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A NEW GENUS AND SPECIES OF BOPYRID ISOPOD INFESTING THE CRAB *MUNIDOPSIS DEPRESSA* (ANOMURA: GALATHEIDAE) FROM THE GULF OF CALIFORNIA, WITH NOTES ON ITS ECOLOGY

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A B S T R A C T

A new genus and species *Bathione magnafolia* of bopyrid infesting the deep-water galatheid crab *Munidopsis depressa* is described on the basis of material collected in the southern Gulf of California, in depths between 835 and 870 m and extreme hypoxic conditions (0.007 and 0.29 ml O_2/L). Females and males of the new species were compared with females and males of 21 closely related pseudionine genera. Infestation rates by these bopyrids of *M. depressa* were estimated from 1.2% to 2.5%. *Pseudione humboldtensis* Pardo, Guisado & Acuña, 1998, shares many characters with the new species and is transferred to the new genus.

Introduction

The distribution of bopyrids in the eastern Pacific has been reviewed by Markham (1986, 1992) who included two genera of Galatheidae: *Munida* Leach, 1820, *Munidopsis* Whiteaves, 1874, as hosts of bopyrid isopods, in addition to *Pleuroncodes planipes* Stimpson, 1860, reported previously by Markham (1975) off Baja California. The first two genera are widespread throughout the eastern tropical Pacific and lists of galatheid species have been presented by Hendrickx and Harvey (1999), and Hendrickx (2000, 2003) for this region. Bourdon (1972) pointed out that galatheids constitute a group particularly exposed to bopyrid infestation and that approximately 60 species of galatheid crabs are known to host bopyrid isopods. Markham (1986) ranked *Munidopsis* as the third most common galatheid genus to be infested by bopyrids with 13 known host species from middle latitudes in the Atlantic, Pacific and Indian oceans. Genera found as parasites on *Munidopsis* include *Pseudione* Kossmann, 1881, *Pleurocryptella* Bonnier, 1900, *Parapleurocyptella* Bourdon, 1972, and *Galathocrypta* Román-Contreras and Soto, 2002. Nevertheless, excepting *Pleurocryptella wolfii* Bourdon, 1972, collected in the Gulf of Panama infesting *Munidopsis antonii* (A. Milne-Edwards, 1884), there are no other records of bopyrids parasitizing any species of *Munidopsis* in the eastern Pacific (see Markham, 1992).

Material and Methods

During a four-leg survey of the deep water invertebrate fauna of the SE Gulf of California aboard the R/V El Puma of the Universidad Nacional Autónoma de México (UNAM) undertaken in August and December 2000 as well as March and June 2001, a large series of specimens of *Munidopsis depressa* Faxon, 1893, were collected with a bottom sledge. Nine specimens were branchially infested by bopyrid isopods that were not assignable to any described bopyrid genus, and a new genus and species are proposed to include the specimens herein described. Length of isopods is given as anterior margin to posterior of telson, while that of the hosts is given as carapace length (CL, inclusive of rostrum). Sex and size of host is noted, except when the specimen is no longer available for study. Type specimens are deposited Acronyms in the Reference Collection of the Laboratorio de Invertebrados Bentónicos housed in Unidad Mazatlán, Universidad Nacional Autónoma de México (UNAM) (EMU) and the Los Angeles County Museum (LACM).

Systematics

Bopyridae Rafinesque-Schmaltz, 1815
Pseudioninae R. Codreanu, 1967
Bathione gen. nov.

Diagnosis.—Head of female medially fused with first pereiomere, all other segments separated; barbula formed by two pairs of different structures, inner pair tubular, surface finely setose; outer pair enlarged, sub-flattened, fleshy, directed medially; maxillipedal palp unsegmented; eyes and pigmentation absent. Coxal plates of pereiomeres 5-7 lamellar, well developed, borders rounded; pleopods biramous, foliaceous, well developed; five pairs of uniramous lateral plates foliaceous, semi-ovoid, very well developed; margins of pleopods and lateral plates slightly undulated, surfaces smooth; uropods uniramous. Head of male medially fused with first pereiomere; body shape linear (not tapering markedly anteriorly or posteriorly), pleopods globose, slightly flattened; pleotelson trilobed; maxillipeds, midventral tubercles, pigmentation, eyes and uropods absent.

Type Species.—*Bathione magnafolia* n. sp.

Etymology.—*Bathy-* from the Greek genitive *bathos*, in reference to the depth of collection, combined with *Ione*; the genus is feminine.

Hosts.—Galatheidae: *Munidopsis depressa*, *Cervimunida johni* Porter,1903, and *Pleuroncodes monodon* (H. Milne Edwards, 1837).

Bathione magnafolia, new species
Figs. 1-3

Material Examined.—Holotype female 6 mm, allotype male 2.4 mm (EMU-5460), from left branchial chamber of female

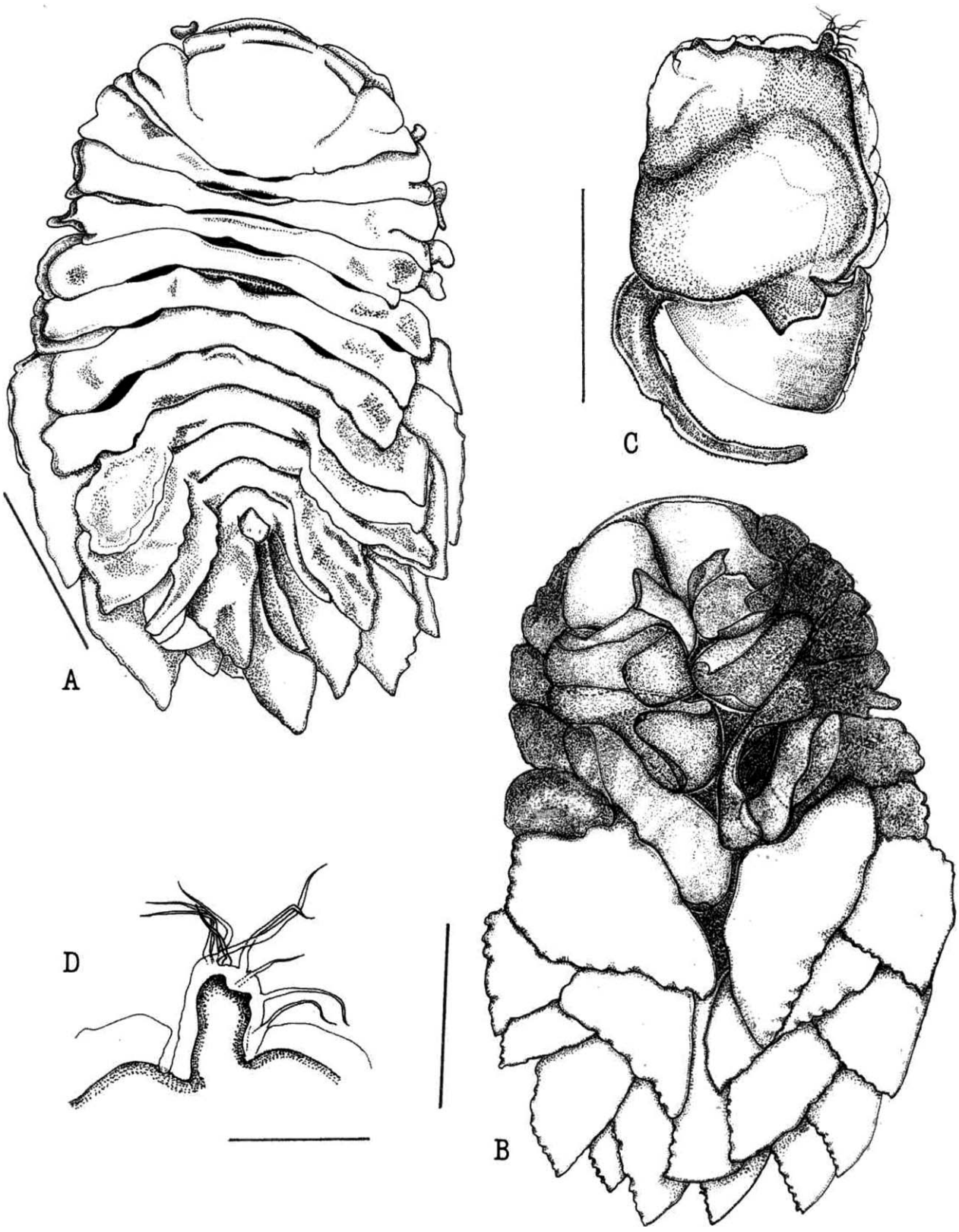

Fig. 1. Female of *Bathione magnafolia* n. gen., n. sp., holotype (EMU-5460). A, dorsal view; B, same, ventral view (legs omitted); C, maxilliped and first structure of barbula; D, palp of maxilliped. Scale bars: A & B = 1.4 mm, C = 0.5 mm, D = 0.062 mm.

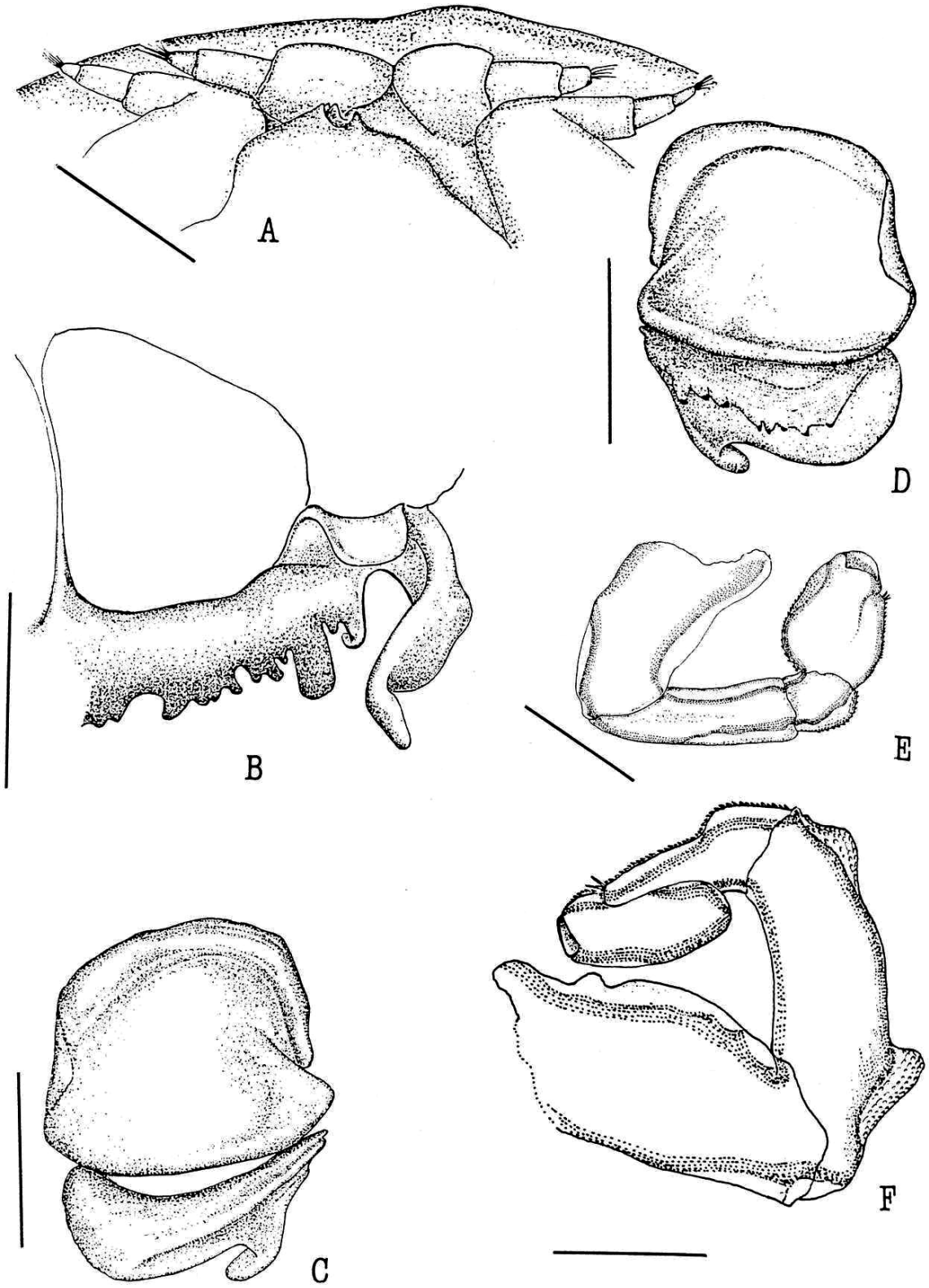

Fig. 2. Female of *Bathione magnafolia* n. gen., n. sp., holotype (EMU-5460). A, head with antennae and buccal cone, frontal view; B, left second structure of barbula; C, first right oöstegite, dorsal view; D, same, ventral view; E, left first pereiopod; F, left seventh pereiopod. Scale bars: A, E & F = 0.25 mm; B, C & D = 0.5 mm.

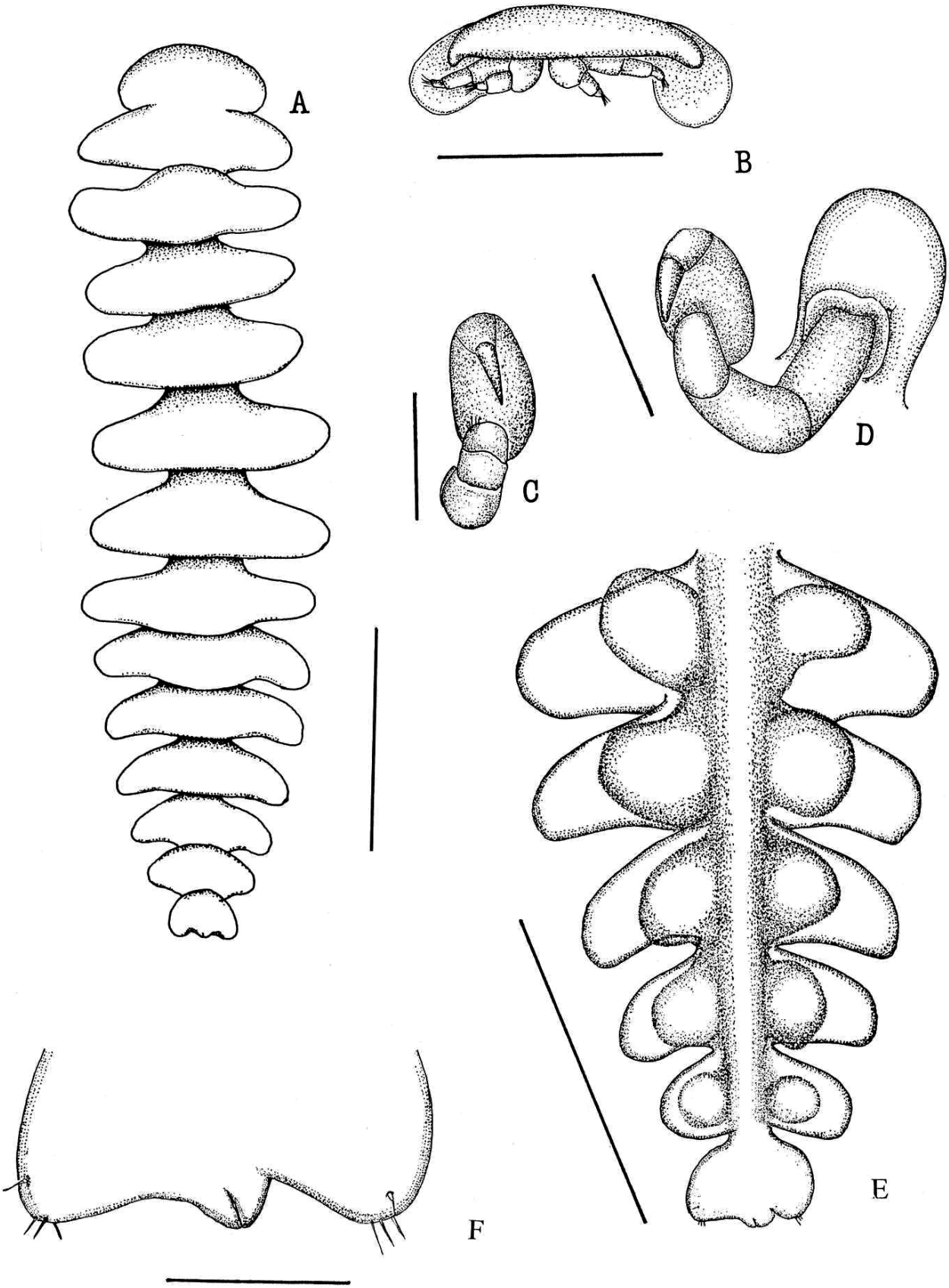

Fig. 3. Male of *Bathione magnafolia* n. gen., n. sp., allotype (EMU-5460). A, dorsal view; B, head with antennae, frontal view; C, left first pereiopod; D, left seventh pereiopod; E, pleon, ventral view; F, pleotelson, ventral view. Scale bars: A, C & D = 0.62 mm; B & E = 0.5 mm; F = 0.25 mm.

Munidopsis depressa (17.4 mm CL) (EMU-5421A). Paratypes: female (7 mm) and larva (EMU-5461) from left branchial chamber of female *M. depressa* (15.4 mm CL) (EMU-5421B); female (5.5 mm) and male (2.8 mm) (EMU-7030) from left chamber of *M. depressa* (13.1 mm CL) (EMU-6013); female (5 mm) and male (2.8 mm) (EMU-7031) from left chamber of *M. depressa* (14.2 mm CL); female (4.1 mm) and male (2.2 mm) (LACM CR 2000-067.1) from *M. depressa*; female (6 mm) (LACM CR 2000-067.2); single female (7 mm) (in Coll. R-C), from *M. depressa*; All type specimens collected by TALUD IV, St. 25 (24°53.2′N, 108°59.4′W), 835-870 m, benthic sledge, 26 Aug 2000. Nontypes: female (6 mm), male (2 mm) and larva (in Coll. R-C), from left branchial chamber of female *M. depressa* (17.6 mm CL) (EMU-5422A); ovigerous female (6.5 mm) and male (2.3 mm) (in Coll. R-C) from left branchial chamber of female *M. depressa* (17.9 mm CL) (EMU-5422B); all nontypes collected by Talud V, St. 11 (23°14.0′N, 107°00.0′W), 850-870 m, benthic sledge, 17 Dec 2000.

Description.—Holotype female outline ovoid, body margins slightly curved (Fig. 1A, B); total length 6 mm, maximal width at fifth pereiomere, 4.0 mm; head medially fused with first pereiomere, surface smooth, front rounded; frontal lamella broad, eyes and pigmentation absent; anterolateral corners of head produced into small rounded lobes. Maxilliped subquadrate, posterolateral portion slightly curved (Fig. 1C); palp subovoid, unsegmented, nine setae on distal and mesial margins (Fig. 1D), spur short and broadly rounded. Antennula 3-segmented; basal segment globose; second segment subcylindrical; third segment subtriangular, smaller, a tuft of short setae on tip. Antenna 4-segmented; basal segment subpyramidal, incompletely fused with third segment; segments 2-3 subcylindrical, distal segment smaller than former, a tuft of small setae at tip (Fig. 2A); barbula formed by two pairs of structures: inner pair cylindrical, surface finely squamous (Fig. 1C); outer pair fleshy, subflattened, directed inward; middle region irregularly digitate (Fig. 2B). Pereiomeres dorsally, ventrally and laterally distinct; coxal plates on pereiomeres 1-4 obscure, small gaps dividing borders in 2 rounded lobes on short side, but only on first pereiomere on longer side; dorsolateral bosses absent; coxal plates 5-7 larger than previous segments, lamellar, extending laterally, wider and larger posteriorly (Fig. 1A). Oöstegites fully enclosing brood pouch; first oöstegite 2-segmented, relatively small, covering head and forming the anterior part of brood pouch, external surface smooth; anterior segment rounded, almost 3 times as high as the distal segment, which is almost as wide as high, with posteriorly directed thin lobe (Fig. 2C); inner surface concave in both segments; subdigitate, smooth transverse ridge dividing anterior and posterior segments (Fig. 2D); oöstegites 2-5 different in shape, increasing in size posteriorly; fifth oöstegite extending across posterior border of marsupium and overlapping opposite one. Pereiopods progressively larger posteriorly; first pereiopod relatively small, uncarinated; surface of basis and ischium smooth; merus short; carpus and propodus fused, globose; surfaces of merus, and carpus-propodus slightly squamous (Fig. 2E), pereiopod 7 largest, elevated subpyramidal squamous carinae proximally and distally on ventral surface of ischium; merus and carpus fused, small scales on ventral surface (Fig. 2F). Pleon 1.6 times length of head/pereion; 5 pleomeres dorsally and laterally separated, sixth segment subquadrate, small; lateral plates strongly developed, foliaceous; five pairs of biramous foliate pleopods, endopods and exopods very strongly developed, larger than lateral plates (Fig. 1A, B); margins of both lateral plates and pleopods undulated, uropods uniramous.

Allotype Male.—Body unpigmented, elongated, clearly segmented dorsally, ventrally and laterally; head ovoid, medially fused with first pereiomere; almost three times as wide as long; anterolateral borders rounded and produced ventrally (Fig. 3B); maxillipeds and eyes absent; antennae different in size, both 3-segmented; antennule with proximal segment subspherical; second and third segments smaller; a small tuft of setae at tip of distal segment. Antenna with basal segment subpyramidal; middle segment subcylindrical, slightly smaller than basal segment; distal segment shortest, a small tuft of setae at tip (Fig. 3B). Pereiomeres widely separated, directed laterally (Fig. 3A), maximal width at seventh pereiomere; midventral tubercles absent; thin, uncarinated isomorphic pereiopods, slightly larger posteriorly; ishium slightly larger than carpus, carpus shortest (Fig. 3C, D). Pleomeres progressively narrower posteriorly, distinctly separated, tips subrounded; flat, globose pleopods on pleomeres 1-5 near midline (Fig. 3E); pleotelson produced in 2 rounded lateral lobes and one smaller centrally, 3 small setae on distal lateral borders and one inner smaller seta posterolaterally; anal cone present; uropods absent (Fig. 3F).

Etymology.—From the Latin *magna*, great, and *folia*, leaf (*magnafolia*), in reference to the remarkable development of pleopods and lateral plates of females. The gender is feminine.

Type Locality.—Gulf of California (24°53.2′N, 108°59.4′W).

Distribution and Ecology.—The host of *Bathione magnafolia* gen. et sp. nov., *M. depressa*, is currently known from southern California, USA, to the Gulf of California (Baba, 2005). In addition, there is one record from Baja California, Mexico (south of Isla San Pedro, ca. 27°40′N, 111°22.6′W, 931-952 m), in the SCRIPPS crustacean catalogue (Luke, 1977). The total known depth range is from 185 m to 1260-1300 m. Records in the Gulf of California are from 26°06.5′N-110°06.7′W to off Tres Marias Islands (Hendrickx, 2003). Review of selected samples of *M. depressa* in the holdings of the Los Angeles County Museum of Natural History showed no presence of any bopyrid parasites.

During this study a total of 707 specimens of *M. depressa* were collected in 11 sampling stations and examined for bopyrids. Only nine specimens (1.2%) were infested; these were all collected within a depth range of 835-870 m. Within each individual sample that contained bopyrids percentages of infestation were from 1.2% to 2.5%. In the southern Gulf of California, where the samples of *P. magnafolia* were collected, epibenthic dissolved oxygen is considered the most important environmental parameter on

Table 1. Specimens of *Munidopsis depressa* infested with *Bathione magnafolia* n. g., n. sp. collected in the SE Gulf of California. T = TALUD cruise; M = Males; F = Females; OF = Ovigerous females.

Cruise	Station	Date of collection	Dissolved oxygen (ml/L)	Depth (m)	Specimens collected			Specimens with parasite
					M	F	OF	
T IV	25	26-Aug-00	0.29	835-870	207	64	4	7
T IV	26	26-Aug-00	0.76	1225-1240	33	13	3	NONE
T IV	33	27-Aug-00	0.51	1040	1	0	1	NONE
T V	11	17-Dec-00	0.07	850-870	119	11	33	2
T V	18	15-Dec-00	0.15	940-990	9	0	0	NONE
T VI	18	15-Mar-00	0.29	890-950	6	1	8	NONE
T VI	25	16-Mar-00	0.20	830-850	3	0	1	NONE
T VII	18	7-Jun-00	—	950-1010	37	2	29	NONE
T VII	25	8-Jun-00	0.10	780-850	5	0	0	NONE
T VII	32B	9-Jun-00	0.10	850-880	72	0	44	NONE
T VII	33B	9-Jun-01	0.60	1260-1300	1	—	—	NONE

the outer continental shelf and upper slope. Severe hypoxic or anoxic conditions occur from ca. 150 m to ca. 750 m, rendering this depth range inhospitable for survival of macrofauna. Below that depth, a moderately rich decapod crustacean fauna distinct from the fauna found on the platform is found. *M. depressa* is one of the dominant species of this community and it is able to withstand dissolved oxygen concentrations as low as 0.07-0.76 ml O_2/L (Hendrickx, 2001, 2003; present work, table 1). Specimens infested with *B. magnafolia* were obtained in extremely hypoxic conditions (0.07 and 0.29 ml O_2/L) and were associated with the two largest concentrations of *M. depressa* (163 and 273 specimens) detected during this survey (Table 1).

Discussion

Twenty-five bopyrid genera were grouped by Shiino (1965) into a "*Pseudione*-group", which was later formalized by Codreanu (1967) as a subfamily. The majority of the species (currently 54) are placed into the heterogeneous genus *Pseudione*. Over the past 30+ years many new genera have been erected to contain new species of pseudionines, as well as include older species formerly placed in the genus *Pseudione* (see Bourdon, 1976).

Bathione magnafolia presents the following important characters for comparison with other galatheid-infesting pseudionines: 1) female with fusion of the head with pereiomere 1 and with 6 pleonal segments, 5 pairs of biramous pleopods, uniramous lateral plates, and uniramous uropod-like extension of the pleotelson, 2) unsegmented palp on the maxilliped and barbula composed of 2 unlike pairs of appendages, 3) female coxal plates lamellar and (at least in part) well developed, 4) male head medially fused with first pereiomere, 6 pleonal segments, 5 pairs of uniramous pleopods and no uropods.

In the present work, important generic characters of both females and males for *Bathione* were compared with 21 genera in the subfamily Pseudioninae, that contain species found infesting galatheoid anomurans (Table 2) and appear to be the most basal of peudionines (Shiino, 1965; personal observation). Although bopyrid genera are usually separated based on the characteristics of the females, we have included several male characters as well and feel strongly that males, despite their often plesiomorphic features, deserve more attention when considering generic affiliations. A comparison with all pseudionines is not given here, as the closest relatives of *Bathione* are all found infesting galatheoids (personal observation). Although a thorough revision of the Pseudioninae is desirable, such a feat is outside the scope of this work.

One of the most conspicuous characters of both females and males of *B. magnafolia* is the partial fusion of the head with the first pereiomere. This character does not appear to be frequent among Pseudioninae taxa and, except for *B. magnafolia*, no species in any of the compared genera exhibit this character. However, the fusion of the head and the first thoracic segment is frequently observed in females of the subfamily Bopyrinae (Shiino, 1965; Bourdon, 1968), so that at the generic level *Bathione* appears to share the fusion of the head more with bopyrine genera than with other members of the subfamily Pseudioninae. The fusion of the head with the first pereiomere of males was noted by Bonnier (1900) for the genus *Bopyrella* Bonnier, 1900, and he considered fusion of the head and the first pereiomere to be an important diagnostic features for the males. Shiino (1949) and Adkison and Heard (1978) also considered the importance of the fusion of head and the first pereiomere to be important in the systematics of bopyrids, but Boyko and Williams (2001) suggested that the reliability of the fusion of the head and the first pereiomere is not a diagnostic feature because of the potential for variability of this character among the individuals in a same species when larger series of specimens are examined. Given that cryptoniscids may become either males or females depending on whether another individual is present on the host (Trilles, 1999), the fusion of the head and pereion should be studied carefully in both males and females to determine if it is a useful diagnostic character for either or both sexes.

In Shiino's (1965) opinion, the gradual degeneration of the organs increases as evolution progresses in bopyrid lineages, and the fusion of pleomeres and progressive loss of pleopods in both males and females are the best-documented examples of this. Shiino (1965) stated that the fusion of pleomeres constitutes a typical feature in the evolution of bopyrids. Sars (1898) noted that in males of the family Bopyridae the "metasoma sometimes is distinct", i.e., separate segments, but in other times it is "confluent", i.e., fusion of some or all segments. Among the pseudionines this feature is likewise not common in females being seen among four of the compared genera. However, fusion of

Table 2. Synopsis of generic characters of bopyrid pseudionids infesting galatheoids and comparison with *Bathione* n. g.

	Female characters							Male characters			
Genera	Coxal plates	MXP palp	Barbula	# pleomeres	Pleopods	Uropods	Lateral plates	# pleomeres	Pleopods	Uropods	Hosts
Allorbimorphus Bourdon, 1976 (3 spp.)	Lamellar	Absent or present (not segmented)	2 pairs, lamellar	5	4 pairs biramous	Biramous	Little to moderately developed	6	4 pairs	Absent	*Aliaporcellana*, *Porcellana* and *Petrolisthes*
Anuropodione Bourdon, 1967 (5 spp.)	Lamellar	Absent	2 pairs, lamellar	6	4-5 pairs biramous	Absent or uniramous (reduced)	Moderately-well developed	1-5 (varying fusion)	Absent	Absent	*Galathea*, *Munida* and *Pisidia*
Aporobopyrina Shiino, 1934 (4 spp.)	Lamellar	Absent	2 pairs, lamellar	6	5 pairs biramous	Uniramous or biramous	Moderately developed	1-5	Absent	Absent	*Munida*, *Petrolisthes* and *Sadayoshia*
Aporobopyrus Nobili, 1906 (20 spp.)	Small	Unsegmented	2 pairs, digitate	6	5 pairs biramous	Uniramous	Moderately developed	6	5 pairs rudimentary	Absent	2 galatheid and 8 porcellanid genera
Astalione Markham, 1975 (lsp.)	Absent	Absent	2 pairs, lamellar	6	5 pairs biramous	Uniramous	Absent	5	Absent	Absent	*Clastotoechus*
Balanopleon Markham, 1973 (1 sp.)	Lameller	?	1 pair lameller	5	4 pairs biramous	Uniramous	Little developed	2	Absent	Absent	*Munida*
Galathocrypta Román-Contreras & Soto, 2002	?	Unsegmented	1 pair lameller	6	5 pairs biramous	Uniramous uroprod-like extensions	Moderately developed	6	Absent	Absent	*Munidopsis*
Kolourione Markham, 1978 (1 sp.)	Well-developed	Unsegmented	2 pairs, lamellar	5	4 pairs biramous	Absent	Reduced or absent	1	Absent	Absent	*Pachycheles*
Munidion Hansen, 1897 (7 spp.)	Lamellar	Absent	2 pairs, lamellar	6	5 pairs biramous	Biramous	Well developed	1	Absent	Absent	*Munida* and *Pleuroncodes*
Orbimorphus Richardson, 1910 (1 sp.)	Lamellar	?	?	5	4 pairs biramous	Biramous	Little developed	1	Absent	Absent	*Petrolisthes*
Paragigantione Barnard, 1920 (3 spp.)	Lamellar	Absent	1 pair, lamellar	6	5 pairs biramous	Uniramous (bilobed)	Moderately developed	6	5 pairs	Present	*Munida*
Parapleurocryptella Bourdon, 1972 (2 spp.)	Lamellar	2 segmented	1 pair, lamellar	6	5 pairs biramous	Uniramous	Little developed	6	5 pairs	Present	*Elasmonotus*, *Munidopsis* and *Uroptychus*
Parapseudione N & BB, 1931 (1 sp.)	Lamellar	?	?	6	4 pairs biramous & 1 pairs uniramous	Uniramous	?	?	?	?	*Galathea*
Parione Richardson, 1910 (5 spp.)	Small or lacking	Unsegmented	1 pair lateral lamellar ± 1 pair mesial reduced	6	5 pairs biramous	Uniramous	Little developed	5	4 pairs	Absent	*Munida*. *Pachycheles*, *Pisidia* and *Polyonyx*
Parionella N & BB, 1923 (4 spp.)	Lamellar	Unsegmented	2 pairs, lamellar	6	5 pairs biramous	Uniramous	Little developed	≈5 (fusion)	5 pairs	Absent	*Eumunida*, *Munida* and *Petrolisthes*
Parionina N & BB, 1929 (2 spp.)	Lamellar	?	?	6	5 pairs biramous	Uniramous	Little developed	4	Absent	Absent	*Allogalathea*
Parioninella N & BB, 1930	Lamellar	Unsegmented	2 pairs, lamellar	6	5 pairs biramous	Uniramous or absent	Little developed	4	5 pairs	Absent	*Pachycheles* and *Pisosoma*
Pleurocrypta Hesse, 1865 (5 spp.)	Lamellar	Unsegmented	2 pairs, lamellar	6	5 pairs biramous	Uniramous	Moderately developed	1-6 (fusion)	Absent	Absent	*Galathea*. *Munida*, *Pachycheles*, *Petrolisthes* and *Pisidia*
Pleurocryptella Bonnier, 1900 (10 spp.)	Lamellar	Segmented	1-2 pairs, lamellar	6	5 pairs biramous	Uniramous	Little developed	6	5 pairs	Present	*Chirostylus*, *Galathea*, *Munida*, *Munidopsis*, *Parapagurus*, and *Sympagurus*

Table 2. Continued.

Genera	Female characters: Coxal plates	MXP palp	Barbula	# pleomeres	Pleopods	Uropods	Lateral plates	Male characters: # pleomeres	Pleopods	Uropods?	Hosts
Pleurocryptina N & BB, 1929 (1 sp.)	Reduced	?	?	6	5 pairs biramous	Uniramous	Little developed	6	5 pairs	Present (foliaceous)	*Galathea*
Pseudione Kossmann, 1881 (55 spp.)	Reduced	Unsegmented or absent	2 pairs, lamellar	6	5 pairs biramous	Uniramous	Moderately to well developed	6	5 pairs or absent	Absent	Caridea, Galathoidea, Nephropidae, Paguroidea and Thalassinoidea
Bathione gen. nov. (2 spp.)	Lamellar	Unsegmented	1 pair, tubular & 1 pair fleshy	6	5 pairs biramous	Uniramous	Very well developed	6	5 pairs	Absent	*Munidopsis*, *Cervimunida* and *Pleuroncodes*

pleomeres is about as common as not, with males of 12 genera showing fusion. There seems to be separate evolutionary tracks for female and male pleomere fusion as only females and males of *Balanopleon* Markham, 1973, *Kolurione*, and *Orbimorphus* Richardson, 1910a, both show fusion. The possession of six distinct pleomeres in both female and male *Bathione magnafolia* is shared with seven of the compared genera (and partly with *Pleurocrypta*, in which the males are highly variable in degree of pleomere fusion).

The palp of the maxilliped in female bopyrids can be either unsegmented (rarely 2 segmented as in *Parapleurocryptella*) or absent. Bourdon (1972) considered the bisegmentation of the palp in females of bopyrids as an archaic character and is does indeed appear as if the more derived pseudionines show the most reduced palps and maxillipeds of females with segmented palps are less common than those with unsegmented palps. The unsegmented palp of *Bathione* is shared with the galatheoid-infesting pseudionine genera *Allorbimorphus* Bourdon, 1976, (in part), *Aporobopyrus* Nobili, 1906, *Galathocrypta*, *Kolourione* Markham, 1978, *Parione* Richardson, 1910, *Parioninella* Nierstrasz and Brender á Brandis, 1930, *Pseudione* (in part), and *Pleurocrypta* Hesse, 1865 (see Table 2), but in all other characters they differ markedly from those genera.

The barbula is a term proposed by Markham (1988) for the projections on the posterior margin of the female head and has been a character extensively illustrated by Bonnier (1900) but not used in his description of bopyrid species. The barbula as composed by two pairs of lamellae is the state most frequently observed among the pseudionines (Table 2); an exception to this rule is *Aporobopyrus* in which the barbula is formed by two pairs of digitate structures. The barbula composed of only one lamellar pair is present in 4 galatheoid-infesting genera (Table 2) whereas in the genus *Pleurocryptella* the barbula may be either of one or two (or even including a third small structure in some species of the genus *Probopyru*s Giard & Bonnier, 1888 (R. Bourdon, personal communication to R-C, 1999) depending on the species. In *Parione* the barbula is composed of two structures, but the outer lamellar pair is much larger than the inner pair. In *Bathione*, the barbula is, as in the majority of the other compared genera, composed of two pairs of structures. However, the inner pair is tubular and the outer pair is fleshy and this kind of barbula has not been previously observed in other galatheoid infesting pseudionines.

Adult isopods usually have five pairs of pleopods but in many bopyrids species both sexes may have a reduced number, or abdominal limbs may be lacking completely (Calman, 1909; Schultz, 1969; McLaughlin, 1980). This reduction appears to always be correlated with a reduction in the number of pleomeres for females, but not in all cases for males. Females of *Bathione* show the primitive state for both the number of pleomeres (6) and pleopods (5 pairs biramous). In these, they agree with females of 15 other galatheid-infesting genera, including *Pseudione* (putatively the most primitive genus in the subfamily). However, the pleopods in *Bathione* differ markedly from those of other

compared genera due to their exceptional development that overreaches the borders of the lateral plates. Pleopods are present on males of 11 genera of galatheoid-infesting pseudionines, with nine genera containing species bearing 5 pairs of uniramous pleopods and two genera (*Allorbimorphus* and *Parione*) containing species with only 4 pairs.

The presence of the uropods is variable in the bopyrid females but when present, the uropods can be composed of one or two rami. Uniramous uropods are more frequently observed than the biramous type (Table 2). Sometimes the presence of uropods is variable within a single genus (*Anuropodione* Bourdon, 1967). In the genus *Galathocrypta*, the presence of uropods in the female is unclear, as this depends on the definition of the uropod itself. Generally, a uropod is often considered to be any structure protruding from the pleotelson of the sixth pleomere, but some authors (Adkison and Heard, 1978) consider uropods to be only those structures that are set off from the pleomere by sutures, as in species of *Ione* Latreille, 1817. Females of *Bathione* share their uniramous uropods with the majority of the compared genera (Table 2). Male uropods are much rarer and are seen in only three of the compared genera (Table 2); they are lacking in *Bathione*.

Shiino (1965) also considered the evolution in bopyrid females of the elongation of the lateral plates. These structures are absent in *Astalione* Markham, 1975, and variously developed in the other compared genera (Table 2). The best developed lateral plates were previously seen in species of the genus *Munidion*, but those of *Bathione* are even larger and of a shape seen in none of the other galatheoid-infesting genera.

Bathione is similar to females and males of species of *Aporobopyrus* and *Galathocrypta*, as well as some species of *Pseudione* (probably a paraphyletic genus and therefore difficult to discuss in terms of generic characters). Females of species in these genera have 6 pleomeres, moderately to well-developed lateral plates, and 5 pairs of biramous pleopods. All species of *Aporobopyrus*, *Galathocrypta*, and *Bathione* have unsegmented maxilliped palps, whereas *Pseudione* species either have this state or lack palps entirely. Males of all 4 genera have 6 pleomeres and lack uropods, and most have 5 pairs of pleopods (some *Pseudione* species lack pleopods). *Bathione* females differ from those of *Aporobopyrus* in having better-developed coxal plates and unequal, non-digitate barbular lobes; the males are similar to those of *Aporobopyrus* but have a more pronounced trilobation of the pleotelson. They differ from females of *Galathocrypta* in having 2 pairs of barbular lobes (1 pair in *Galathocrypta*), and in lacking the uropod-like extensions of the pleotelson; the males possess 5 pairs of pleopods lacking in *Galathocrypta*. *Bathione* females differ from those of *Pseudione* in having two very different barbular lobes and a strongly digitate posterior barbular margin (two similar pairs of lobes and a smooth posterior margin in *Pseudione*); the males are similar to those of *Pseudione* males (especially those from species infesting anomurans). Females of *Bathione* differ from those of all three other genera in having extremely developed lateral plates on the pleomeres that completely obscure the pleopods in dorsal view. Although *Bathione magnafolia* is clearly related to *Aporobopyrus* and *Pseudione* (at least in part), the above-cited differences justify the erection a new genus and species for this parasite.

Specimens of *Pseudione humboldtensis* Pardo, Guisado & Acuña, 1998 (found on hosts *Cervimunida johni* and *Pleuroncodes monodon*) are very similar to those of *Bathione magnafolia* in all important characters and this species is transferred herein to *Bathione*. Females of the two species differ in degree of head and first pereiomere fusion (fused in *B. magnafolia* vs. distinct in *B. humboldtensis*), proportionally larger lateral plates and pleopods in *B. humboldtensis*, more pronounced digitation on the inner margin of the first oöstegite in *B. humboldtensis*, and in having differently shaped outer barbular lobes. Males of the two species are very similar and difficult to separate, based on published illustrations and description of *B. humboldtensis*, except for the fusion of head and first pereiomere in *B. magnafolia*, which is not found in *B. humboldtensis*. Males of *Bathione humboldtensis* are said to lack pleopods but the illustration provided gives the suggestion of low, rounded pleopods such as seen in males of *B. magnafolia*. When describing *Pseudione humboldtensis*, Pardo et al. (1998) compared this species to *Pseudione brattstroemi* Stuardo, Vega and Céspedes, 1986, a parasite of the callianassid *Neotrypaea uncinata* (H. Milne Edwards, 1837). Females of *P. brattstroemi* are very different from either *Bathione* species in having crenulated coxal plates (not crenulated in *Bathione* spp.), tuberculate outer barbular lobes that are much shorter than those seen in *Bathione* spp., and pereiopods strongly tuberculated on entire surface (weakly marginally tuberculate in *Bathione* spp.). Males of *P. brattstroemi* differ from those of *Bathione* spp. in having markedly laterally elongated pleomeres differing little in their relative width (posterior pleomeres much narrower than anterior ones in *Bathione* spp.), clearly lacking any pleopods (low rounded pleopods likely in both *Bathione* spp.), and having a laterally elongate pleotelson with little to no median projection (narrow, rounded and trilobed in *Bathione* spp.). Clearly, *P. brattstroemi* is generically distinct from both species of *Bathione* and is retained in *Pseudione* in the absence of a thorough revision of that genus. The most obvious similarity between females of *P. brattstroemi* and those of *Bathione* spp. is in the extremely enlarged lateral plates and pleopods. However, this character must be treated with caution as it is very possible that development of these structures, being respiratory in function, may sometimes reflect independent origins in regions of low oxygen content (see Pardo et al., 1998), rather than necessarily shared common ancestry. An additional species that has been discussed in terms of its possible relationships to *Bathione humboldtensis* is *Pseudione tuberculata* Richardson, 1904, but this species can easily be distinguished from both species of *Bathione* by both female (proportionally smaller head, deeply inserted articulated maxilliped palp, margins of pereiopod segments weakly undulating in *P. tuberculata* vs. larger head partially fused with first pereiomere, non-inserted, non-articulated maxilliped palp, strongly crenulated margins of pereiopods in *Bathione* spp.) and male (head and first pereiomere separate, anteriorly and posteriorly tapered body form, rounded

pleotelson in *P. tuberculata* vs. head and first periomere fused, linear body form, trilobed pleotelson in *Bathione* spp.) characters. Previous confusion regarding these species' relationships indicated the need for a comparison of all important morphological features to properly assess relationships in bopyrids, especially among the complex pseudionines.

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References

Adkison, D. L., and R. W. Heard. 1978. Description of a new genus and species of Pseudioninae (Isopoda: Bopyridae) parasite of the hermit crab *Pagurus annulipes* (Stimpson) from North Carolina. Proceedings of the Biological Society of Washington 91: 408-417.

Baba, K. 2005. Deep-sea chirostylid and galatheid crustaceans (Decapoda: Anomura) from the Indo-Pacific, with a list of species. Galathea Report 20: 1-317.

Bonnier, J. 1900. Contribution a l'étude des épicarides Les Bopyridae. Travaux de la Station Zoologique de Wimereux 8: 1-476, pls. 1-41.

Bourdon, R. 1968. Les Bopyridae des mers Européennes. Mémoires du Muséum National d'Histoire Naturelle, n. sér. A, Zoologie 50: 77-424.

———. 1972. Sur quelques Bopyridae (Crustacea, Isopoda) parasites de galathéides. Bulletin du Muséum National d'Histoire Naturelle, 3e sér. (66), Zoologie 52: 817-838.

———. 1976. Les bopyres des porcellanes. Bulletin du Muséum National d'Histoire Naturelle, 3e sér. (359), Zoologie 252: 165-245.

Boyko, C. B., and 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.

Calman, W. T. 1909. Crustacea. viii + 346 pp. In, R. Lankester (ed.), A Treatise on Zoology. Part VII. Appendiculata. Third Fascicle. London: Adam and Charles Black.

Codreanu, R. 1967. Clasificarea evolutivâ a bopirienilor, isopode parazite ale crustaceelor decapode şi importanta lor biologică generală. Studii si Cercetari de Biologie Seria Zoologie 19: 203-211.

Hendrickx, M. E. 2000. The genus *Munida* Leach (Crustacea, Decapoda, Galatheidae) in the eastern tropical Pacific, with description of two new species. Bulletin de′Institut Royal des Sciences Naturelles Belgique. Biologie 70: 163-192.

———. 2001. Occurrence of a continental slope decapod crustacean community along the edge of the minimum oxygen zone in the southeastern Gulf of California, Mexico. Belgium Journal of Zoology 131 (Suppl. 2): 95-109.

———. 2003. Geographic and bathymetric distributions of species of *Munidopsis* (Crustacea: Decapoda: Galatheidae) in the SE Gulf of California, Mexico, pp. 21-30. In, M. E. Hendrickx (ed.), Contributions to the Study of East Pacific Crustaceans. [Contribuciones al Estudio de los Crustáceos del Pacífico Este 2] Instituto de Ciencias del Mar y Limnología, UNAM.

———, and A. W. Harvey. 1999. Checklist of anomuran crabs (Crustacea: Decapoda) from the eastern tropical Pacific. Belgian Journal of Zoology 129: 363-389.

Luke, S. R. 1977. Catalog of the benthic invertebrate collections of the Scripps Institution of Oceanography. I. Decapod Crustacea and Stomatopoda. SIO Reference Series 77-9: 72 pp.

Markham, J. C. 1975. A review of the bopyrid isopod genus *Munidion* Hansen, 1897, parasitic on galatheid crabs in the Atlantic and Pacific Oceans. Bulletin of Marine Science 25: 422-441.

———. 1986. Evolution and zoogeography of the Isopoda Bopyridae, parasites of Crustacea Decapoda, pp. 143-164. In, R. H. Gore and K. L. Heck (eds.), Crustacean Issues 4. Crustacean Biogeography, Balkema, Rotterdam.

———. 1988. Descriptions and revisions of some species of Isopoda Bopyridae of the north western Atlantic Ocean. Zoologische Verhandelingen 246: 1-63.

———. 1992. The Isopoda Bopyridae of the eastern Pacific—missing or just hiding? Proceedings of the San Diego Society of Natural History 17: 1-4.

McLaughlin, P. 1980. Comparative Morphology of Recent Crustacea. W. H. Freeman and Company, San Francisco. 177 pp.

Pardo, L. M., C. Guisado, and E. Acuña. 1998. *Pseudione humboldtensis*, a new species (Isopoda: Bopyridae) of parasite of *Cervimunida johni* and *Pleuroncodes monodon* (Anomura: Galatheidae) from the northern coast of Chile. Proceedings of the Biological Society of Washington 111: 272-277.

Sars, G. O. 1898. An account of the Crustacea of Norway with short descriptions and figures of all the species. Vol. II. Isopoda. 185-232 pp. 104 pls. Bergen Museum, Norway.

Schultz, G. A. 1969. How to Know the Marine Isopod Crustaceans. Wm. C. Brown Company, Dubuque, Iowa. vii + 359 pp.

Shiino, S. M. 1949. On two new genera of Bopyridae found in Japan. Bulletin of the Biogeographical Society of Japan 14: 57-63.

———. 1965. Phylogeny of the genera within the family Bopyridae. Bulletin du Muséum National d'Histoire Naturelle, ser. 2, 37: 462-465.

Trilles, J.-P. 1999. Ordre des isopodes sous-ordre des épicarides (Epicaridea Latreille, 1825), pp. 279-352. In, J. Forest (ed.), Traité de Zoologie. Anatomie, Systématique, Biologie (Pierre-P. Grassé). Tome VII, Fascicule III A, Crustacés Péracarides. Memoires de l'Institut Oceanographique, Monaco 19.

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