionella* spp. predominantly infest hosts belonging to the family Paguridae, only *P. akuaku* being known to infest a diogenid hermit crab.

Pseudionella spiropaguri is most similar to *P. akuaku* Boyko & Williams, 2001, but only the male keys to that species in the key presented by Boyko & Williams (2001). Its female keys to *P. deflexa* Bourdon, 1979, but it more closely resembles the female of *P. attenuata* Shiino, 1949. The female of *P. attenuata*, according to Shiino (1949) differs from that of *P. spiropaguri* in having a proportionately larger head, relatively more slender body, no tubercles on oostegites and uropods close together without anal cone between them. The female of *P. akuaku*, according to Boyko & Williams (2001) differs from that of *P. spiropaguri* in having the head largely fused with the first pereomere, the first oostegite less sharply pointed and the pleopods less dorsally placed, while the male of that species differs in having the head proportionately larger, the sides of the pereon more parallel, the pleon less abruptly narrowing and the terminal pleomere much shorter and broader. The female of *P. deflexa* differs markedly from the all other species of the genus in having a body distortion of almost 90° and maxilliped completely lacking a palp, while its male is the only other species of *Pseudionella* matching that of the type species in having its head fused with the pereon and pleotelson ending in a single point. There might have been some slight question about the inclusion of the new species in *Pseudionella* before the description of *P. akuaku*, whose female is the only species of the genus to have the head fused with the first pereomere; the addition of *P. akuaku* to *Pseudionella* enlarges the definition of the genus enough to accommodate *P. spiropaguri* as well. Females of *Pseudionella* occur in both dextral (two species) and sinistral (three species) forms.

Species of the pagurid hermit crab genus *Spiropagurus* Stimpson have been only rarely reported to host bopyrids, all in the South China Sea. An et al. (2010, 2011) recorded a *Spiropagurus* sp. being infested by another branchial bopyrid, *Asymmetrione globifera* An, Markham & Yu, 2010, and a *Spiropagurus* sp. hosts the athelgine (abdominal) bopyrid *Parathelges enoshimensis* Shiino. Whether those species are the same as each other or the *Spiropagurus* sp. reported here as host of *Pseudionella spiropaguri* n. sp. is unknown. This is the first record of bopyrid infestation of *Spiropagurus profundorum* and *S. spiriger*.

ACKNOWLEDGEMENTS

This study was supported by the National Natural Youth Science Foundation (Grant nos. 31101614 and 31071889). We are indebted to Yongliang Wang and Ruiyu Liu (IOCAS) for their identification of the hosts. Thanks are also due to all collectors of the China-Vietnam Joint Comprehensive Oceanographic Survey from Beibu Gulf (Gulf of Tonkin).

LITERATURE CITED

- Adkison, D. L. & R. W. Heard, 1978. Description of a new genus and species of Pseudioninae (Isopoda: Bopyridae) parasite of the hermit crab *Pagurus annulipes* (Stimpson, 1860) from North Carolina. *Proceedings of the Biological Society of Washington*, **91**: 408–417.
- Alcock, A., 1905. A revision of the “Genus” *Penaeus*, with diagnoses of some new species and varieties. *Annals and Magazine of Natural History*, **16**: 508–532.
- An, J., J. C. Markham & H. Yu, 2010. Description of two new species and a new genus of bopyrid isopod parasites (Bopyridae: Pseudioninae) of hermit crabs from China. *Journal of Natural History*, **44**: 2065–2073.
- An, J., J. D. Williams & H. Yu, 2011. Three abdominal parasitic isopods (Isopoda: Epicaridea: Bopyridae: Athelginae) on hermit crabs from China and Hong Kong. *Journal of Natural History*, **45**: 2901–2913.
- Berthold, A. A., 1846. Ueber verschiedene neue oder seltene Reptilien aus New Granada und Crustaceen aus China. *Nachrichten Gesellschaft Wissenschaftern Göttingen*, **1845**: 37–59.
- Bourdon, R., 1968. Les Bopyridae des mers Européennes. *Mémoires du Muséum National d’Histoire Naturelle de Paris*, Nouvel Série A, **50**: 77–424.
- Bourdon, R., 1979. Campagne de la Calypso au large des côtes Atlantiques de l’Amérique du Sud (1961–1962) I. 32. Crustacés Isopodes: Bopyridae parasites de Pagures. *Résultats scientifiques des Campagnes de la Calypso*, **9**: 139–144.
- Boyko, C. B. & J. D. Williams, 2001. A review of *Pseudionella* Shiino, 1949 (Crustacea: Isopoda: Bopyridae), with the description of a new species parasitic on *Calcinus* hermit crabs from Easter Island. *Proceedings of the Biological Society of Washington*, **114**: 649–659.
- Buitendijk, A. M., 1937. Note on *Dardanus crassimanus* (H. M.-Edw.) and *Dardanus rufus* nov.spec. *Zoologische Mededelingen*, **20**: 55–57.
- Codreanu, R., 1967. Clasificarea evolutiva a bopirienilor, isopode parazite ale crustaceelor decapode si importanta lor biologica generala. *Studii si Cercetari de Biologie Seria Zoologie*, **19**: 203–211.
- Codreanu, R., 1968. Y a-t-il des espèces biologiques (jumelles) chez les épicarides et les rhizocéphales? *Travaux Muzeul National de Istorie Naturala Grigore Antipa*, București, **8**: 601–614.
- Dana, J. D., 1852. Conspectus crustaceorum, &c. Conspectus of the Crustacea of the exploring expedition under Capt. C. Wilkes, U.S.N. Macroua. *Proceedings of the Academy of Natural Sciences, Philadelphia*, **6**: 6–28.
- Forsskål, P., 1775. Descriptiones Animalium, Avium, Amphibiorum, Piscium, Insectorum, Vermium; quae in Itinere Orientali Observavit Petrus Forsskål. Prof. Haun. Post Mortem Auctoris Ed. *Carsten Neibuhr*. Adjuncta est Materia Medica Kahirina atque Tabula Maris Rubri Geographica. Hauniae. Pp 1–20 + i–xxxiv + 1–164, map.
- De Haan, W., 1833–1850. Crustacea. In: von Siebold, P. F., *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. Pp. i–xxxv, ix–xvi, 1–243, pls. A–J, L–Q, 1–55.
- Harada, E., 1991. Inventory of Zoological type specimens in the museum of Seto Marine Biological Laboratory. *Publications of the Seto Marine Biological Laboratory*, **35**: 171–233.
- Herbst, J. F. W., 1791–1796. *Versuch einer Naturgeschichte der Krabben und Krebse nebst einer systematischen Beschreibung ihrer verschiedenen Arten*. Vol. 2. Stralsund, Berlin. 226 pp.
- Latreille, P. A., 1817. *Isopodes, Isopoda*. *Nouveau dictionnaire d’histoire naturelle: appliquée aux arts, à l’agriculture, à*

- l'économie rurale et domestique, à la médecine, etc.* Deterville, Paris.
- Madad, A. Z., 2008. *New Records and Descriptions of Branchial Parasitic Isopods (Crustacea: Isopoda: Bopyridae: Pseudioninae) of Anomurans from the Philippines*. MSc thesis, Hofstra University. 99 pp.
- Markham, J. C., 1978. Bopyrid isopods parasitizing hermit crabs in the northwestern Atlantic Ocean. *Bulletin of Marine Science*, **28**: 102–117.
- Markham, J. C., 1988. Descriptions and revisions of some species of Isopoda Bopyridae of the north western Atlantic Ocean. *Zoologische Verhandelingen*, **246**: 1–63.
- Markham, J. C., 2003. A worldwide list of hermit crabs and their relatives (Anomura, Paguroidea) reported as hosts of Isopoda Bopyridae. *Memoirs of Museum Victoria*, **60**: 71–77.
- Markham, J. C., 2010. The isopod parasites (Crustacea: Isopoda: Bopyridae) of decapod Crustacea of Queensland, Australia, with descriptions of three new species. *Memoirs of the Queensland Museum, Nature*, **54**: 151–197.
- McDermott, J. J., J. D. Williams & C. B. Boyko, 2010. The unwanted guests of hermits: A global review of the diversity and natural history of hermit crab parasites. *Journal of Experimental Marine Biology and Ecology*, **394**: 2–44.
- Milne-Edwards, A., 1880. Reports on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico and in the Caribbean Sea, etc. VIII. Études préliminaires sur les Crustacés. *Bulletin of the Museum of Comparative Zoology at Harvard College*, **8**: 1–68, 2 pls.
- Milne-Edwards, A. & Bouvier, E. L., 1893. Description des Crustacés de la famille des Paguriens recueillis pendant l'Expédition. Reports on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877–78), in the Caribbean Sea (1878–79), and along the Atlantic Coast of the United States (1880), by the U.S. Coast Survey Steamer Blake, Lieut. Com. S.D. Sigsbee, U.S.N., and commander J.R. Bartlett, U.S.N., Commanding. 33. *Memoirs of Museum of Comparative Zoology*, **14**(3): 1–172.
- Milne-Edwards, H., 1848. Note sur quelques nouvelles espèces du genre Pagure. *Annales des Sciences Naturelles Zoologie*, Paris, **3**: 59–64.
- Nierstrasz, H. F. & Brender a Brandis, G. A., 1931. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–16. 57. Epicaridea 2. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i Kjobenhavn*, **91**: 147–225.
- Rafinesque, C. S. [-Schmaltz], 1815. *Analyse de la Nature ou Tableau de l'univers et des corps organisés*. Palerme. —224 pp.
- Saito, N., G. Itani & N. Nunomura, 2000. A preliminary check-list of isopod crustaceans in Japan. *Bulletin of the Toyama Science Museum*, **23**: 1–107.
- Shiino, S. M., 1933. Bopyrids from Tanabe Bay. *Memoirs of the College of Science, Kyoto Imperial University (B)*, **8**: 249–300.
- Shiino, S. M., 1949. On two new genera of Bopyridae found in Japan. *Bulletin of the Biogeographical Society of Japan*, **14**(11): 57–63.
- Shiino, S. M., 1958. Note on the bopyrid fauna of Japan. *Report Faculty of Fisheries Prefectural University of Mie*, **3**: 27–73.
- Shiino, S. M., 1972. The Epicaridea (list of species) from Japan. *Kansai Shizenkagaku*, **24**: 7–10. (Text in Japanese).
- Stimpson, W., 1859. Prodomus descriptionis animalium evertibratorum, quae in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, Cadwaladaro Ringgoid et Johanne Rodgers Ducibus, observavit et descripsit W. Stimpson. P. VII, Crustacea anomoura. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **1858**: 225–252.
- Stimpson, W., 1860. Notes on North American Crustacea, in the Museum of the Smithsonian Institution, No. II. *Annals of the Lyceum of Natural History of New York*, **7**: 177–246, pls. 2, 5.
- Terao, A., 1913. A catalogue of hermit-crabs found in Japan (Paguridea excluding Lithodidae), with descriptions of four new species. *Annotationes Zoologicae Japonenses*, **8**: 355–391.
- Whitelegge, T., 1901. Scientific results of the trawling expedition of H.M.C.S. "Thetis", off the coast of New South Wales. Crustacea, Pt. II. Isopoda. Part I. *Memoirs of the Australian Museum*, **4**: 201–246.