

Atyidae and Palaemonidae (Crustacea: Decapoda: Caridea) of Bocas del Toro, Panama

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ABSTRACT: The present contribution is a preliminary report on the freshwater caridean fauna of Bocas del Toro province, northeastern Panama, based on field collections carried out during a Shrimp Taxonomy Workshop at the STRI station in Bocas del Toro in August 2008. A total of eight species from two families, Atyidae and Palaemonidae, were collected at 17 different collection sites in the rivers, streams and ponds on several islands of the Bocas del Toro archipelago and the adjacent mainland. The species reported herein are *Atya scabra* (Leach, 1815), *Jonga serrei* (Bouvier, 1909), *Micratya poeyi* (Guérin-Méneville, 1855), *Potimirim glabra* (Kingsley, 1878), *P. potimirim* (Müller, 1881) (Atyidae), *Palaemon pandaliformis* (Stimpson, 1871), *Macrobrachium acanthurus* (Wiegmann, 1836) and *M. crenulatum* Holthuis, 1950 (Palaemonidae). The record of *J. serrei* is the first for Panama, and *M. poeyi* and *P. glabra* the first for Bocas del Toro province.

INTRODUCTION

The province of Bocas del Toro is located in the northern-most Atlantic region of Panama, near the border with Costa Rica. With an estimated area of 68% covered by tropical rainforest, the area receives 2870 mm/year of mean rainfall (Guzmán *et al.* 2005). Part of this province is an archipelago that comprises seven relatively large islands (total surface area >8 km²) and numerous smaller islands. The largest islands, *e.g.*, Isla Colón (61 km²) and Isla Bastimentos (52 km²), as well as the mainland region of Changuinola, contain various freshwater environments, such as small lakes, ponds, rivers, streams, creeks and flooded caves. Most of the Bocas del Toro province is relatively pristine, but anthropogenic activities, including the expanding urbanization around the towns of Bocas del Toro and Changuinola, as well as tourism-related activities in the archipelago are increasingly taking their toll on the natural environment. In this sense, there is an urgent need for basic data on the aquatic biodiversity of this region.

When considering the Neotropical freshwater shrimp fauna, two caridean families appear to be dominant. The family Atyidae is represented in this region by five genera and 19 species, most of which are found in Central America and the Antillean region, with a few species in northern and eastern South America (Chace and Hobbs 1969; Melo 2003; De Grave *et al.* 2008). The family Palaemonidae is represented by nine genera and 83 species (all in the subfamily Palaemoninae), distributed all over Central and South America and the West Indies (Holthuis 1952; Chace and Hobbs 1969; Melo 2003; De Grave *et al.* 2008).

The freshwater shrimp fauna of Panama is relatively well known from taxonomic and ecological perspectives (Hobbs and Hart 1982; Abele and Kim 1989), but there is a lack of knowledge of the distribution of freshwater shrimps on more regional scales. The aim of the present study is to present results of a brief field survey of freshwater shrimps

in some hydrographic basins of Bocas del Toro, mainly on the islands Colón and Bastimentos and the adjacent mainland, near Changuinola. This survey was carried out as part of the Shrimp Taxonomy Workshop organized by the Smithsonian Tropical Research Institute (STRI) at the STRI Bocas del Toro Research Station in August 2008.

MATERIALS AND METHODS

All specimens were collected in the field using dip nets of various sizes and brought alive to the STRI station for photography, after which they were preserved in 75% or 96% ethanol. All collection sites (Figure 1) were geo-referenced using a GPS. Additional field information on the collection sites is provided in Table 1. Voucher specimens of each species are deposited in the collection of the Oxford University Museum of Natural History, Oxford, the United Kingdom (OUMNH), and in the Crustacean Collection of the Department of Biology of the Faculty of Philosophy, Sciences and Letters of Ribeirão Preto, University of São Paulo (USP-CCDB). The distribution of each species in the Bocas del Toro region is summarized in Table 2. The abbreviation CL stands for carapace length, which was measured in mm along mid-dorsal line from the orbital margin to the posterior margin of the carapace. Juvenile specimens of *Macrobrachium* spp. could not be positively identified to species (without DNA data) and therefore are not discussed further. Taxonomic, ecological and distributional notes are provided for each species. In addition, each species is illustrated in color. Collection permits were issued by Autoridad Nacional del Ambiente of the Republic of Panama, No. SC/A-9-08.

RESULTS AND DISCUSSION

A total of eight species of caridean shrimps were collected at 17 different sites (Figure 1): five species of Atyidae and three species of Palaemonidae.

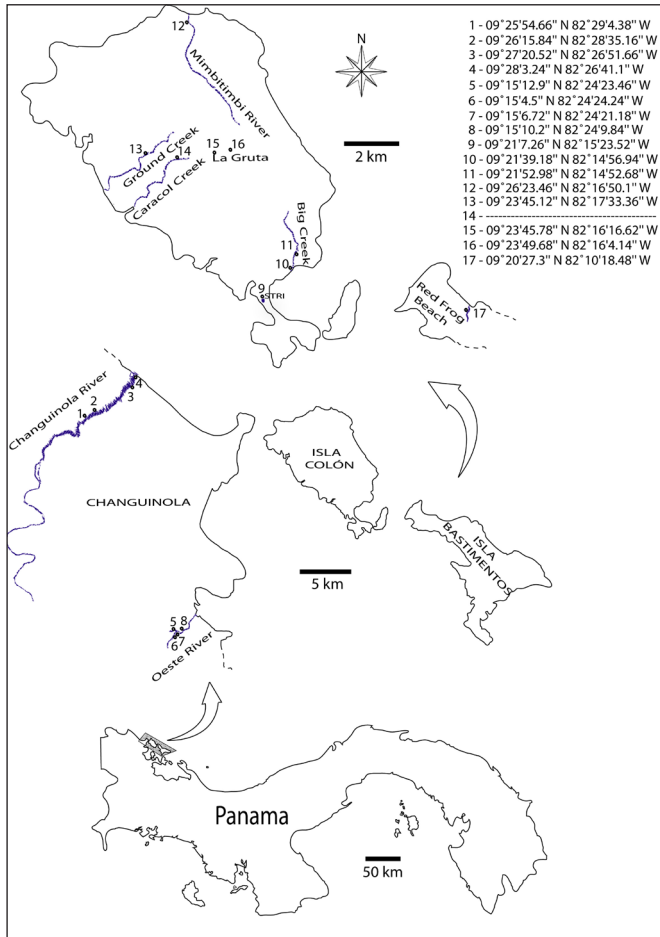


FIGURE 1. Map of Panama, with details of rivers and creeks of Changuinola region, Isla Colón and Isla Bastimentos (Bocas del Toro).

TABLE 1. Brief characterization of freshwater collection sites in Bocas del Toro, Panama. For site locations refer to Figure 1, for species composition at each site refer to Table 2. * Sites under tidal influence.

SITE N°	ADDITIONAL FIELD NOTES
1	Río Changuinola, on submerged grasses and roots of bushes
2	Río Changuinola, on submerged grasses and roots of bushes
3	Río Changuinola, on submerged grasses and roots of bushes
4*	Río Changuinola, near estuary on submerged tree roots, slow flowing water
5	Río Oeste, on submerged tree roots, slow flowing water
6	Río Oeste, on submerged grasses and roots of bushes
7	Río Oeste, on submerged grasses and roots of bushes
8	Río Oeste, on submerged grasses and roots of bushes
9	STRI pond, among floating macrophytes
10*	Big Creek, near the mouth, on submerged grasses and under floating macrophytes, slow flowing water
11	Big Creek, beneath reservoir outflow, on marginal submerged vegetation
12*	Río Mimbitimbi, approximately 50 m inside the river mouth, on submerged tree roots
13	Ground Creek, under a small bridge, on submerged grasses, fast flowing water
14	Caracol Creek, a small stream with rocky bottom
15	La Gruta, a small stream at the main entrance outside the first cave, fast flowing water, rocky bottom
16	La Gruta, same stream as site 15, after crossing the second cave from the entrance of La Gruta
17	Small shallow stream in the rainforest, close to Red Frog Beach, sandy bottom, some rocks and litter

Infraorder Caridea Dana, 1852

Superfamily Atyoidea De Haan, 1849

Family Atyidae De Haan, 1849

Atya scabra (Leach, 1815) (Figure 2)

Material examined: Panama, Bocas del Toro: 1 ♂ (CL 13 mm), 1 ovigerous ♀ (CL 10.7 mm), Isla Colón, Caracol Creek (Site 14), 7 km from Bocas del Drago road “T” junction, 7 km from STRI station on the same road, 14.08.2008, coll. L. Torati, T. Page, CCDB 2401; 1 ovigerous ♀ (CL 8.5 mm); same collection data as for previous specimens, OUMNH.ZC-2008-14-006; 7 ♀ (CL 5.5–6.5 mm), 1 ovigerous ♀ (CL 9.0 mm), Isla Colón, Ground Creek (Site 13), 09°23’45.12” N 82°17’33.36” W, 13.08.2008, coll. L. Torati, J. Jugovic, T. Page, OUMNH.ZC-2008-14-011; 2 ovigerous ♀ (CL 9.0–9.2 mm), 1 ♀ (CL 5.7 mm), Isla Colón, La Gruta (Site 16), 09°23’49.68” N, 82°16’4.14” W, 10.08.2008, coll. L. Torati, C. Tavares, J. Luque, A. Anker, T. Page, OUMNH.ZC-2008-14-12.

Distribution: West Africa; Cape Verde Islands; coastal regions of Mexico; Guatemala; Honduras; West Indies; Panama; Brazil (Chace and Hobbs 1969; Hobbs and Hart 1982). The first record of *A. scabra* from Panama was by Doflein (1900), who reported it from the “Atlantic watershed”; Doflein’s record was followed by several records throughout Panama, including Bocas del Toro

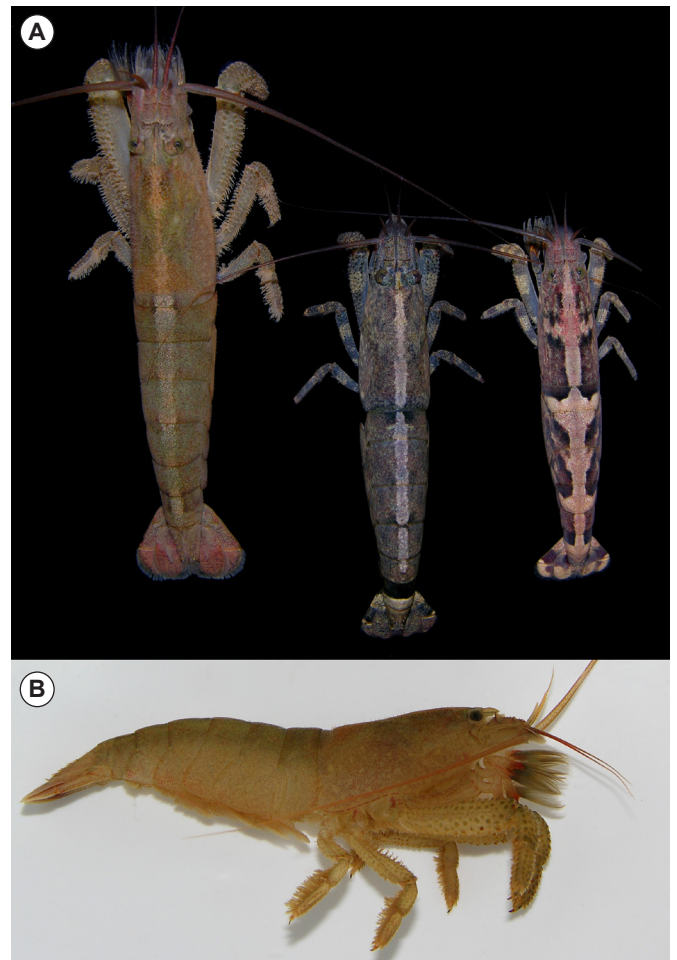


FIGURE 2. *Atya scabra* (Leach, 1815) from Bocas del Toro, Panama: A. Dorsal view of three adult specimens showing variation in color pattern; B. Lateral view of the largest (left) specimen in A.

(Hobbs and Hart 1982) and Panama Canal (Abele and Kim 1989).

Ecology: *Atya scabra* was found together with two other atyids, *Micratya poeyi* (Guérin-Méneville, 1855) and *Potimirim potimirim* (Müller, 1881) at Ground Creek (Site 13). At this site, the specimens were collected under rubble and pebbles in an area of fast-flowing water and also between roots on the margins. *Atya scabra* was found in a different environment at sites 14 and 15 (close to La Gruta), namely in rocky niches of shallow water (about 20 cm deep). Juvenile atyids, later identified by DNA sequencing as *A. scabra* (Page et al., unpublished data), were collected at estuarine sites (Sites 2, 10 and 12), as well as in marine habitats in three locations (off Bocas del Drago, STRI Pier, Playa Bluff). Minute zoeas from a freshwater site (Site 13) were also identified as *A. scabra* (as above).

Color in life: Pale brown, with reddish, yellowish or olive tinge, with or without pale dorsal band running along the mid-dorsal line. A rather significant color pattern variation was observed amongst the sampled material (Figure 2).

Remarks: The Bocas del Toro material of *A. scabra* agrees well with the description and illustrations of Hobbs and Hart (1982).

Jonga serrei (Bouvier, 1909) (Figure 3)

Material examined: Panama, Bocas del Toro: 4 ♂ (CL 2–2.3 mm); 1 ovigerous ♀ (CL 4.9 mm), Río Oeste (Site 6), 09°15'4.5" N 82°24'24.24" W, 12.08.2008, coll. L. Torati, S. De Grave, T. Page, CCDB 2398; 7 specimens (not sexed, CL 2.5–4.2 mm), same collection data as for previous specimens, OUMNH.ZC-2008-14-016; 1 ♂ (CL 2.6 mm); 1 ovigerous ♀ (CL 4.5 mm); Isla Colón, Big Creek (Site 10), 09°21'39.18" N 82°14'56.94" W, 13.08.2008, coll. L. Torati, B. Martínez-Guerrero, J. Jugovic, S. De Grave, T. Page, CCDB 2403; 3 ♂ (CL 2.5–2.5 mm); same collection data as for previous specimens, OUMNH.ZC-2008-14-022; 3 ovigerous ♀ (CL 2.9–3.8 mm), Isla Colón, Río Mimbitimbi (Site 12), 09°26'23.46" N 82°16'50.1" W, 13.08.2008, coll. L. Torati, P. Hernández, J. Jugovic, T. Page, CCDB 2404.

Distribution: Cuba; Jamaica; Puerto Rico; Dominica; Barbados; Costa Rica (Chace and Hobbs 1969); Guadeloupe (Lévêque 1974); Venezuela (Pereira 1991); Tobago (Page et al. 2008); Panama: Bocas del Toro (present study), being the first record for the country.

Ecology: *Jonga serrei* was found inhabiting the Changuinola area at Río Oeste (sites 5, 6 and 8) and also in two rivers on Isla Colón (sites 10 and 12), all sites with slow-flowing water. At site 10, *J. serrei* was found at the mouth of the river, approximately 15 m from the open sea. At the mouth of Río Mimbitimbi (site 12), *J. serrei* was found living together with *P. potimirim*, in slack-water environments, adhering to submerged ramified roots of marginal trees and plants. The species occurred in a similar microhabitat pattern at sites 5 and 6 of Río Oeste. Site 8 was different by the abundance of grasses at the water margin, offering a shelter for *J. serrei*.

Color in life: Dorsolateral surface of the carapace and abdominal flanks dark brown-red; ventrolateral part of the carapace olive-green; pale longitudinal stripe running from the rostral tip to the proximal third of the telson; pereopods and antennal scaphocerite transparent, with

several rounded, reddish spots (Figure 3).

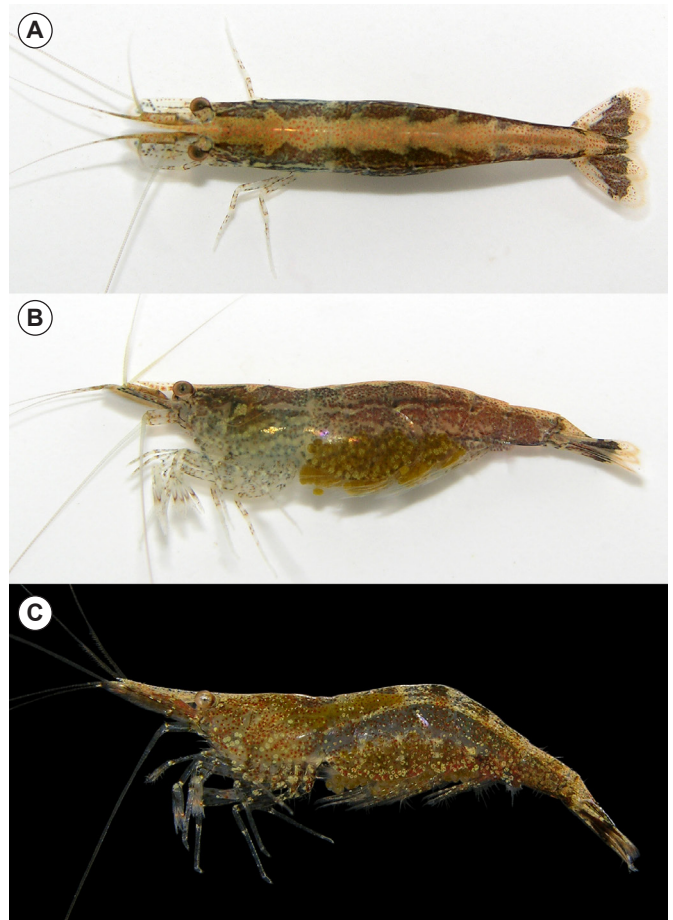


FIGURE 3. *Jonga serrei* (Bouvier, 1909) from Bocas del Toro, Panama: A. Dorsal view of an ovigerous female; B. Lateral view of the same female as in A. C. Lateral view of a different female on black background.

Micratya poeyi (Guérin-Méneville, 1855) (Figure 4)

Material examined: Panama, Bocas del Toro: 1 ♂ (CL 3.2 mm), Isla Colón, Ground Creek (Site 13), 09°23'45.12" N 82°17'33.36" W, 13.08.2008, coll. L. Torati, J. Jugovic, T. Page, CCDB 2397; 1 ovigerous ♀ (CL 4.2 mm), same collection data as for previous specimen, OUMNH.ZC-2008-14-015; 1 ovigerous ♀ (CL 5.2 mm), same collection data as for previous specimen, OUMNH.ZC-2008-14-023.

Distribution: Costa Rica; Cuba; Jamaica; Puerto Rico; Dominica; Martinique (Chace and Hobbs 1969); Barbados; Grenada; Curaçao (Debrot 2003); Venezuela (Pereira and García 1995); Guadeloupe (Fièvet 2000); Trinidad (Page et al. 2008); Panama: Barro Colorado Island, Atlantic drainage streams (Abele and Kim 1989), Bocas del Toro (present study).

Ecology: This species was found at Isla Colón (Ground Creek, site 13), in coexistence with two other atyids, *Atya scabra* and *Potimirim potimirim*, and the palaemonid *Macrobrachium acanthurus* (Wiegmann, 1836). It was collected under small rocks in an area with relatively strong water flow or among marginal vegetation.

Color in life: Body background blackish to chocolate-brown with small yellow-greenish spots; carapace flanks with conspicuous band of whitish color speckled with reddish chromatophores; abdomen usually with a similar large whitish band on the fourth pleuron and a smaller whitish band on the sixth pleuron; distal part of telson and uropods conspicuously white; walking legs with

white patches; abdominal bands may be inconspicuous or absent in some individuals (Figure 4); this color pattern types corresponds to one of three color types reported and illustrated by Chace and Hobbs (1969, fig. 12).

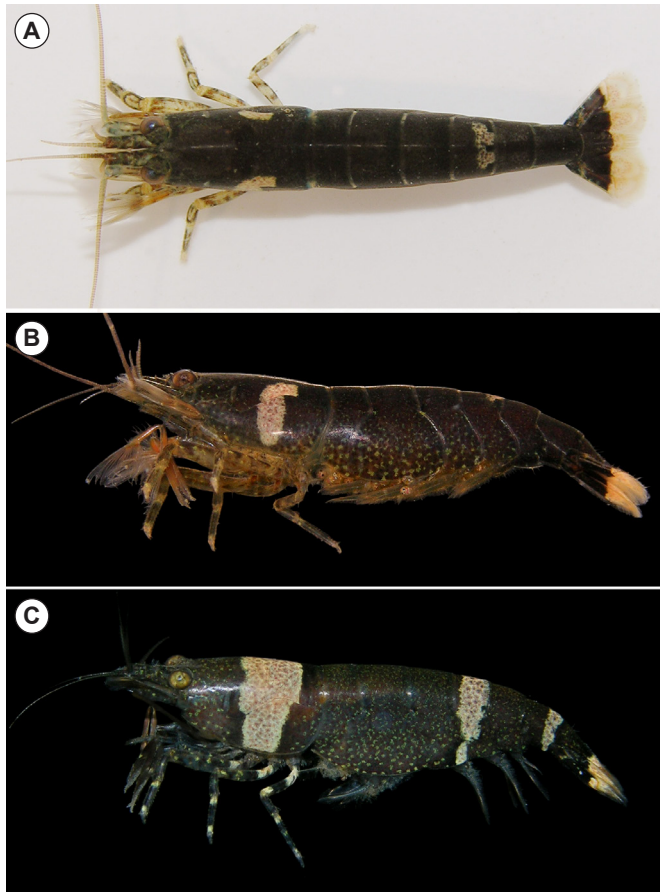


FIGURE 4. *Micratya poeyi* (Guérin-Méneville, 1855) from Bocas del Toro, Panama: A. Dorsal view of an ovigerous female; B. Lateral view of the same female as in A, showing white lateral band on the carapace only; C. Lateral view of a different female, with white bands on the carapace and fourth and sixth pleura.

Potimirim glabra (Kingsley, 1878) (Figures 5 and 6)

Material examined: Panama, Bocas del Toro: 7 ♂ (CL 3.4–3.7 mm); 1 ♀ (CL 4.2 mm); 1 ovigerous ♀ (CL 4.8 mm), Isla Colón, La Gruta, freshwater stream near small cave (Site 16); 09°23'49.68" N 82°16'4.14" W, 10.08.2008, coll. L. Torati, C. Tavares, J. Luque, A. Anker, T. Page, CCDB 2400; 1 ovigerous ♀ (CL 5.6 mm), same collection data as for previous specimen, OUMNH.ZC-2008-14.014; 2 ♀ (CL 2.7–3.6 mm), 3 ♂ (CL 2.4–3.2 mm), Isla Bastimentos, Red Frog Beach (Site 17), 09°20'27.3" N 82°10'18.48" W, 14.08.2008, coll. A. Anker, S. De Grave, T. Page, OUMNH.ZC-2008-14-008.

Distribution: El Salvador; Nicaragua; Costa Rica; Trinidad; Tobago (Chace 1972); Dominica (Chace and Hobbs 1969); Guadeloupe (Lévêque 1974); Panama: Barro Colorado (Abele and Kim 1989) and Bocas del Toro (present study); Brazil: Rio de Janeiro to Santa Catarina (Melo 2003).

Ecology: This species was found only in a small stream near La Gruta cave on Isla Colón (site 16), where specimens were collected adhering to submerged ramified roots of marginal bushes and inside a small pool formed on the rocky bottom of the creek, in a region of slow water flow.

Color in life: Extremely variable, often pale to brownish, sometimes with greenish or bluish tinges, usually with pale fishbone-like dorsal pattern (Figures 5 and 6).

Potimirim potimirim (Müller, 1881) (Figure 7)

Material examined: Panama, Bocas del Toro: 1 ♂ (CL 2.7 mm); 4 ovigerous ♀ (CL 3.7–4.6 mm), Isla Colón, Big Creek (Site 11); 09°21'52.98" N 82°14'52.68" W, 12.08.2008, coll. L. Torati, B. Martínez-Guerrero, J. Jugovic, S. De Grave, T. Page; CCDB 2399; 5 ♂ (CL 2.1–2.7 mm); 3 ♀ (CL 3.1–4.5 mm); 7 ovigerous ♀ (CL 3.5–4.4 mm), Isla Colón, Ground Creek (Site 13), 09°23'45.12" N 82°17'33.36" W, 13.08.2008, coll. L. Torati, J. Jugovic, T. Page; CCDB 2402; 2 ♂ (CL 2.1–2.5 mm), same collection



FIGURE 5. *Potimirim glabra* (Kingsley, 1878) from Bocas del Toro, Panama: A. B. Dorsal view of two ovigerous females on different backgrounds; C. D. Lateral view of the same ovigerous female as in B, on different backgrounds.



FIGURE 6. *Potimirim glabra* (Kingsley, 1878) from Bocas del Toro, Panama: Variation in the color pattern.

data as for previous specimen, OUMNH.ZC-2008-14-009; 7 specimens (not sexed, CL 2.2–4.5 mm), Isla Colón, Big Creek (Site 10), 09°21'39.18" N 82°14'56.94" W, 13.08.2008, coll. L. Torati, B. Martínez-Guerrero, J. Jugovic, S. De Grave, T. Page, OUMNH.ZC.2008-14-24.

Distribution: Puerto Rico (Rathbun 1901); Guadeloupe (Lévêque 1974); Venezuela (Pereira 1991); Trinidad; Panama: Bocas del Toro (Page *et al.* 2008; present study); Brazil: Pernambuco to Santa Catarina (Melo 2003); introduced to Florida, USA (Abele 1972).

Ecology: *Potimirim potimirim* appears to be the most common atyid species in Bocas del Toro. It was found sympatrically with *Atya scabra*, *Micratya poeyi* and *Macrobrachium acanthurus* at site 13 and with *Jonga serrei* at site 12 (see Table 2). This species was also found in Río Guarumo (Cabbage Creek), about 16 km from Chiriquí Grande (Page *et al.* 2008).

Color in life: Variable, apparently related to age and sex; one of the previously unreported color variations is a light blue with translucent pleural areas, with dark blue small spots all over the body and a longitudinal white to yellow mid-dorsal stripe, running from the rostrum to the end of the sixth pleura and broadening at pleural junctions; a transversal white to yellow stripe may be present distally on the tail fan (Figure 7).



FIGURE 7. *Potimirim potimirim* (Müller, 1881) from Bocas del Toro, Panama: A. Dorsal view of adult female, bluish color pattern; B. Lateral view of the same female.

Superfamily Palaemonoidea Rafinesque, 1815

Family Palaemonidae Rafinesque, 1815

Macrobrachium acanthurus (Wiegmann, 1836) (Figure 8)

Material examined: Panama, Bocas del Toro: 3 ♂ (CL 25–35 mm), 1 ♀ (CL 20 mm), Isla Colón, STRI pond (in front of laboratory) (Site 9), 09°21'7.26" N 82°15'23.52" W, August 2008, coll. C. Ashelby, S. De Grave, OUMNH.ZC-2008-14-002.

Distribution: Southeastern USA: North Carolina, Georgia, Florida, Mississippi, Louisiana, Texas; Mexico; Cuba; Hispaniola; Puerto Rico; Nicaragua; Panama; Colombia; Venezuela; Suriname; Brazil: Pará to Rio Grande do Sul (Holthuis 1952; Ramos-Porto and Coelho 1998; Melo 2003); the first record from Panama is probably that of Rathbun (1919).

Ecology: *Macrobrachium acanthurus* is widespread in Bocas del Toro Province: it was found in Changuinola Canal and Río Oeste on the mainland, in Ground Creek (site 13), together with four other species (see Table 2) and also in the STRI station pond.

Color in life: Brown or dark brown with even darker dorsolateral longitudinal stripes on the carapace (Figure 8).

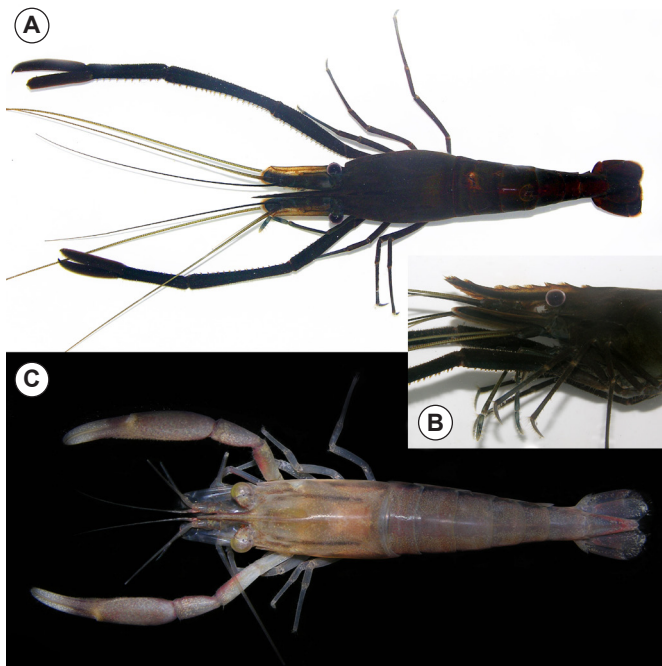


FIGURE 8. *Macrobrachium acanthurus* (Wiegmann, 1836) from Bocas del Toro, Panama: A. Dorsal view of large adult male; B. Lateral view of the anterior cephalothorax of the male in A; C. Dorsal view of a smaller male specimen.

Macrobrachium crenulatum Holthuis, 1950 (Figure 9)

Material examined: Panama, Bocas del Toro: 2 ♂ (CL 8.4 mm), Isla Bastimentos, Red Frog Beach (Site 17), 09°20'27.3" N 82°10'18.48" W, 14.08.2008, coll. A. Anker, S. De Grave, T. Page, OUMNH.ZC-2008-14-001; 2 ♂ (CL 7.2 mm), Isla Colón, Ground Creek (Site 13), 09°23'45.12" N 82°17'33.36" W, 13.08.2008, coll. L. Torati, J. Jugovic, T. Page, OUMNH.ZC-2008-14-003; 1 ♂ (CL 6.3 mm), Isla Colón, Caracol Creek, 7 km from Bocas del Drago road "T"

junction, 7 km from STRI station on the same road (Site 14), 14.08.2008, coll. L. Torati, T. Page; OUMNH.ZC-2008-14-004.

Distribution: Panama; Colombia; Venezuela; Jamaica; Hispaniola; Guadeloupe; Saint-Croix Island; Dominica; Grenada; Trinidad (Holthuis 1952; Chace and Hobbs 1969; Valencia and Campos 2007); previously recorded from Bocas del Toro province from Río Peje Bobo (Chace and Hobbs 1969) and now from Isla Colón (present study).

Ecology: *Macrobrachium crenulatum* was found together with several other species at Ground Creek (site 13), which seems to be the most species-rich collection site in Bocas del Toro (see Table 2). Most specimens were found among aquatic vegetation.

Color in life: Body olive-brown to reddish brown, with irregular speckling; chelipeds darker, especially distally, with blackish spine tips; chromatophore-free areas may be present on some abdominal somites, especially in larger individuals (Figure 9).

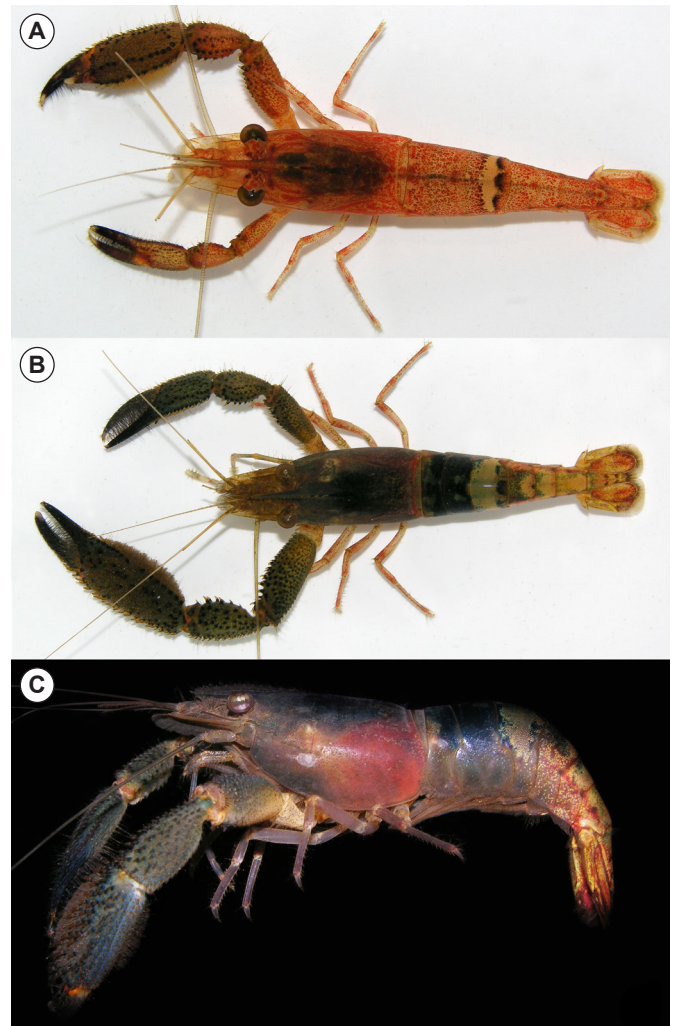


FIGURE 9. *Macrobrachium crenulatum* Holthuis, 1950 from Bocas del Toro, Panama: A. Dorsal view of a medium-size male; B. Dorsal view of a large male; C. Lateral view of the male in B.

Palaemon pandaliformis (Stimpson, 1871) (Figure 10)

Material examined: Panama, Bocas del Toro: 1 ♂ (CL 4.6 mm), 2 ♀ (CL 4.2–4.5 mm), Río Oeste (Site 6), 09°15'4.5" N 82°24'24.24" W, 12.08.2008, coll. L. Torati, S. De Grave, T. Page, OUMNH.ZC.2008-14-020; 31 specimens

(both sexes, CL 3.1–5.5 mm), same collection data as for previous specimens, OUMNH.ZC-2008-14-017-021; 12 specimens (both sexes, CL 4.0–5.5 mm), Río Oeste (Site 7), 09°15'6.72" N 82°24'21.18" W; 12.08.2008, coll. L. Torati, S. De Grave, T. Page; OUMNH.ZC-2008-14-018.

Distribution: Cuba; Puerto Rico; Barbados; Trinidad; Guatemala through Panama, south to Brazil: Rio Grande do Norte to Rio Grande do Sul (Holthuis 1952; Melo

2003).

Ecology: *Palaemon pandaliformis* was found at two sites on Río Oeste, associated with overhanging vegetation, often together with *Jonga serrei* (see Table 2).

Color in life: Mostly transparent, with some scattered reddish chromatophores forming diffuse intense bands, more conspicuous on the carapace, eyestalks and sternum; freshly laid eggs pale olive-green (Figure 10).



FIGURE 10. *Palaemon pandaliformis* (Stimpson, 1871) from Bocas del Toro, Panama: A. B. Lateral view of an ovigerous female on different backgrounds; C. Dorsal view of the same ovigerous female.

TABLE 2. Occurrence of species of Atyidae and Palaemonidae at 17 sampling sites in Bocas del Toro province, Panama. For site locations and descriptions refer to Figure 1 and Table 1, respectively. No specimens were collected at sampling locations 1, 2 and 4.

SPECIES	SITES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
ATYIDAE																			
<i>Atya scabra</i> (Leach, 1815)														X	X	X	X		
<i>Jonga serrei</i> (Bouvier, 1909)						X	X	X		X			X						
<i>Micratya poeyi</i> (Guérin-Méneville, 1855)														X					
<i>Potimirim potimirim</i> (Müller, 1881)							X				X	X	X	X					
<i>P. glabra</i> (Kingsley, 1878)																	X	X	
PALAEMONIDAE																			
<i>Macrobrachium acanthurus</i> (Wiegmann, 1836)			X			X			X	X			X	X					X
<i>M. crenulatum</i> Holthuis, 1950														X	X	X			X
<i>Palaemon pandaliformis</i> (Stimpson, 1871)						X	X	X	X										

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