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SHORT COMMUNICATION

First record and range extension of the Jewel Box clam crab *Gemmotheres chamae* (Roberts, 1975) to the Gulf of Mexico, with comments on the systematics of the pinnotherines with a 2-segmented palp on the third maxilliped (Crustacea: Brachyura: Pinnotheridae)

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ABSTRACT

An adult female of the Jewel-Box clam crab *Gemmotheres chamae* (Roberts, 1975) was collected from a shrimp trawl during a biological exploration off Campeche coast, Mexico. This finding represents its first record in the Gulf of Mexico and the second locality for this species along the Atlantic coast of America, the first being from off North Carolina, U.S.A. As an adult, *G. chamae* has a soft, thin carapace, and a subconical protuberance on article 1 of the antennae (with the nephridiopore of the antennal gland), so it is considered to belong to the Pinnotherinae *sensu stricto*. *G. chamae* and *Nannotheres moorei* Manning and Felder, 1996 (Atlantic) are the only members of the American Pinnotherinae *sensu stricto* that have the maxilliped 3 with a 2-segmented palp. The asymmetry of pereiopod 3 is confirmed, as well as that of the pereiopod 4, but the right legs are the longest. All these features are diagnostic for *G. chamae*.

KEYWORDS

Distribution, symbiotic Pinnotheridae, bivalve *Chama*, Western Atlantic, Campeche

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The family Pinnotheridae De Haan, 1833 along the Western Atlantic Ocean comprises a group of symbiotic crabs constituted by 19 genera (Schmitt *et al.*, 1973; Campos, 1996; Ng *et al.*, 2008; 2019; Ahyong, 2018). One of them, *Gemmotheres* Campos, 1996, type species, *G. chamae* (Roberts, 1975), is monotypic and known only from its type locality, off the North Carolina coast, living in symbiosis with the corrugated Jewel Box clam *Chama congregata* Conrad, 1833 (Chamidae Lamarck, 1809). Study of material incidentally collected during a biological exploration in the Gulf of Mexico produced one adult female of *G. chamae* caught off Campeche coast, Mexico, which represents the first record in the Gulf of Mexico and only the second locality for this species along the Atlantic coast of America. The female collected was measured for carapace width (= cw), stored in 70% ethanol and deposited in the Crustacean Collection of the Academic Unit Yucatán (Campus Sisal) of the Universidad Nacional Autónoma de México YUC-CC-255-11-6495. The following abbreviation are used: Museo Marino de Margarita, Isla Margarita, Venezuela (MMM); National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A. (USNM); Naturalis, National Naturhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands (RMNH).

Systematics

Family Pinnotheridae De Haan, 1833

Subfamily Pinnotherinae De Haan, 1833

Gemmotheres Campos, 1996

Gemmotheres chamae (Roberts, 1975)

(Fig. 1)

Material examined. 1 ovigerous female paratype, cw= 5 mm, USNM 139098, off North Carolina, U.S.A., in *Chama congregata;* 1 adult female, cw = 5.6 mm, caught with a shrimp trawl, 20°12'06" N 91° 09'36"W, 06 August 1981, coll. J.L. Hernández-Aguilera, time 12:50h, depth 32.0 m.

Comparative material examined. 1 adult female, *Zaops ostreus* (Say, 1817), same sample locality; 1 adult female, *Dissodactylus mellitae* (Rathbun, 1900), USNM 259647, St. Petersburg, off East Beach, Florida (Gulf of Mexico), U.S.A.; 1 female, holotype, *Parapinnixa bolagnosi* Hernandez-Avila and Campos, 2007, MMM. cr. 0352, Cubagua Is., Venezuela; 1 female holotype, *Tunicotheres moseri* (Rathbun, 1918), USNM 74954, Kingston Harbor, Port Royal, Jamaica, Caribbean Sea.; 1 female holotype, *Calyptraeotheres hernandezi* Hernández-Ávila and Campos, 2006, MMM.cr.03651 to 57, Cubagua Is., Venezuela; 1 male, 1 female, *Ostracotheres tridacnae* (Rüppell, 1830) MNHN-IU-2016-10946 (B10578), Suez, from branchial cavity of *Tridacna* Bruguière, 1797; 1 female, *Discorsotheres spondyli* Nobili 1905, RMNH D22681, 8 miles NNW of Arzana Island, 5 fms [9 m], stn LIV, in *Spondylus*, dredge, coll. J. Bonnier & Ch. Perez, 1901; 1 female, *Austrotheres pregenzeri* Ahyong, 2018 UABC uncat., New South Wales, Australia; *Latatheres* sp., MNHN B.10584, Red Sea.

Diagnosis. Carapace suborbicular, soft, smooth, membranous, widest medially, regions undefined, lacking both sharp anterolateral border and longitudinal depressions (sulci), front deflexed, narrow. Eyes not visible in dorsal view. Antennae with a subconical protuberance on basal article which has nephridiopore of antennal gland. Maxilliped 3 with ischium and merus indistinguishably fused, inner distal angle of merus absent; palp 2-segmented, carpus shorter but wider than styliform propodus. Exopod with incompletely bi-segmented flagellum. Pereiopod (=P) 3–4 (ambulatory legs 2–3) asymmetrical with right legs longer than left ones. Pleon wider than long, 6 somites and telson free.

Right and left ambulatory leg asymmetry. Roberts (1975) recorded the P2–P5 (ambulatory legs 1–4) of *G. chamae* as symmetrical. Campos (1996) pointed out that the left dactylus of P3 was longer than the right one, but the paratype studied by him had the relative lengths of right pereiopods P2 > P4 > P5 > P3, while those of the left pereiopods are P2 >P3 > P4 > P5. We believe the shorter right P3 was abnormal and regenerating, for this reason is atypically small. The present female specimen examined has the P3 and P4 asymmetrical, with the right propodi longer than the left ones, while the dactyli of these legs are subequal. Because of poor preservation and damage, it was not possible to measure some of the female's legs, their relative length remains unknown.

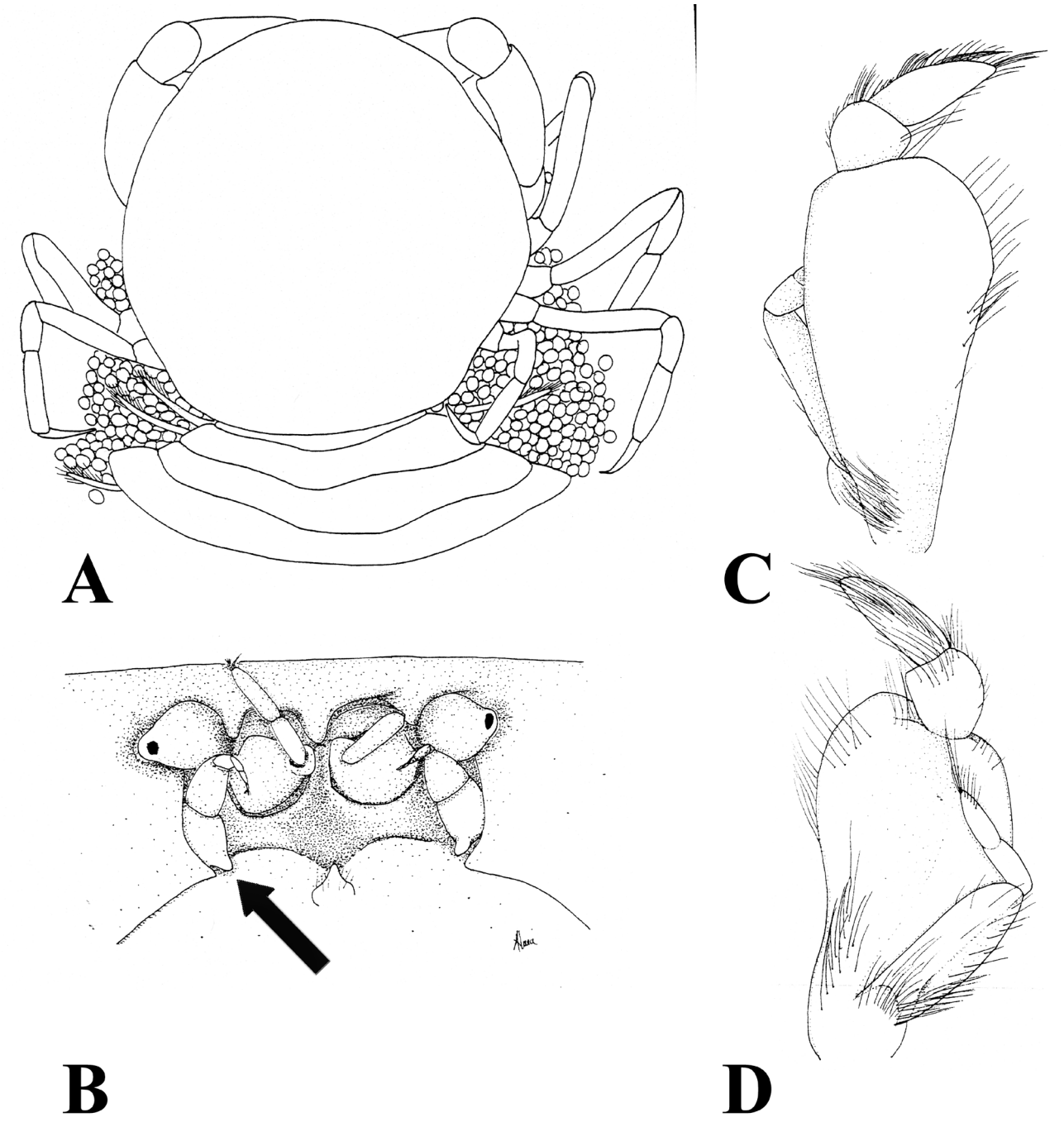

Figure 1. *Gemmotheres chamae* (Roberts, 1975). Ovigerous female. A, dorsal view; B, frontal view; C, D, maxilliped 3, inner and outer face respectively. Arrow indicates a subconical protuberance on article 1 of antennae which has the nephridiopore of the antenna 1 gland (= green gland). Carapace width 5 mm, paratype, USNM 139099 off North Carolina, U.S.A. (after Campos, 1996).

Host. The present female was collected outside its host. However, two Jewel Box clams (family Chamidae) were caught in the same trawl, *Chama congregata* Conrad, 1833 and *Ch. macerophylla* Gmelin, 1791. The former is a known host of *G. chamae* (see Roberts, 1975), while the second species is listed among the multiple hosts of *Tumidotheres maculatus* (Say, 1818) (Schmitt *et al.*, 1973). The known distribution of *Ch. congregata* extends from North Carolina to Texas, USA, Tamaulipas to Yucatán, Mexico, Cuba, Honduras, West Indies, Bermuda and Brazil (García-Cubas and Reguero, 2007; Turgeon *et al.*, 2009; Correa-Sandoval and Rodríguez-Castro, 2013). However, the Brazilian population of *Ch. congregata* may represent a different

species (Campbell *et al.*, 2004). Nevertheless, it is very well possible that the distribution of *G. chamae* may be greater than the two localities registered herein, and the lack of additional records is explained by the absence of collections of *Ch. congregata* subtidally. Because other pinnotherid crabs may infest two or more hosts (Campos, 2016; Hernández *et al.*, 2017), we believe the presence of *G. chamae* in other species of *Chama* would be possible, so we recommend examining additional *Chama* species throughout its range. Other pinnotherid crab species symbiotic with Jewel Box clams include *Bonita mexicana* Campos, 2009 (Pacific, Baja California, México in *Pseudochama exogyra* (Conrad, 1837)) and *Durckheimia caeca* Bürger, 1895 (Palau and Japan, in *Ch. reflexa* Reeve, 1846 [= *Ch. pacifica* Broderip, 1835]) (Ahyong and Ng, 2005; Campos, 2009).

Remarks. Campos (2009) included *Gemmotheres* within the Pinnotherinae *sensu stricto*, the principal synapomorphies of the adult female phase being a soft, thin carapace, and a subconical protuberance on the basal article of the antenna (Fig. 1B). This protuberance is, in fact, an extension of article 1, which has the nephridiopore of the antennal gland (= green gland) (Davie *et al.*, 2015; Ng *et al.*, 2019). Despite the debate regarding this taxonomic proposal (Campos, 2009; Palacios-Theil *et al.*, 2016), the current evidence (morphological and molecular) clearly support the Pinnotherinae *sensu stricto* as a monophyletic clade, distinct from those artificially grouped in the Pinnotherinae *sensu lato* by Rathbun (1918), Schmitt *et al.* (1973), Števčić (2005) Ng *et al.* (2008) and Palacios-Theil *et al.*, (2016). Both *G. chamae* and *Nannotheres moorei* Manning and Felder, 1996 (Atlantic) are the only members of the American Pinnotherinae *sensu stricto* in which the maxilliped 3 has a 2-segmented palp (Campos, 2009). Other American species with a 2-segmented palp include *Calyptraeotheres granti* (Glassell, 1933) (Pacific), *C. hernandezi* Hernández-Ávila and Campos, 2006 (Atlantic), *C. pepeluisi* Campos and Hernández-Ávila, 2010 (Pacific), *C. camposi* Ayón-Parente and Hendrickx, 2014 (Pacific), *Dissodactylus mellitae* (Rathbun, 1900) (Atlantic), *D. glasselli* Rioja, 1944 (Pacific), *Parapinnixa bolagnosi* Hernandez-Ávila and Campos, 2007 (Atlantic) and *Tunicotheres moseri* (Rathbun, 1918) (Atlantic). These genera and species do not fit well in Pinnotherinae *sensu stricto* because the adult phase has the carapace firm instead of thin and soft, and the lack of a subconical protuberance on antennal article 1 as previously discussed by Campos (2009) and Campos and Hernández-Ávila (2010). Notwithstanding, the reduced segmentation of the maxilliped 3 palp from 3-segments (presumably plesiomophic) to 2-segments (presumably apomorphic) has been useful in pinnotherid taxonomy to distinguish genera and species (*e.g.*, Campos, 1990; 1996; Manning, 1993a; 1993b; Ahyong and Ng, 2005; Hernández-Ávila and Campos, 2006; Campos and Hernández-Ávila, 2010; Ahyong, 2018), this feature has otherwise been of little use to recognize phylogenetic lineages within the American Pinnotheridae. The presence of a 2 and 3-segmented palp of the maxilliped 3 within a same genus supports the hypothesis that the loss of the dactylus has occurred independently in different monophyletic groups. Examples of this occur within *Calyptraeotheres* Campos, 1990, *Dissodactylus* Smith, 1870 and *Parapinnixa* Holmes, 1895 which contain species with or without a dactylus on the maxilliped 3. Thus, despite a 2-segmented palp being hypothetically apomorphic among the different genera discussed herein, this trait clearly evolved multiple times and hence is homoplasic among them, having no phylogenetic importance. Contrarily, a 2-segmented palp probably evolved from the same ancestor in some hypothesized sibling species, *e.g.*, *D. mellitae* (Rathbun, 1900) (Atlantic) and *D. glasselli* Rioja, 1944 (Pacific) (Griffith, 1987a; 1987b).

The artificial key below separates the Pinnotheridae of America with a 2-segmented palp of the maxilliped 3. This key includes *Parapinnixa*, a missing genus in the key of Ahyong (2018) who provided accurate information on the non-American genera including *Ostracotheres* H. Milne Edwards, 1853, *Discorsotheres* Ahyong, 2018, *Austrotheres* Ahyong, 2018, and *Latatheres* Ahyong, 2018.

Key to pinnotherid crab genera with 2-segmented palp on maxilliped 3, based on adult females (modified from Campos, 1996).

1. Dactyli of ambulatory legs bifurcated in both male and female ..... *Dissodactylus* Smith, 1870
(West Atlantic [U.S.A. to Brasil]; East Pacific [Mexico to Peru]; type species *Dissodactylus nitidus* Smith, 1870; hosts, Echinodermata-Echinoidea: *Clypeaster, Echiarachnius, Encope, Leodia, Mellita, Plagiobrissus*).

1' Dactyli of ambulatory legs simple, tapering to sharp tip 2

2. First pair of the ambulatory legs robust, longest, others decreasing in size posteriorly .... *Parapinnixa* Holmes, 1895
(West Atlantic [U.S.A. to Brazil]; East Pacific [U.S.A. to Galapagos]; type species *Pinnixa* ? *nitida* Lockington, 1876; hosts, Polychaeta; ? Echinoidea)

2' Second or third pair of ambulatory legs slender, longest 3

3. Maxilliped 3 carpus longer than propodus 4
3' Maxilliped 3 carpus shorter that propodus 5

4. Carapace subpentagonal to subovate with sharp anterolateral margins, dorsally with 2 longitudinal depressions (sulci), sometimes ill-defined .... *Calyptraeotheres* Campos, 1990
(West Atlantic [Venezuela to Argentina] and East Pacific region [Mexico to Chile]; type species *Fabia granti* Glassell, 1933; hosts, Mollusca-Gastropoda: *Acmaea, Bostrycapulus, Calyptraea, Crepidula, Crucibulum, Trochita*)

4' Carapace subcircular, clearly lacking both sharp anterolateral margins and longitudinal depressions (sulci) .... *Nannotheres* Manning and Felder, 1996
(Caribbean Sea region; type species, *N. moorei* Manning and Felder, 1996; host, Mollusca-Bivalvia: *Malleus*)

5. Carapace subpentagonal in shape, firm, uneven, dorsal regions elevated, well defined; eyes visible in dorsal view, front produced, arcuate, medially emarginated, maxilliped 3 with carpus subquadrate, propodus styliform; P5 articulated to cephalothorax dorsal to P4 .... *Tunicotheres* Campos, 1996
(Caribbean Sea region; type species *Pinnotheres moseri* Rathbun, 1918; hosts, Chordata-Ascidiacea: *Ascidia, Molgula, Polycarpa*)

5' Carapace suborbicular in shape, soft, membranous, regions undefined, eyes not visible in dorsal view, front not emarginate; maxilliped 3 with carpus subconical, propodus styliform, P5 articulated to body not dorsal to P4 .... *Gemmotheres* Campos, 1996
(Northwest Atlantic region; type species, *Pinnotheres chamae* Roberts, 1975; host, Mollusca-Bivalvia: *Chama*)

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