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Daniel L. Adkison
Texas A&M University

Richard W. Heard
Gulf Coast Research Laboratory, richard.heard@usm.edu

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***PSEUDIONE OVERSTREETI*, NEW SPECIES (ISOPODA: EPICARIDEA: BOPYRIDAE),
A PARASITE OF *CALLICHIRUS ISLAGRANDE*
(DECAPODA: ANOMURA: CALLIANASSIDAE) FROM THE GULF OF MEXICO**

Daniel L. Adkison¹ and Richard W. Heard²

¹Geochemical and Environmental Research Group, 833 Graham Road, Texas A&M University, College Station, Texas 77845, and 1699 Wesleyan Bowman Road, Macon, Georgia 31210, USA

²Invertebrate Zoology Section, Gulf Coast Research Laboratory, P.O. Box 7000, Ocean Springs, Mississippi 39566-7000, USA

ABSTRACT *Pseudione overstreeti*, new species, is a common bopyrid that infests the branchial chamber of the beach ghost shrimp, *Callinectes islagrande*, occurring along beaches of the Gulf of Mexico from Cape San Blas, Florida to Paraiso, Tabasco, Mexico. Like other members of the genus *Pseudione* that infest callinectid shrimps, the female of *P. overstreeti* is characterized by biramous terminal appendages which result from the combination of uniramous uropods with the closely associated lateral plates of pleomere 6. From the other members of the genus *Pseudione* occurring on callinectid hosts, *P. overstreeti* is distinguished by the distinctive development of the coxal and lateral plates on the female and the presence of elongate, posterolateral processes (= uropods by previous usage) on pleomere 6 of the male. *Pseudione overstreeti* is the second bopyrid from a callinectid host in the northeast Atlantic. The other species, *Ione thompsoni* Richardson, 1904, described from New England waters, infests the branchial chamber of *Gilvossius setimanus* (DeKay, 1844).

INTRODUCTION

Over the past 15 years, we have collected specimens of the beach ghost shrimp, *Callinectes islagrande* (Schmitt, 1935), infested with an undescribed branchial bopyrid parasite. Parasitized ghost shrimp were collected using a suction device or modified "yabbie pump" similar to that described by Manning (1975). Infested *C. islagrande* occurred in both intertidal and shallow subtidal habitats along sand beaches of the Gulf of Mexico. The description of this new species of bopyrid is the subject of this report.

The holotype has been deposited in the National Museum of Natural History (USNM), Washington, D.C. Paratypes are in the collections of the National Museum of Natural History, the Gulf Coast Research Laboratory Museum (GCRL), and the Museum National d'Histoire Naturelle (MNHN-Ep), Paris.

Heard and D.L. Adkison. **PARATYPES; Mississippi:** 1 ♂ (USNM 253088), same collection as holotype; 2 ♀♀ (gravid), 2 ♂♂ NMHN-Ep. 876 (host present); west end of Horn Island; 05 Jul 1992; swash zone; coll. D.L. Adkison and R.W. Heard. 3 ♀♀ (gravid), 2 ♀♀ on same host, 3 ♂♂ (USNM 253089); west end of Horn Island; 01 Jun 1993; swash zone to 0.5m; coll. D.L. Adkison. 1 ♀ (gravid), 1 ♂, USNM 253090; Ship Island; no date; next to swash; coll. R.W. Heard. **Florida:** 1 ♀ (gravid), 1 ♂ (GCRL 1337); Panama City Beach (Bid-A-Wee Beach), Florida; 24 Oct 1990; 0.5 m; salinity 33 ‰; coll. J. Foster. **Alabama:** 2 ♀♀ (gravid), 2 ♂♂ (USNM 253091); Gulf Shores; Oct 1980; 0.5 to 1.0 m; coll. R.W. Heard. 2 ♀♀ (gravid), 2 ♂♂ [double infestation]; west end of Dauphin Island; 08 Jul 92; swash zone; coll. D.L. Adkison. **Louisiana:** 1 ♀ (gravid), 1 ♂ (USNM 253092); Elmer's Island, Jefferson Parish; 21 Jun 1982; coll. R.W. Heard.

Pseudione overstreeti, new species

Figures 1 and 2

Pseudioninae sp. A.: Rakocinski *et al.* 1993:102

MATERIAL EXAMINED

[ALL INFESTING *CALLICHIRUS ISLAGRANDE* (SCHMITT, 1935)]

HOLOTYPE, ♀ (USNM 253087); west end of Horn Island, Mississippi; 9 Oct 1981; 1 m water depth; coll. R.W.

OTHER MATERIAL

Florida: 3 ♀♀ (gravid), 3 ♂♂ (1 double infestation); specimens deposited in GCRL Invertebrate Zoology Class Collection [apparently lost]; Cape San Blas, Florida; 28 June 1983, coll. R. W. Heard. 2 ♀♀ (1 gravid), 2 ♂♂ (USNM 253093); Perdido Key; 16 Jan 1990; swash zone and intertidal coll. R.W. Heard, C. Rakocinski and J.A. McLelland. **Alabama:** 1 ♀ (gravid), 1 ♂ (USNM 253094); west end of Dauphin Island; 30 Jun 93; swash zone; coll.

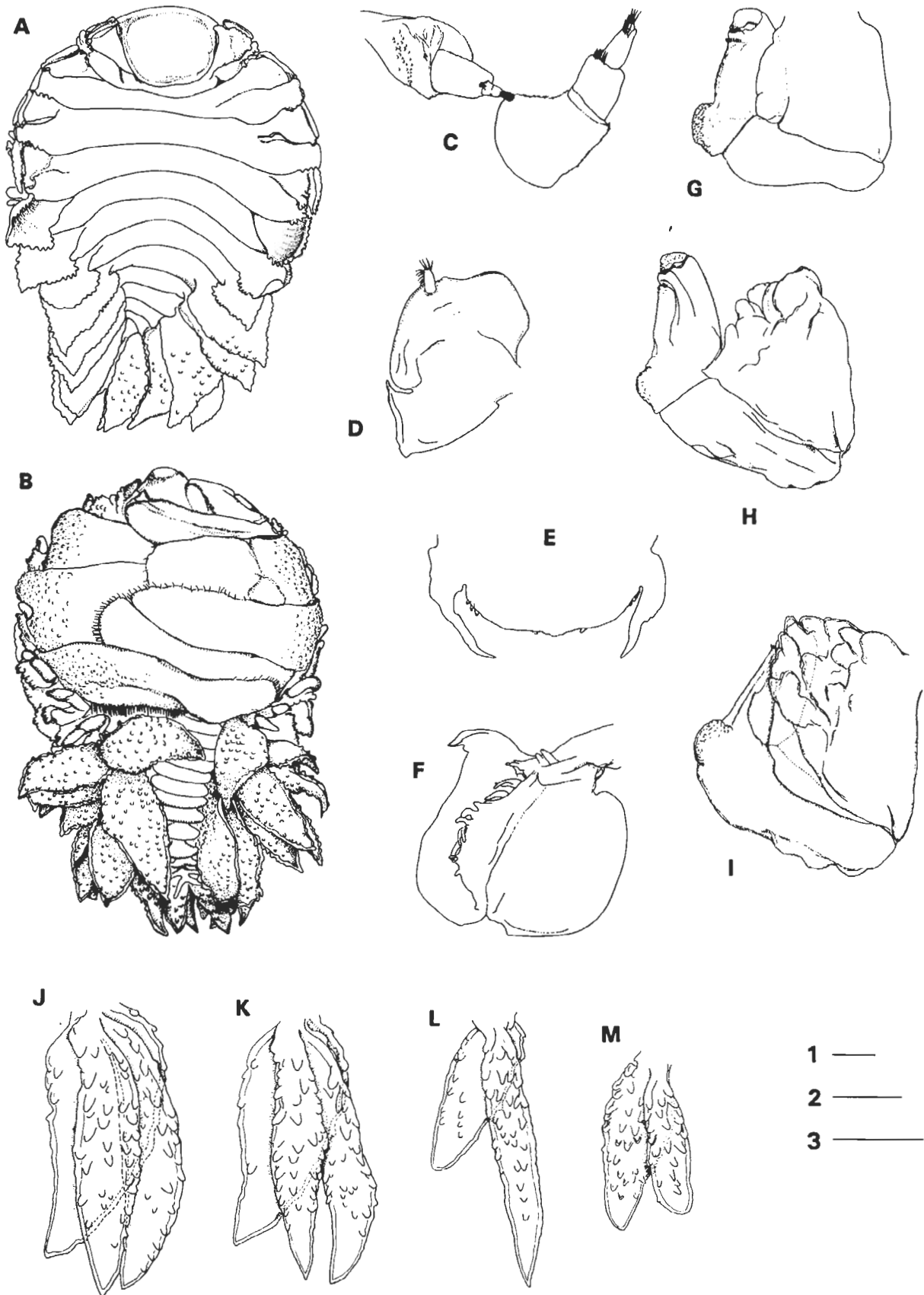


Figure 1. *Pseudione overstreeti*, new species. Female: A, dorsal view; B, ventral view, male shown attached to abdomen; C, antenna; D, maxilliped; E, posterior ventral lamina; F, oostegite 1, internal view; G, pereopod 3; H, pereopod 6; I, pereopod 7; J, pleopod 4; K, pleopod 5; L, left uropod and lateral plate; M, right uropod and lateral plate. Scale 1 = 0.1 mm (C); scale 2 = 5.0 mm (A and B), 1.0 mm (D-F, J-M); scale 3 = 0.5 mm (G-I).

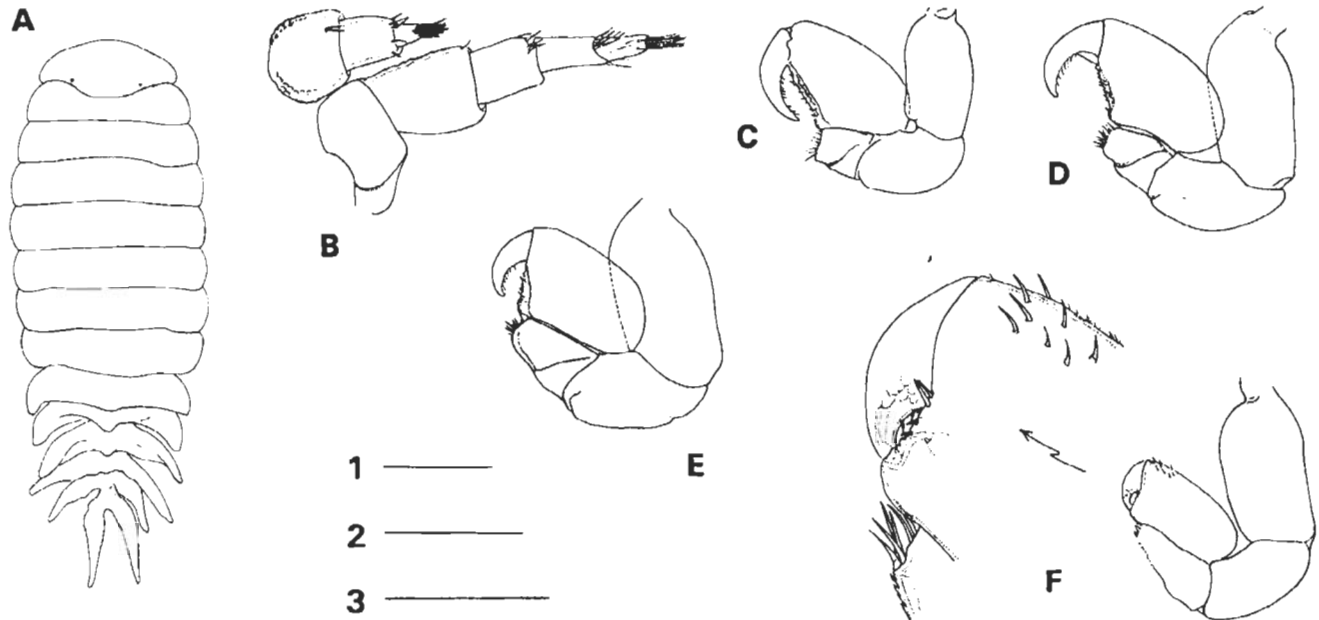


Figure 2. *Pseudione overstreeti*, new species. Male: A, dorsal view; B, antennae; C, pereopod 1; D, pereopod 3; E, pereopod 4; F, pereopod 7. Scale 1 = 1.0 mm (A); scale 2 = 0.2 mm (B); scale 3 = 0.4 mm (C-F).

D.L. Adkison. **Mississippi**: west end of Horn Island; 5 Dec 1980; 0.5 to 1 m; coll. R.W. Heard. 2♀♀ (gravid), 2♂♂ (USNM 253095); west end of Horn Island; 9 Oct 1981; 0.2 to 1.5 m; coll. R.W. Heard and D.L. Adkison. West end of Horn Island; 05 July 1992; coll. D.L. Adkison and R.W. Heard. **Louisiana**: 1♀ (gravid), 1♂ (USNM 253096); bay side of Isles Dernieres; coll. D.L. Felder; 24 Feb 1991. **Texas**: 5♀ (gravid), 5♂ (USNM 253097); Mustang Island, south of Port Aransas; 02 Aug 1990; coll. R.D. Felder and J.L. Stanton. **Mexico, Tabasco**: 2♀ (gravid), 2♂ (one damaged, without pleon) (USNM 253098); Paraiso; 28 Mar 1991; coll. D.L. Felder and J.L. Stanton.

DESCRIPTION

Female. Total length 10.0 to 19.1 mm; head width 3.0 to 6.5 mm; pereon greatest width (pereomere 3) 9.3 to 14.4 mm; pleon length excluding lateral plates 2.0 to 6.1 mm. Distortion angle 15°.

Head with dorsal surface nearly flat; frontal lamina narrow, laterally expanded, with margin often crenulate. Eyes absent. Antennule with 3 articles; covered with scales. Antenna with apparently 4 articles, articulation indistinct; more than twice length of antennule; covered with scales, more apparent than on antenna. Maxilliped palp often articulated indistinctly, with setae on distal and medial margins; maxilliped with numerous fine setae on ventral surface of distal segment. Barbula with 1 pair of

unarmed lanceolate, lateral projections ("spur" of Adkison and Heard 1978 or "epipods" of Bonnier 1900), with numerous tubercles between lateral projections; tubercles shorter medially.

Pereon broadest at pereomere 3. Dorsolateral bosses on pereomeres 1-4; lateral margin with tubercles exhibiting variable development. Coxal plates free on pereomeres 1-4, fused with dorsolateral boss area on pereomeres 5-7; lateral and ventral surfaces tuberculate; tubercles most abundant on proximal ventral surface. Tergal area increasing in size to pereomere 4, then decreasing greatly posteriorly; tergal area on pereomeres 1-4 tuberculate posterolaterally; tubercles often present on pereomere 5. Brood pouch closed. Oostegite 1 with curved, medially directed posterolateral point; internal ridge armed with numerous long tubercles, becoming longer laterally; tubercles and internal ridge covered with scales. Oostegites 2-5 with tubercles on ventral surface in areas not overlapped by other oostegites; tubercles increasing in size proximally, often developed into ridge posterior to respective pereopod; size and area of tubercular coverage increasing on posterior oostegites; oostegite 5 with tubercles over most of ventral surface. Pereopods with basal carina, both increasing in size posteriorly.

Pleon short, width decreasing posteriorly. Uniramous lateral plates on pleomeres 1-6, lengths subequal, with tuberculate margins, dorsal surface without or with few tubercles, ventral surface with numerous tubercles, tubercles most abundant on anteroproximal region and often

developed into ridge. Pleopods 5 biramous pairs, with rami similar in length, width decreasing posteriorly; rami with tubercles on both dorsal and ventral surfaces; with lateral margins having row of tubercles alternatingly directed dorsally and ventrally, with size and number of tubercles decreasing distally; tubercles most apparent on posterior pairs. Pleopods longer than associated lateral plates. Uropods uniramous, similar in appearance to associated sixth pair of lateral plates. Uropods and sixth pair of lateral plates superficially resembling biramous uropods (Figure 1 L,M).

Variation. Frontal lamina development variable, related to size of specimen, larger specimens usually more developed; tubercular development most variable on on barbula, internal ridge of oostegite 1, ventral area of oostegites 2-5, and to lesser degree on pleopods.

Male. Length without posterolateral elongation of pleomere 6 4.7 to 5.9 mm; width across pereomere 4 or 5 1.7 to 2.3 mm; pleon length at midline, excluding posterolateral elongations, 1.6 to 2.0 mm.

Head much narrower than pereomere 1. Eyes indistinct, represented by pair of minute pigment spots, often superficially indistinct. Antennule with 3 segments. Antenna with 5 or 6 segments, more than twice length of antennule. Maxilliped not seen.

Pereon compact without dorsal pigmented areas and lacking midventral tubercles; posterior pereomeres laterally distinct, separated from each other for greater part of width. Pereopods decreasing in length posteriorly, most apparent in dactylus and propodus.

Pleon with 6 pleomeres, with pleomeres separated for most of width, becoming produced laterally on posterior pereomeres; pleomere 1 relatively straight, laterally blunt; posterior pleomeres more elongate and directed more posteriorly. Pleopods vestigial or absent, represented by low mounds mesal to lateral processes of pleomeres when present, larger on anterior pleomeres. Pleomere 6 with posterolateral margins elongate and asymmetrically developed (superficially resembling uropods); uropods absent; anal cone with tubercle on posterodorsal surface.

Variation. Shape and relative elongation of pleomeres variable; posterior processes on pleomere 6 more robust and shorter than illustrated (Figure 2A) in some specimens (i.e., a male from Tabasco, Mexico), but lateral processes on pleomere 5 of most specimens tapered elongate projections like those illustrated in Figure 2A. Posterior pleomeres missing in several specimens, probably from host derived damage. Pleopod development and armature of antennae more pronounced in immature specimens than in adults.

Etymology. The species is named in honor of Robin M. Overstreet in recognition of his many contributions to the field of marine parasitology.

Distribution. *Pseudione overstreeti*, like its callianassid host, appears to be endemic to the Gulf of Mexico. It is presently known from Cape San Blas, Florida to Tabasco, Mexico.

Habitat. In branchial chamber of the beach ghost shrimp, *Callichirus islagrande*. Infected hosts have been collected in the intertidal zone to a depth of approximately two meters.

Remarks. The combination of strongly tuberculate posterior coxal plates and a pair of elongate terminal abdominal appendages formed by the combination of the uniramous uropods and lateral plates of last abdominal somite (sixth pleomere) distinguish the female of *P. overstreeti* from that of other nominal members of the genus *Pseudione*. The male, which lacks uropods and recognizable pleopods, differs from the other described species of the genus by the uniquely elongate, posterolateral margins of its sixth abdominal somite (Fig 2A).

Worldwide, numerous bopyrids are known to infest members of the Callianassidae; however, in the northwestern Atlantic only one other species, *Ione thompsoni* Richardson, 1904, is known. This species was described from *Gilvossius setimanus* (DeKay, 1844) (= *C. atlantica* Rathbun, 1926) collected in New England waters. *Pseudione overstreeti* and *I. thompsoni* belong to different subfamilies and are immediately distinguished by the development of the lateral plates on the pleon of the female. In *I. thompsoni*, the lateral plates are greatly branched and appear branchial in nature, while on *Pseudione overstreeti*, the lateral plates are simple tuberculate processes.

DISCUSSION

Within the Bopyridae, the number and type of appendages or projections on the sixth pleomere of the female have three interpretations: (1) the uropods are biramous (lateral plates absent); (2) the uropods are uniramous with lateral plates present; or (3) the lateral plates are biramous (uropods absent). At least two of these morphological conditions appear to have evolved in female bopyrids.

In the original description of *Pseudione longicauda* Shiino, 1937, a callianassid parasite from Japanese waters, Shiino (1937: 480) described the female as having uropods that are "uniramous on the left..[and] biramous on the right [,] branching at a short distance from the base." His illustration of the right uropod (p.481, Figure 2B) indicated a triramous structure composed of a biramous uropod and a lateral plate. The fifth pair of lateral plates on female of *P. overstreeti* appears to be similar to the unbranched right

uropod of *P. longicauda* as described by Shiino (1937: 480, Figure 1A). Later, Shiino (1958) examined the uropods of two additional adult females of *P. longicauda* and considered the uropods on these specimens to be uniramous. In the same study, however, he reported a juvenile female from the same collection as having a large exopod [lateral plate?] and a rudimentary endopod.

In *P. overstreeti*, the dorsal rami are similar in appearance to lateral plate 5, and the ventral rami are similar in appearance to the rami of pleopod 5. The lateral plates on pleomere 1-5 and the associated pleopodal rami are different in appearance. The pleopodal rami are more elongate than their respective lateral plates. The differences in structure of the pleopods and lateral plates of pleomeres 1-5 are similar to the differences between the dorsal and ventral rami of pleomere 6. Based on these observations, we consider the appendages on the sixth pleomere to represent a pair of lateral plates and a pair of more ventrally located uniramous uropods. The sixth female pleomere of *P. overstreeti* has two pairs of elongate projections, which we consider to be derived from the combination of a pair of uniramous uropods and a pair of lateral plates.

In male bopyrids, "uropods" have two forms. The first is derived from the posterolateral elongations of pleomere 6, and the longer the projections, the more likely they will be considered uropods (see Bourdon, 1968 and Markham, 1982). In the second form, the uropods are described as appendages with distinct proximal constrictions or articulations. In the male of the genera *Entophilus* Richardson, 1903, *Gigantione* Kossman, 1881, *Ionella* Bonnier, 1900, *Parapleurocryptella* Bourdon, 1972, and *Progebiophilus* Codreanu and Codreanu, 1963 (not *P. sinicus* Markham, 1982), the terminal appendages are proximally articulated or constricted. We consider these terminal appendages to be true uropods. Analogous structures arising from the posterolateral margins of the sixth abdominal somite lack any vestiges of a proximal constriction as seen in the male of *P. overstreeti*. These are terminal, lateral processes and not "true" uropods. The previous inexact usage of the term "uropod" for the appendages or processes on the posterior margin of the last pleomere has allowed two different, non-homologous structures to be referred to as the same. This situation causes problems in systematic studies, because within the Bopyridae, the presence of true uropods would be considered a plesiomorphic character and the presence of highly modified lateral processes would be considered an apomorphic character. For bopyrids, we strongly urge that the term "uropods" be reserved for those structures that are distinctly set off from the pleomere by an articulation or the vestige of an articulation.

Ecological notes. As in most other hosts having bopyrid infestations, reproductive activity in *C. islagrande* is suppressed by the presence of *P. overstreeti*. We examined over 100 specimens of *C. islagrande* parasitized with mature pairs of *P. overstreeti*, and all the hosts appeared to be females. These parasitized specimens had greatly reduced ovaries (Figure 3), and no ovigerous specimens were observed. Even when including hosts infested with juvenile or immature female *P. overstreeti*, only a single recognizable subadult male host was found, and it was parasitized by a juvenile female. In this male host, the first major chela was reduced and it appeared to be in transition to a female form. From our limited observations, we are unable to determine whether infestations occurred most commonly on primary females or if many of the hosts are female morphotypes derived from the metamorphosis of juvenile primary males infested with *P. overstreeti*.

We have observed double infestations on several occasions, with a female-male pair of *P. overstreeti* occurring in each host branchial chamber. In some instances, both females on the same host were gravid, but in all cases the females were of similar size and development.

Other symbionts, such as copepods (*Clasidium* sp.) and pinnotherid crabs (*Pinnixa behreae* Manning and Felder, 1989 in Alabama, Mississippi, and Louisiana waters) or *P. chacei* Wass, 1955 (in Mississippi, Alabama, and Florida waters), often co-occurred with hosts infested with *P. overstreeti*.

We also examined several hundred specimens of *Callichirus major* (Say, 1818) from populations co-occurring with those of *C. islagrande* infested with *P. overstreeti*. Although copepods and pinnotherid symbionts were present, we found no bopyrids on *C. major*.

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Figure 3. A, photograph of unparasitized male (left) and female (right) of *Callichirus islagrande*; note orange ovavles seen through exoskeleton of the first two abdominal somites of the female. B, *Pseudione overstreeti*, new species, in right gill chamber of "female" *C. islagrande*.

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