A NEW GENUS AND SPECIES OF PRIMITIVE BOPYRID (ISOPODA, BOPYRIDAE) PARASITIZING HERMIT CRABS (ANOMURA) FROM DEEP WATERS IN THE EASTERN ATLANTIC AND JAPAN

BY

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ABSTRACT

A new genus of primitive bopyrid isopod, *Pagurocryptella* gen. nov., is erected for *Pleurocryptella paguri* Bourdon, 1979, the only species of *Pleurocryptella* previously known from a hermit crab host. Additionally, a new species in this new genus, *Pagurocryptella holthuisi* sp. nov., is described from a female specimen found parasitizing a *Solitariopagurus tuerkayi* from Japan. Females of *Pagurocryptella* differ from those in *Pleurocryptella* based on the morphology of oostegite I and pleopod counts. Males of *Pagurocryptella holthuisi* are unknown but males of *P. paguri* differ dramatically from those in *Pleurocryptella* based on their distinct body form, maxilliped morphology, antennae segment counts, and pereopod morphology. Discussion is provided on the relationships between this new genus and *Pleurocryptella*.

RÉSUMÉ

Un nouveau genre d'isopode Bopyridae primitif, *Pagurocryptella* gen. nov., est érigé pour *Pleurocryptella paguri* Bourdon, 1979, la seule espèce de *Pleurocryptella* précédemment connue comme l'hôte d'un bernard l'ermite. En outre, une nouvelle espèce de ce nouveau genre, *Pagurocryptella holthuisi* sp. nov., est décrite à partir d'un spécimen femelle parasitant un *Solitariopagurus tuerkayi* du Japon. Les femelles de *Pagurocryptella* se déférencient de celles de *Pleurocryptella* par la morphologie de l'oostégite I et le nombre de pléopodes. Les mâles de *Pagurocryptella holthuisi* sont inconnus mais les mâles de *P. paguri* diffèrent profondément de ceux de *Pleurocryptella* par la forme différente de leur corps, la morphologie du maxillipède, le nombre de segments des antennes, et la morphologie des péréopodes. Les relations entre le nouveau genre et *Pleurocryptella* sont discutées.

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INTRODUCTION

The genus *Pleurocryptella* Bonnier, 1900, is considered to be the most primitive of the extant Bopyridae (Shiino, 1965; Bourdon, 1979; Markham, 1986; Boyko & Williams, 2009). Females in this genus possess rudimentary oostegites on the pereomeres VI and VII (lacking in all other bopyrids), males have both lamellar pleopods and uropods (male uropods are only found in a few genera), and females and males have bisegmented maxilliped palps (palp may be lacking in the female of *Pleurocryptella paguri* Bourdon, 1979, or is missing due to damage in the holotype). To date, 10 species and subspecies have been described in this genus from chirostylid, galatheid and paguroid hosts at a variety of moderate to extreme depths (ca. 55-3200 m) from locations in the Atlantic, Pacific and Indian Oceans (see table I). Examination of a female parasite obtained from a *Solitariopagurus tuerkayi* McLaughlin, 1997 from Japan (ca. 200 m depth) revealed that this specimen represents a new species, congeneric with the only *Pleurocryptella* species reported from a paguroid (*P. paguri*) and of a genus clearly distinct from *Pleurocryptella*. Although the new genus, like *Pleurocryptella*, possesses rudimentary oostegites on pereomeres VI & VII, it differs from all species of *Pleurocryptella* in several other important characters that we consider to be of taxonomic value at the genus level. This new genus, as well as the new species from Japan, is described herein.

Specimens were examined from the following collections: Museum National d'Histoire Naturelle, Paris, France (MNHN) and Natural History Museum and Institute, Chiba, Japan (CBM).

The size of the isopods is given as total length from anterior cephalon to posterior of pleotelson (exclusive of uropods); shield length (SL) is provided as an indicator of specimen size for the hosts.

SYSTEMATICS

Family BOPYRIDAE Rafinesque-Schmaltz, 1815

Subfamily PSEUDIONINAE Codreanu, 1967

Pagurocryptella gen. nov.

Pleurocryptella. — Bourdon, 1979: 507-509. — Bourdon, 1981: 615-618 (part) (not *Pleurocryptella* Bonnier, 1900).

Diagnosis. — Female: Body compact, with moderate deflection of the pereon, distortion of about 20°. Head about as long as wide, deeply set into

TABLE I
Species and subspecies described or subsequently placed in *Pleurocryptella* Bonnier, 1900

Taxon	Distribution	Depth range	Host(s)	Reference(s) other than original description
Pleurocryptella crassandra Bourdon, 1976	Madagascar	460-500 m	*Munidopsis cylindrophthalma* (Alcock, 1894)	
Pleurocryptella fimbriata Markham, 1974	Jamaica, Cuba	400-720 m	*Munida constricta* A. Milne Edwards, 1880; *Munida miles* A. Milne Edwards, 1880	
Pleurocryptella formosa Bonnier, 1900	Canary Is.	914-946 m	*Gastroptychus formosus* (Filhol, 1884)	Giard & Bonnier, 1888 (nomen nudum); Tattersall, 1905 (2nd record)
Pleurocryptella infecta infecta Nierstrasz & Brender à Brandis, 1923	Indonesia, Japan, New Zealand	55-1207 m	*Munida militaris* Henderson, 1885; *Munida japonica* Stimpson, 1858; *Munida* sp.; *Galathea* sp.	Shiino, 1937 (2nd record); Page, 1985 (3rd record)
Pleurocryptella infecta tuberculata Bourdon, 1976	Madagascar	403-444 m	*Paramunida tricarinata* (Alcock, 1894)	
Pleurocryptella laevis (Richardson, 1910)	Philippines	197-246 m	Unknown	Bourdon, 1979 (n. comb.)
Pleurocryptella latilamellaris (Nierstrasz & Brender à Brandis, 1931)	Indonesia	250-290 m	*Munida* sp.	Bourdon, 1979 (n. comb.)
Pleurocryptella paguri Bourdon, 1979	Azores	843-2100 m	*Parapagurus nudus* (A. Milne Edwards, 1891); *Oncopagurus bicristatus* (A. Milne Edwards, 1880)	
Pleurocryptella superba Bourdon, 1981	Denmark	4475 m	*Munidopsis crassa* Smith, 1885	
Pleurocryptella wolffi Bourdon, 1972	Gulf of Panama	2950-3190 m	*Munidopsis antonii* (Filhol, 1884)	

pereon, eyes lacking, frontal lamina well-developed. Antennae of four segments, antennules of three segments. All pereomeres distinct, pronounced dorsolateral bosses and tergal projections; five pairs of well-developed oostegites on pereomeres I-V, incompletely closing marsupium, and two pairs of rudimentary oostegites on pereomeres VI and VII. Maxilliped with unsegmented palp or palp lacking (see Remarks). Five pleomeres plus pleotelson, lateral plates well-developed; biramous tapering pleopods on pleomeres I-III, uni- or biramous pleopods on pleomere IV, pleomere V with uniramous pleopods or lacking, lamellar uniramous uropods.

Male: Longer than broad, all segments clearly separated; abdomen not abruptly narrower than pereon, tapering anteriorly and posteriorly. Head ovate, eyes lacking. Maxilliped palp with two stout subequal segments. Anterior pereomeres curved anterolaterally, posterior pereomeres and pleomeres curved posterolaterally (in dorsal view) and curved ventrally (in lateral view). Dactyli and propodi of pereopods I and II subequal to other pereopods. Four or five pleomeres plus pleotelson (see Remarks), all pleomeres with lateral margins curved ventrally to tapered tip, no midventral tubercles on pleon; presence of pleopods and uropods unknown.

Type species. — *Pleurocryptella paguri* Bourdon, 1979.

Included species. — *Pagurocryptella paguri* (Bourdon, 1979) and *Pagurocryptella holthuisi* spec. nov.

Etymology. — The generic name is a given for the unusual habitat of this species on a hermit crab, rather than galatheid or chirostylid, host.

Remarks. — The sole species of *Pleurocryptella* described to date from a non-galatheoid host (Galatheidae, Chirostylidae), *P. paguri*, possesses several characters that separate it from the other species of *Pleurocryptella*. For the females, the proximal lobe of the oostegite I being smaller than the distal lobe, and the presence of less than five pairs of biramous pleopods strongly differs from species with oostegite lobes of different relative sizes (proximal lobe either larger or subequal to distal lobe), and the presence of five pairs of biramous pleopods seen in all species of *Pleurocryptella*. The maxilliped palp of *P. paguri* is lacking in the holotype. However, the maxilliped appears to be damaged and the presence or absence of a palp cannot be determined with certainty. If the palp is lacking or unsegmented, this would provide another distinguishing character from all other members of the genus *Pleurocryptella* that possess bisegmented palps (although maxilliped morphology has not been documented in all species). The male of *P. paguri* differs even more dramatically from those of *Pleurocryptella* in having a bisegmented maxilliped with a

stout terminal segment (as opposed to having the terminal segment elongated and much slenderer than the proximal segment), antennae and antennules of a reduced segment count and of stout form, lacking enlarged dactyli and carpi of the pereopods, and of a distinct body form with anterolaterally curved anterior pereomeres and posterolaterally curved posterior pereomeres, as well as ventrally curved pleomeres in lateral view not seen in *Pleurocryptella* species. These differences support the removal of *P. paguri* from *Pleurocryptella* and placement in its own genus.

Pagurocryptella paguri (Bourdon, 1979), n. comb.
(fig. 1)

Pleurocryptella paguri Bourdon, 1979: 507-509, figs. 1, 2a-j. — Bourdon, 1981: 617-618.
Pleurocryptella sp. Bourdon, 1979: 509, fig. 2k (juvenile specimen).

Material examined. — Atlantic Ocean. Campagne Biaçores Stn. 120, NW of Azores, 39°03′05″N 32°43′05″W, 2100 m, 22 Oct. 1971, in right branchial chamber of female *Parapagurus nudus* (A. Milne Edwards, 1891) (2.44 mm SL): non-brooding dextral holotype female (3.8 mm), allotype male (2.7 mm) (MNHN-Ep 170). — Campagne Biaçores Stn. 101, NW of Azores, 39°23′05″N 31°05′00″W, 843-900 m, 19 Oct. 1971, in left branchial chamber of damaged *Oncopagurus bicristatus* (A. Milne Edwards, 1880) (3.90 mm SL): juvenile sinistral female (3.75 mm), (MNHN-Ep 171A).

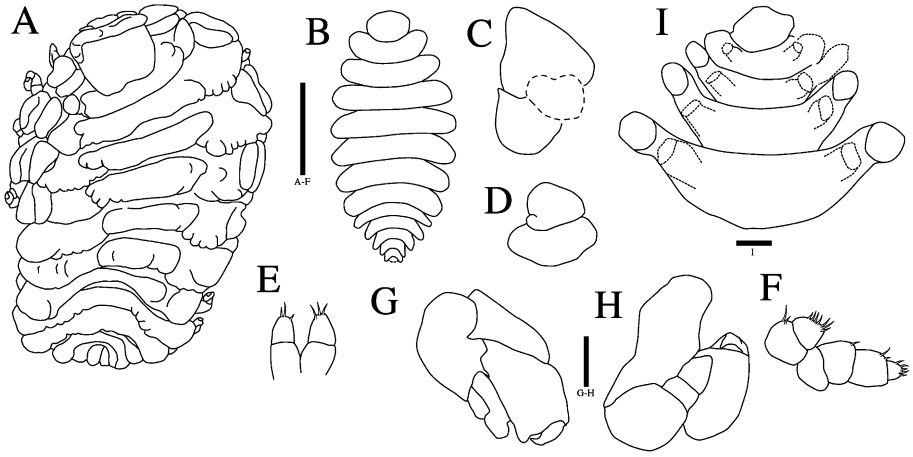

Fig. 1. *Pagurocryptella paguri* (Bourdon, 1979). Female (A, C, D), MNHN-Ep 170a, holotype; male (B, E-I), MNHN-Ep 170b, allotype. A, dorsal view; B, dorsal view; C, maxilliped; D, right oostegite 1, external; E, maxilliped; F, left antenna and antennule; G, right pereopod 2; H, right pereopod 7; I, ventral pleon (see text for discussion of identity of structures indicated in dashed lines). A-F redrawn after Bourdon (1979). Scale bars = 1 mm (A, B, D), 0.4 mm (C), 0.2 mm (E), 0.15 mm (F), 0.1 mm (G-I).

Distribution. — Known only from northwest of the Azores. Depth: 843-2100 m.

Type specimens. — Female holotype and male allotype (MNHN-Ep 170).

Redescription. — Female (fig. 1A, C, D). Body length 3.8 mm, maximal width 2.6 mm, head length 0.88 mm, head width 0.88 mm. Pereon deflexed dextrally at approximately 20° (fig. 1A). All body regions and pereomeres distinctly segmented.

Head subrectangular, approximately as broad as long, weakly produced with frontal lamina equal to approximately one-fifth length of head (fig. 1A); barbula unknown. Eyes lacking. Antenna of four articles, antennule of three articles. Maxilliped (fig. 1C) with short subacute spur; palp lacking (or missing due to damage; see Remarks), distolateral margin gently rounded, subtriangular, weakly produced. First oostegite (fig. 1D) proximal lobe globular, distal lobe approximately 50% longer than proximal lobe, irregularly ovate with rounded margins, lacking distally produced projection, internal ridge smooth. Oostegites incompletely enclosing the marsupium, last two pairs (VI & VII) rudimentary.

Pereon composed of seven pereomeres, broadest across pereomere III, gradually tapering anteriorly and posteriorly; pereomere I with convex posterior margin, II straight, III-VI laterally straight with slight median concavity, VII strongly concave. Coxal plates pronounced and thin on pereomeres I-IV, clearly separated from pereomeres. Dorsolateral bosses on pereopods I-IV large, oblong, and clearly separated from pereomeres; bosses on pereomeres VI and VII partly subsumed into pereomeres. Pereomeres I-VII with low and rounded tergal projections having strong crenulations laterally. Pereopods subequal, first two pairs surrounding head region, others evenly spaced.

Pleon with five distinct pleomeres plus pleotelson; posterior margins of all pleomeres strongly concave with dorsolateral crenulations on I-III. Pleomeres I-IV with biramous pleopods, last pair much smaller than those on segments I-III; pleomeres I-V with short lateral plates, edges and surfaces of all lateral plates smooth; uropods uniramous.

Male (fig. 1B, E-I). Length 2.7 mm, maximal width 1.3 mm, head length 0.36 mm, head width 0.46 mm, pleon length 0.66 mm.

Head ovate, widest medially, distinct from first segment of pereon (fig. 1B). Eyes lacking. Maxilliped bisegmented (fig. 1E) with stout terminal segment subequal to proximal segment. Antenna of four articles, distally setose, extending beyond margin of cephalon; antennule of two articles, distally setose (fig. 1F).

Pereomere IV broadest, others markedly tapering anteriorly and posteriorly. Pereomeres I and II directed anterolaterally, III and IV straight, V-VII directed posterolaterally, distolateral margins of all pereomeres rounded. No detectable pigmentation. First pair of pereopods missing due to damage, pereopods II-VII (fig. 1G, H) subequal, all articles distinctly separated.

Pleon damaged, with five segments (six if pleotelson lacking, see below). All pleomeres directed posterolaterally (in dorsal view), with distolateral margins rounded; extended ventrally (in lateral view). No midventral tubercles on pleomeres. Pleotelson shape uncertain; pleopods present or absent (see below), uropods unknown.

Remarks. — Bourdon (1979) did not figure several of the key morphological features that separate *P. paguri* from species of *Pleurocryptella*. Males of *P. paguri* have pereopods II and VII essentially identical (fig. 1G, H), with equal sized dactyli and propodi that sharply contrast with the males of *Pleurocryptella* which all have pereopods I and II with enlarged dactyli and propodi (both pereopods on pereomere I are missing in the allotype of *P. paguri*, but are likely to be similar in size to pereopod II). Bourdon (1979) described the male pleon as having six segments and pleopods, but noted that the male was probably dead when collected, as the head was detached and almost all the pleopods as well as the pleotelson were missing. Examination of the male shows that the pleopods may or may not exist; structures interpreted as pleopods by Bourdon (1979) may instead represent the lateral projections of the pleomeres in a premolt condition (shown in fig. 1I). No distinct, raised pleopods exist on this specimen as found in other *Pleurocryptella*. It is possible that the male died during biphasic molt and the posterior portion of the specimen failed to molt properly. Additionally, as the pleotelson of the male is lacking, or is at least damaged, the status of the uropods is unknown. Bourdon (1979, fig. 1b) drew a hypothetical pleotelson with dotted lines, but the shape and form of this structure remains unknown. In fact, the presence of a sixth pleonal segment in this species is questionable, as the final pleomere shows no sign of damage on the posterior margin and is of a different shape than the other pleomeres with a differently shaped lateral projection (fig. 1I). This suggests the pleotelson is either fused with the fifth pleomere or there is loss of the fifth pleomere. Reduction of segmentation in the male pleon is supported by the fact that the female only has four pairs of biramous pleopods. If true, then males of this species have only five pleomeres (including the pleotelson) and lack uropods. However, verification of male pleon features must await discovery of additional specimens.

The juvenile female (MNHN-Ep 171A) was referred to *Pleurocryptella* by Bourdon (1979) with only the comment that its specific identity was indeterminable. Most of the characters of this specimen illustrated by Bourdon (1979) indicate conspecificity with *P. paguri*, including head shape, coxal plate and dorsolateral boss development, and form of the dorsomedial bosses. Examination of the specimen shows the oostegites, although not fully developed, strongly resemble those of *P. paguri*. Bourdon (1979) incorrectly depicted the frontal lamina of the juvenile specimen as absent, when it is well-developed, and similar to that seen in the holotype of *P. paguri* (fig. 1A), and the uropods as distally tapered, when they are distally rounded. Both of these corrections make the case for conspecificity with *P. paguri* even stronger, as does the close proximity of the collection site with that of the types of *P. paguri*. Therefore, this juvenile specimen is referred to *P. paguri*.

Pagurocryptella holthuisi n. sp.

(figs. 2, 3)

Bopyrid visible in color photo of host: Komai & Takeda, 2006: fig. 14c.

Material examined. — Pacific Ocean. R/V "Tansei-maru", KT02-3 cruise, St. E-5-1, Kerama group, Ryukyu Islands, Japan, 26°18.046′N 127°08.681′E, 202-207 m, 19 April 2002, coll.

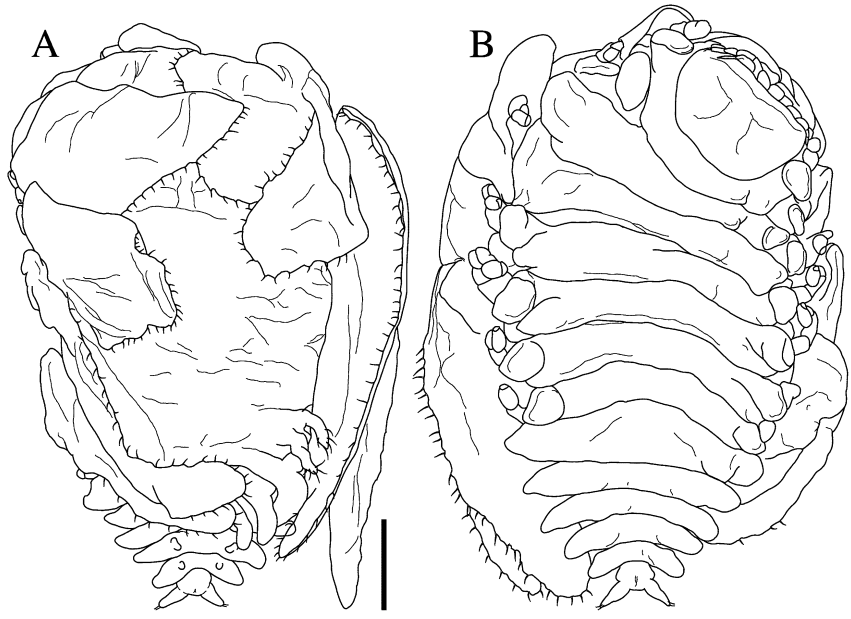

Fig. 2. *Pagurocryptella holthuisi* n. sp. Female, CBM-ZC 9741, holotype. A, ventral view; B, dorsal view. Scale bar = 500 μm.

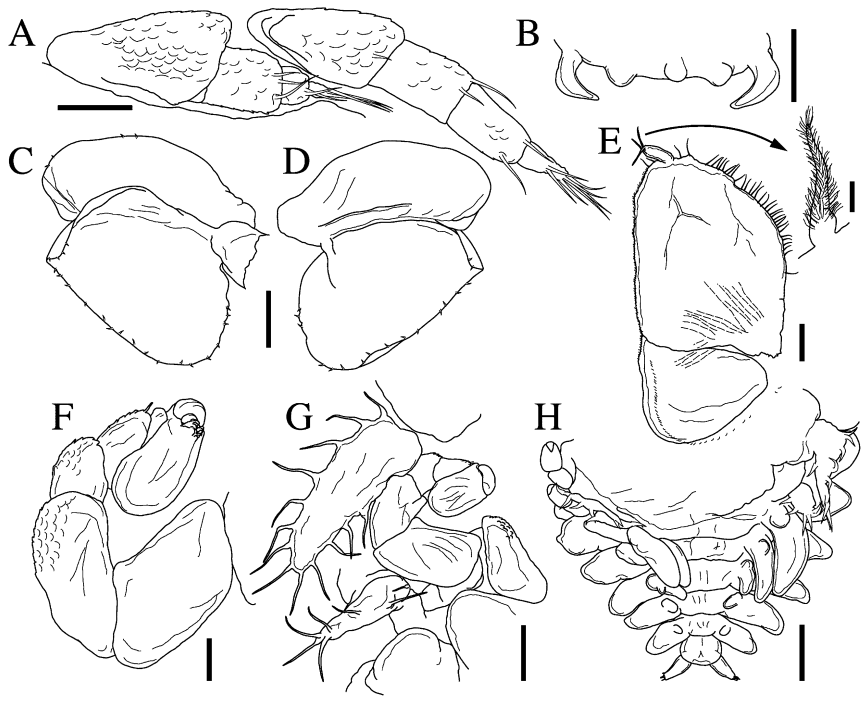

Fig. 3. *Pagurocryptella holthuisi* n. sp. Female, CBM-ZC 9741, holotype. A, right antennule and antenna; B, barbula; C, left oostegite 1, external view; D, left oostegite 1, internal; E, left maxilliped, external view (inset showing spine on palp); F, left pereopod 1; G, left pereopod 7 and posterior oostegites, lateral view; H, pleon, ventral view. Scale bars = 50 μm (A, F), 100 μm (E), 250 μm (B-D, H), 125 μm (G), 10 μm (E inset).

T. Komai, in left branchial chamber of male *Solitariopagurus tuerkayi* McLaughlin, 1997 (3.5 mm SL, CBM-ZC 8598): ovigerous sinistral holotype female (3.1 mm) (CBM-ZC 9741).

Distribution. — Known only from Ryukyu Islands, Japan. Depth: 202-207 m.

Type specimen. — Female holotype (CBM-ZC 9741).

Description. — Female (figs. 2, 3). Body length 3.1 mm, maximal width 1.9 mm, head length 0.51 mm, head width 0.81 mm. Pereon deflexed sinistrally at approximately 20° (fig. 2A). All body regions and pereomeres distinctly segmented.

Head subrectangular, broader than long, weakly produced with frontal lamina equal to approximately one-sixth length of head (fig. 2B); barbula of two long, curved, tapering lateral lobes and two low mediolateral rounded lobes (fig. 3B). Eyes lacking. Antenna of four articles, antennule of three articles (fig. 3A). Maxilliped (fig. 3E) covered with rows of minute setae,

distal margin setose, with short subacute spur; unsegmented subcylindrical palp present, with three stout setae on distal margin, setae covered with setules (fig. 3E inset). First oostegite (fig. 3C, D) proximal lobe elongate ovate, distal lobe approximately 40% longer than proximal lobe, elongate ovate with rounded margins, lacking distally produced projection, internal ridge smooth.

Pereon composed of seven pereomeres, broadest across pereomeres III, IV, very gradually tapering anteriorly and posteriorly; pereomere I with convex posterior margin, II, III straight, IV-VII with progressively greater median concavity. Coxal plates very small on all right side pereomeres, appear lacking on left side. Dorsolateral bosses on pereopods I-VII large, ovate, and clearly separated from pereomeres; bosses on pereomeres II and III lacking on left side. Pereomeres I-VI with low, weakly produced, smooth tergal projections. Oostegites incompletely enclosing marsupium (fig. 2A) last two pairs of oostegites digitiform, rudimentary, with long stout setae widely distributed around margin (fig. 3G). Pereopods subequal (fig. 3F, G); first two pairs surrounding head region, others evenly spaced.

Pleon with five distinct pleomeres plus pleotelson (figs. 2B, 3H); posterior margins of pleomeres I, II nearly straight, II-V progressively more concave, all margins smooth. Pleomeres I-III with biramous smooth pleopods, endopods minute, both lobes progressively smaller posteriorly; pleomeres IV-V with uniramous smooth pleopods (endopods lacking); pleomeres I-V with well developed lateral plates, distally tapered and directed slightly posterolaterally, edges and surfaces of all lateral plates smooth; uropods uniramous, tapering distally, directed distolaterally, tips setose.

Male unknown.

Etymology. — The specific name is given to honor the crustacean maven par excellence, Lipke B. Holthuis, in recognition of his contributions to crustacean biology, taxonomy, nomenclature and history. He was a curator, in the truest sense of the word, of all things crustacean and his passing is mourned by all with an appreciation of the wonders of natural history.

Remarks. — Although the female general habitus morphology of this new species does not at first glance appear to be very similar to that of *Paguro-cryptella paguri*, the two species share many characteristics in common. Both have a compact body shape with a very similar head shape and orientation, as well as frontal lamina relative size. Both have antennae of four segments and antennules of three segments (in contrast to all species of *Pleurocryptella* having five and three segments, respectfully). Both have a first oostegite that has the distal lobe subequal or larger than the proximal lobe (in contrast to species

of *Pleurocryptella* that have a larger proximal lobe). The maxilliped has an unsegmented palp, in contrast to the bisegmented palps found in all other species of *Pleurocryptella* for which the structure has been described. Unfortunately, the male is unknown for *P. holthuisi* n. sp. which, together with our limited knowledge of the male of *P. paguri*, leaves the male characters of the genus imperfectly known.

Females of *Pagurocryptella holthuisi* n. sp. can easily be distinguished from those of *P. paguri* by their lack of dorsal crenulations on the pereomeres or pleomeres and lack of medial raised regions on the pereomeres, much smaller coxal plates, dorsolateral bosses and tergal projections, different pleopodal formula (three biramous + two uniramous vs. four biramous), and extended pleotelson and uropods (much more so than in the adult female of *P. paguri*, and even more than in the juvenile of that species; see Bourdon, 1979, fig. 2k).

ACKNOWLEDGEMENTS

We would like to thank Alain Crosnier (formerly of MNHN) for making materials available and for inviting one of us (CBB) to come to Paris and study them. Tomoyuki Komai (Chiba Museum, Japan) kindly provided a loan of the parasitized *Solitariopagurus tuerkayi* specimen.

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First received 16 October 2009.
Final version accepted 10 January 2010.