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Estuarine caridean shrimps (Crustacea: Decapoda) from Ilhéus, Bahia, Brazil: Updated checklist and a key for their identification

Alexandre Oliveira Almeida*, Ana Carla Costa-Souza, Andressa Maria Cunha, Patricia Souza Santos, Mário Vitor Oliveira and Guidomar Oliveira Soledade

Universidade Estadual de Santa Cruz, Departamento de Ciências Biológicas. Rodovia Jorge Amado, km 16. 45662-900. Ilhéus, Bahia, BA, Brazil.
* Corresponding author. E-mail: *aalmeida@uesc.br*

Abstract: We provide an updated list of the 22 species of caridean shrimps occurring in estuaries at Ilhéus, state of Bahia, Brazil, in the following families: Palaemonidae (4 species), Alpheidae (15 species), Hippolytidae (2 species) and Ogyrididae (1 species). The alpheid *Automate* cf. *dolichognatha* De Man, 1888 and the ogyridid *Ogyrides alphaerostris* (Kingsley, 1880) are reported from Bahia for the first time. The alpheids *Alpheus brasileiro* Anker, 2012, *A. buckupi* Almeida, Terossi, Araújo-Silva and Mantelatto, 2013, *A. chacei* Carvacho, 1979, *A. nuttingi* (Schmitt, 1924), *Leptalpheus axianassae* Dworschak and Coelho, 1999 and *Salmoneus carvachoi* Anker, 2007 are recorded from Ilhéus for the first time. *Alpheus angulosus* McClure, 2002 and *A. carlae* Anker, 2012 were previously reported from Ilhéus as *A. armillatus* (H. Milne Edwards, 1837). A key for identification of the carideans from estuaries of Ilhéus is provided.

Introduction

With almost 3500 species described so far, caridean shrimps are the second most diverse decapod infraorder and the most diverse group among the shrimp-like decapods (De Grave and Fransen 2011). Caridean shrimps are also remarkable for their ecological diversity, occurring from tropical to polar regions, in intertidal, subtidal and pelagic habitats, on hard and soft bottoms as epi- or infaunal organisms, on algae and seagrass, or in symbiosis with other animals (Bauer 2004). They have also successfully colonized diverse freshwater environments (De Grave *et al*. 2008), as well as estuaries and mangroves (*e.g*., Carvacho 1979; Echeverría-Sáez 2003; Neves *et al*. 2007). Similarly to other decapods, caridean shrimps are permanent inhabitants of estuaries or use them as nursery grounds. As abundant members of the benthic communities in this type of environment, they are also an important link in aquatic food webs (Hooks *et al*. 1976; Gore *et al*. 1981; Eggleston *et al*. 1998; Neves *et al*. 2007).

Almeida *et al*. (2006), based on a survey conducted between 2003 and 2005, reported 51 species of decapod crustaceans in the estuaries of Ilhéus, state of Bahia, Brazil, of which 12 were caridean shrimps, belonging to three families (Palaemonidae, Alpheidae, and Hippolytidae). New samples were taken in 2011 and 2012, resulting in several new records for the study area. In Brazil, the caridean shrimps are less studied than other crustaceans such as members of the infraorders Brachyura and Anomura. This is due, in part, to the complicated taxonomy of certain groups, the lack of taxonomic revisions, and the absence of comprehensive keys for identification of Brazilian species. This contribution provides an updated list of estuarine caridean shrimps from Ilhéus. We also provide a key for identification of the species in the area.

Materials and Methods

Study area

The Municipality of Ilhéus, located on the southeastern coast of the state of Bahia (Figure 1), northeastern Brazil, covers an area of 1,712 km^2. Its coastline is about 80 km long, is limited to the north by the Sargi River (14°30'06.7"S, 39°02'29.4"W) and to the south by the Acuípe River (15°05'41"S, 38°59'50"W), and includes several estuaries (Andrade 2003; Almeida *et al*. 2006). The Cachoeira River is the main river of Ilhéus, and together with the Santana and Fundão rivers forms a large estuary in the Ilhéus urban area. The Cachoeira River basin receives inputs from domestic and industrial effluents from Ilhéus and Itabuna, the major urban centers of the region, as well as heavy metals from fungicides used on cacao plantations (Klumpp *et al*. 2002; Lima *et al*. 2010).

Sampling Methods

The material examined was obtained mainly from February 2003 to February 2005 and in 2011 and 2012. The collection methods used from 2003 through 2005 were described by Almeida *et al*. (2006). In 2011 and 2012 the sampling was qualitative, with no standardization effort or predetermined frequency, and covered intertidal and shallow subtidal zones. Field activities were concentrated in the basins of the Cachoeira, Santana and Acuípe rivers. The caridean shrimps were sought in estuarine microhabitats such as burrows in fine sand and mud, on decomposing leaves and branches, on the roots and trunks of mangrove trees, under rocks or other hard substrates including oyster shells, and in association with algae and other invertebrates. The epibenthic shrimp were collected by hand or small hand nets in the intertidal or with hand nets in the shallow subtidal zone. We used a suction pump made of PVC pipe 50 mm in diameter to capture infaunal

species from mud and fine-sand bottoms. The sediment obtained with the pump was sieved to reveal the small-sized infaunal shrimp. Salinity, measured using a portable refractometer, ranged from 1 to 32.5 in this study. However, it may reach at least 36.5 at the mouth of the Cachoeira River (A.O. Almeida, pers. obs.). The collections conducted in this study complied with current applicable state and federal laws of Brazil (permanent license for collection of Zoological Material No. 24408-1 MMA/IBAMA/SISBIO for AOA).

The specimens were anesthetized on ice, fixed in 70% ethanol, and all but the specimens of *Alpheus brasileiro* Anker, 2012 (specimen not collected, identified by means of the color pattern according to Anker 2012, p. 79, fig. 55, and p. 80, fig. 56) were deposited in the collection of crustaceans of the Universidade Estadual de Santa Cruz (UESC), Ilhéus. The classification adopted follows the proposal by De Grave and Fransen (2011). For complete synonymies of the taxa, also refer to De Grave and Fransen (2011). The order of species within families is alphabetical. The key for identification was developed taking as a starting point an adaptation of the keys proposed by Chace (1972) and Holthuis (1993). Additional distinctive characters were obtained by examining the material and in the original description of the taxa. Abbreviations used: (f) female, (m) male, (nov) non-ovigerous specimen, (ovf) ovigerous female.

Results

Infraorder Caridea Dana, 1852
Superfamily Palaemonoidea Rafinesque, 1815
Family Palaemonidae Rafinesque, 1815
Leander paulensis Ortmann, 1897

Material examined: See material reported by Almeida *et al*. (2006).

Distribution: Western Atlantic – Florida, West Indies, and Brazil (Maranhão to São Paulo) (Ramos-Porto 1986). Previous records from Ilhéus: estuaries: Almeida *et al.* (2006; 2012); marine environment: Almeida *et al.* (2007a).

Macrobrachium acanthurus (Wiegmann, 1836)

Material examined: 1 m, 10 f (1 ovf), Santana River near Povoado do Rio de Engenho (14°51'09.3"S, 39°03'50.5"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 19.IV.2011 (UESC 1547); 5 m, Cachoeira River, Banco da Vitória, coll. F. Flores-Lopes, 2011 (UESC 1553). See also material reported by Almeida *et al*. (2006).

Distribution: North Carolina to Texas, Mexico, Cuba, Haiti, Dominican Republic, Puerto Rico, Nicaragua, Panama, Colombia, Venezuela, Suriname and Brazil (Pará to Rio Grande do Sul) (Melo 2003).

Previous records from Ilhéus: estuaries: Almeida *et al.* (2006, 2012); freshwater: Almeida *et al*. (2008) and Ferreira *et al*. (2010).

Palaemon northropi (Rankin, 1898)

Material examined: 6 m, 8 f, Cachoeira River, Banco da Sapetinga, confluence of Fundão and Cachoeira rivers (14°48'36.0"S, 39°02'38.9"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 19.IV.2011, salinity 2 (UESC

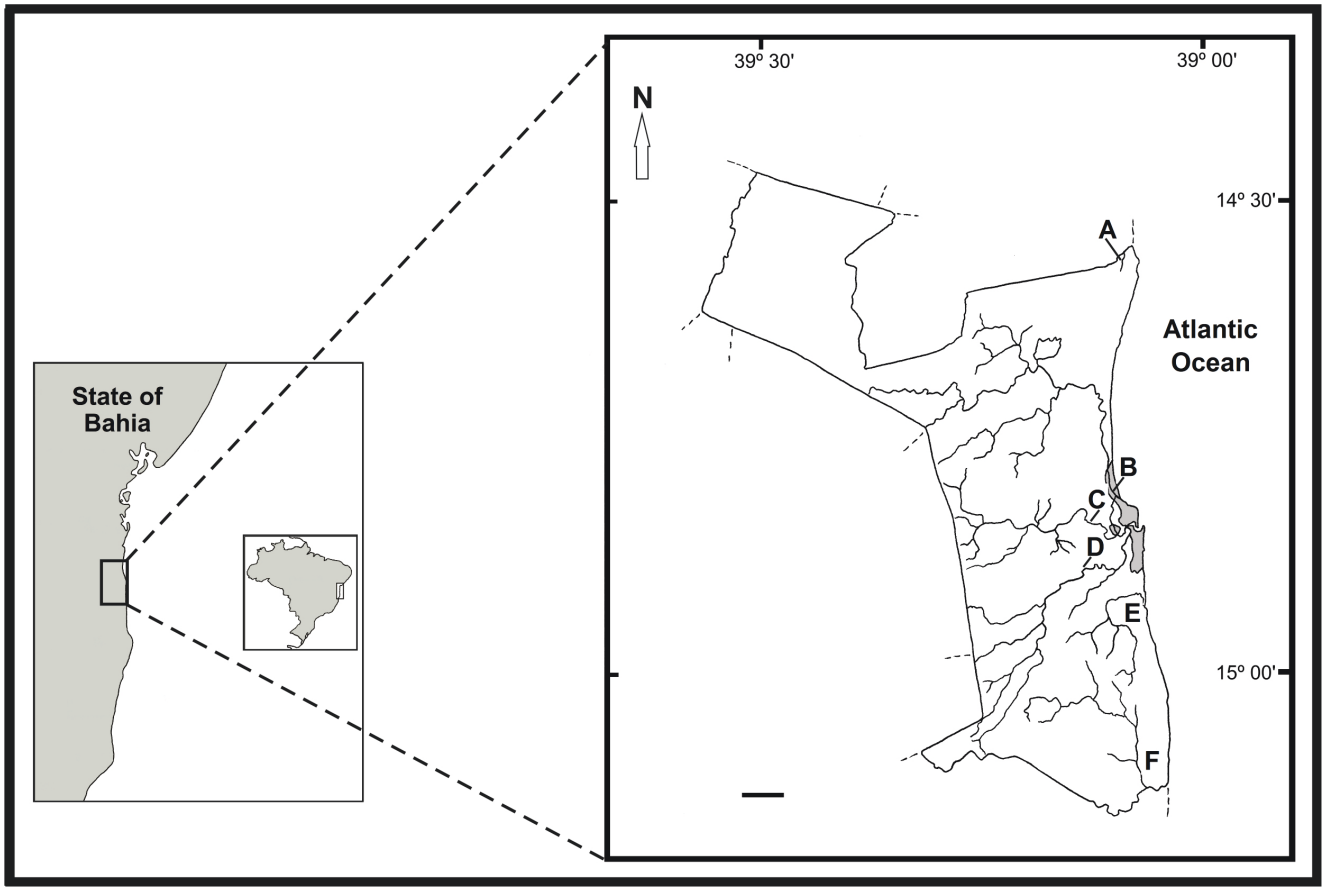

Figure 1. Main estuaries at Ilhéus, state of Bahia, Brazil. Gray area corresponds to Ilhéus urban area. (A) Sargi River, (B) Almada River, (C) Cachoeira River, (D) Santana River, (E) Cururupe River, (F) Acuípe River. Scale bar: 5 km.

1540); 1 f, Acuípe River (15°04'59.9"S, 38°59'55.9"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 23.VII.2009, on leaves on fine sand (UESC 1557). See also material reported by Almeida *et al*. (2006).

Distribution: Western Atlantic – Bermuda, West Indies, Central America, northern South America, Brazil (Ceará to Santa Catarina) and Uruguay (Ramos-Porto and Coelho 1990).

Previous records from Ilhéus: estuaries: Almeida *et al.* (2006) [as *Palaemon* (*Palaeander*) *northropi*]; marine environment: Almeida *et al.* (2012) (as *P. northropi*).

Palaemon pandaliformis (Stimpson, 1871)

Material examined: 1 f, Santana River, Fazenda Leoa (14°50'36.0"S, 39°02'46.7"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 19.IV.2011, salinity 1 (UESC 1546); 1 m, 6 f, Acuípe River (15°04'59.9"S, 38°59'55.9"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 23.VII.2009, on leaves on sand-mud bottom (UESC 1555). See also material reported by Almeida *et al*. (2006).

Distribution: Cuba, Puerto Rico, Barbados, Trinidad and Tobago, Guatemala, Nicaragua, Panama, Venezuela and Brazil (Rio Grande do Norte, and from Sergipe to Rio Grande do Sul, including Minas Gerais) (Melo 2003).

Previous records from Ilhéus: estuaries: Almeida *et al.* [2006, as *Palaemon* (*Palaemon*) *pandaliformis*; 2012, as *P. pandaliformis*]; freshwater: Almeida *et al.* (2008) [as *Palaemon* (*Palaemon*) *pandaliformis*].

Superfamily Alpheoidea Rafinesque, 1815
Family Alpheidae Rafinesque, 1815
Alpheus sp.

Material examined: See material reported by Almeida *et al*. (2006, as *A. heterochaelis* Say, 1818).

Previous records from Ilhéus: estuaries: Almeida *et al.* (2006, 2012, as *A. heterochaelis*).

Remarks: The material reported from Ilhéus in previous studies by Almeida *et al.* (2006, 2012) as *A. heterochaelis* is now recognized as a new species of *Alpheus* Fabricius, 1798, currently in process of description by the first author.

Alpheus angulosus McClure, 2002

Material examined: 7 m, 7 f, Cachoeira River, Maramata Beach (14°48'28.7"S, 39°01'33.3"W), coll. A.O. Almeida, A.M. Cunha, G.O. Soledade, M.V. Oliveira and P.S. Santos, 15.VII.2011, salinity 32.5, under rocks (UESC 1564); 1 m, Cachoeira River, Maramata Beach (14°48'28.7"S, 39°01'33.3"W), 23.III.2011, under rocks (UESC 1525).

Distribution: Western Atlantic - North Carolina to Florida, Gulf of Mexico, Caribbean Sea, French Guiana, and Brazil (Atol das Rocas, Fernando de Noronha, Ceará, Paraíba, Bahia, Rio de Janeiro, São Paulo, Santa Catarina, and Rio Grande do Sul) (Anker 2012).

Previous records from Ilhéus: estuaries: Almeida *et al*. (2013).

Alpheus bouvieri A. Milne-Edwards, 1878

Material examined: 8 m, 12 f, Cachoeira River, Maramata Beach (14°48'28.7"S, 39°01'33.3"W), coll. A.O. Almeida, A.M. Cunha, G.O. Soledade, M.V. Oliveira and P.S. Santos, 23.III.2011, salinity 7.5 (UESC 1558). See also material reported by Almeida *et al*. (2006).

Distribution: Western Atlantic – Bermuda, Florida, West Indies, Panama, and Brazil (Atol das Rocas, Fernando de Noronha, and Ceará to Rio Grande do Sul). Central Atlantic - Ascension Island. Eastern Atlantic - Cape Verde, Senegal to Gulf of Guinea and Congo (Crosnier and Forest 1966; Christoffersen 1979, 1998; Manning and Chace 1990; Anker *et al*. 2009).

Previous records from Ilhéus: estuaries: Almeida *et al.* (2006; 2012).

Alpheus brasileiro Anker, 2012

Material examined: 1 ovf, not deposited, Cachoeira River, Av. Lomanto Jr. (14°48'31.1"S, 39°02'08.3"W), under rocks, 2012, recognized by color pattern (see Material and Methods section).

Distribution: Western Atlantic - Brazil (Pará, Ceará, Rio Grande do Norte, Alagoas, Bahia, Rio de Janeiro, São Paulo, and Santa Catarina) (Anker 2012).

Previous records from Ilhéus: none.

Alpheus buckupi Almeida, Terossi, Araújo-Silva and Mantelatto, 2013

Material examined: 2 m, Cachoeira River, Maramata Beach (14°48'28.7"S, 39°01'33.3"W), coll. A.O. Almeida, A.M. Cunha, G.O. Soledade, M.V. Oliveira and P.S. Santos, 23.III.2011, salinity 7.5, under rocks (UESC 1559).

Distribution: Western Atlantic – Venezuela (Orinoco Delta) and Brazil (Ceará, Rio Grande do Norte, Pernambuco, Alagoas, Bahia and São Paulo). Eastern Atlantic – São Tomé and Príncipe (Almeida *et al.* 2013).

Previous records from Ilhéus: none.

Alpheus carlae Anker, 2012

Material examined: 2 m, 4 f, mouth of Almada River, Station 2 (14°46'27.2"S, 39°03'14.8"W), coll. A.O. Almeida and J.T.A. Santos, 22.II.2005 (UESC 551); 1 m, 3 f, Cachoeira River, Station 8, Pontal, trawl (14°48'10"S, 39°02'12.3"W), coll. A.O. Almeida, J.T.A. Santos and J.R. Luz, 22.II.2005 (UESC 598); 1 f, Cachoeira River, Av. Lomanto Jr. (14°48'31.1"S, 39°02'08.3"W), coll. A.O. Almeida, G.O. Soledade, P.S. Santos and A.C. Costa-Souza, 18.IV.2011, salinity 14, burrow in mud (UESC 1551); 9 m, 2 f, Cachoeira River, Maramata Beach (14°48'28.7"S, 39°01'33.3"W), coll. A.O. Almeida, A.M. Cunha, G.O. Soledade, M.V. Oliveira and P.S. Santos, 17.V.2011, salinity 29, under rocks (UESC 1562); 1 ovf, Cachoeira River, Maramata Beach (14°48'28.7"S, 39°01'33.3"W), 04.II.2011, under rocks (UESC 1528).

Distribution: Western Atlantic - southern Florida, Puerto Rico, Jamaica, Belize, Panama, Venezuela, French Guiana, and Brazil (Ceará to São Paulo) (Anker 2012).

Previous records from Ilhéus: estuaries: Almeida *et al*. [2006, as *A. armillatus* (H. Milne Edwards, 1837 - in part; 2012, as *A.* cf. *armillatus* - in part; 2013, as *A. carlae*].

Alpheus chacei Carvacho, 1979

Material examined: 3 m, 2 f, Cachoeira River, Av. Lomanto Jr. (14°48'31.1"S, 39°02'08.3"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 18.IV.2011, salinity 14, burrows in mud (UESC 1548).

Distribution: Western Atlantic - French Antilles

(Guadeloupe) and Brazil (Pará and Paraíba to São Paulo) (Christoffersen 1979, as *A. maxilliplanus* Christoffersen, 1979; 1984; 1998; Soledade and Almeida 2013).

Previous records from Ilhéus: none.

Alpheus estuariensis Christoffersen, 1984

Material examined: 3 m, 2 f, Cachoeira River, Banco da Sapetinga, confluence of Cachoeira and Fundão rivers (14°48'36.0"S, 39°02'38.9"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 19.IV.2011, salinity 2, burrows in mud (UESC 1539); 2 f, Santana River, Nossa Senhora da Maré Island (14°50'57.8"S, 39°03'15.0"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 19.IV.2011, salinity 2 (UESC 1542); 2 m, 3 f, Santana River, Fazenda Leoa (14°50'36.0"S, 39°02'46.7"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 19.IV.2011, salinity 1, under rocks (UESC 1544); 1 f, Cachoeira River, Av. Lomanto Jr. (14°48'31.1"S, 39°02'08.3"W), coll. A.O. Almeida, G.O. Soledade, P.S. Santos and A.C. Costa-Souza, 18.IV.2011, salinity 14, burrows in mud (UESC 1550); 2 m, 2 f, Acuípe River (15°04'59.9"S, 38°59'55.9"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 23.VII.2009, under rocks (UESC 1556). See also material reported by Almeida *et al*. (2006).

Distribution: Western Atlantic – Florida, Mississippi to Texas, Cuba, Dominican Republic, Trinidad and Tobago, Curaçao, and Brazil (Pará to Santa Catarina) (Christoffersen 1984; Soledade and Almeida 2013; Almeida and Mantelatto in press).

Previous records from Ilhéus: estuaries: Almeida *et al.* (2006; 2012).

Alpheus intrinsecus Spence Bate, 1888

Material examined: See material reported by Almeida *et al*. (2006).

Distribution: Western Atlantic - Puerto Rico to Brazil (Piauí to Santa Catarina). Eastern Atlantic - Western Sahara to Gabon (Crosnier and Forest 1966; Christoffersen 1979; Soledade and Almeida 2013).

Previous records from Ilhéus: estuaries: Almeida *et al.* (2006, 2012); marine environment: Almeida *et al*. (2007a).

Alpheus nuttingi (Schmitt, 1924)

Material examined: 1 m, 1 f, Cachoeira River, Maramata Beach (14°48'28.7"S, 39°01'33.3"W), coll. A.O. Almeida, A.M. Cunha, G.O. Soledade, M.V. Oliveira and P.S. Santos, 20.IV.2011, salinity 10.5, under rocks (UESC 1561).

Distribution: Western Atlantic - southern Florida, southwestern Gulf of Mexico, and West Indies to Brazil (Ceará to Santa Catarina) (Anker *et al*. 2007; Soledade and Almeida 2013).

Previous records from Ilhéus: none.

Alpheus pontederiae de Rochebrune, 1883

Material examined: 1 f, Santana River, Nossa Senhora da Maré Island (14°50'57.8"S, 39°03'15.0"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 19.IV.2011, salinity 2 (UESC 1543); 1 m, 4 f, Santana River, Fazenda Leoa (14°50'36.0"S, 39°02'46.7"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 19.IV.2011, salinity 1, under rocks (UESC 1545). See also material reported by Almeida *et al*. (2006).

Distribution: Western Atlantic - Venezuela to Brazil (Pará, Maranhão, Paraíba, Alagoas, Bahia, São Paulo, Paraná). Eastern Atlantic - Senegal to Congo (Crosnier and Forest 1966; Christoffersen 1984; Soledade and Almeida 2013).

Previous records from Ilhéus: estuaries: Almeida *et al.* (2006, 2012).

Automate cf. *dolichognatha* De Man, 1888
(Figure 2)

Material examined: 1 nov, Cachoeira River, Maramata Beach (14°48'28.7"S, 39°01'33.3"W), coll. A.O. Almeida, A.M. Cunha, G.O. Soledade, M.V. Oliveira and P.S. Santos, 25.IX.2011, salinity 35, under rocks (UESC 1563). Additional material: 5 nov, Bahia, Itacaré, Concha Beach, mouth of Contas River (14°16'31.4"S, 38°59'14.5"W), coll. G.O. Soledade, P.S. Santos and M.V. Oliveira, 27.XI.2012, under rocks (UESC 1565).

Distribution: Western Atlantic – North Carolina, Yucatan Peninsula, Virgin Islands, Antigua, Barbados, Brazil (Rio de Janeiro). Central Atlantic – Ascension. Indo-West Pacific – Red Sea to Samoa. Eastern Pacific – Tres Marias, Revillagigedo, Cocos and Galapagos Islands, California, Gulf of California to Peru (Chace 1972, as *A. gardineri* Coutière, 1902; Banner and Banner 1973; Manning and Chace 1990; Christoffersen 1998; Wicksten and Hendrickx 2003).

Previous records from Bahia: none.

Remarks: *Automate dolichognatha*, originally described from Indonesia, is a widely distributed, almost pantropical species complex (Anker 2001; Anker and Komai 2004) and is in need of a comprehensive revision. The record of the species from Rio de Janeiro by Christoffersen (1998), in a list of alpheoid shrimps from Brazil, is the only known report from the Brazilian coast. No illustrations or morphological account of this material were provided by Christoffersen (1998). Anker and Komai (2004) divided the genus *Automate* De Man, 1888 into three informal groups of species: *A. dolichognatha*, *A. evermanni* Rathbun, 1901, and *A. hayashii* Anker and Komai, 2004. The combination of characteristics such as (1) major chela subrectangular (see Figure 2D), (2) propodus of pereiopod 3 with row of spiniform setae, (3) dactylus of pereiopod 3-5 simple, subconical and (4) diaeresis of uropodal exopodite with two dorsal teeth place our specimens in the *A. dolichognatha* group. The other species within this group is the little-known eastern-Atlantic *A. talismani* Coutière, 1902, whose taxonomic status remains unclear (see Chace 1988; Anker and Komai 2004). For this reason our material is referred provisionally as *A*. cf. *dolichognatha*. Our material also agrees, in general, with the illustrations provided by Chace (1972) as *A. gardineri*. The color pattern of the Brazilian material is illustrated for the first time (Figure 2). The record of color pattern of fresh material will aid in mapping the geographic distribution of the taxa, after a taxonomic revision of *A. dolichognatha sensu lato* can be conducted and our material properly attributed.

Leptalpheus axianassae Dworschak and Coelho, 1999

Material examined: 1 m, 1 f, Cachoeira River, Av. Lomanto Jr. (14°48'31.1"S, 39°02'08.3"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 18.IV.2011, salinity

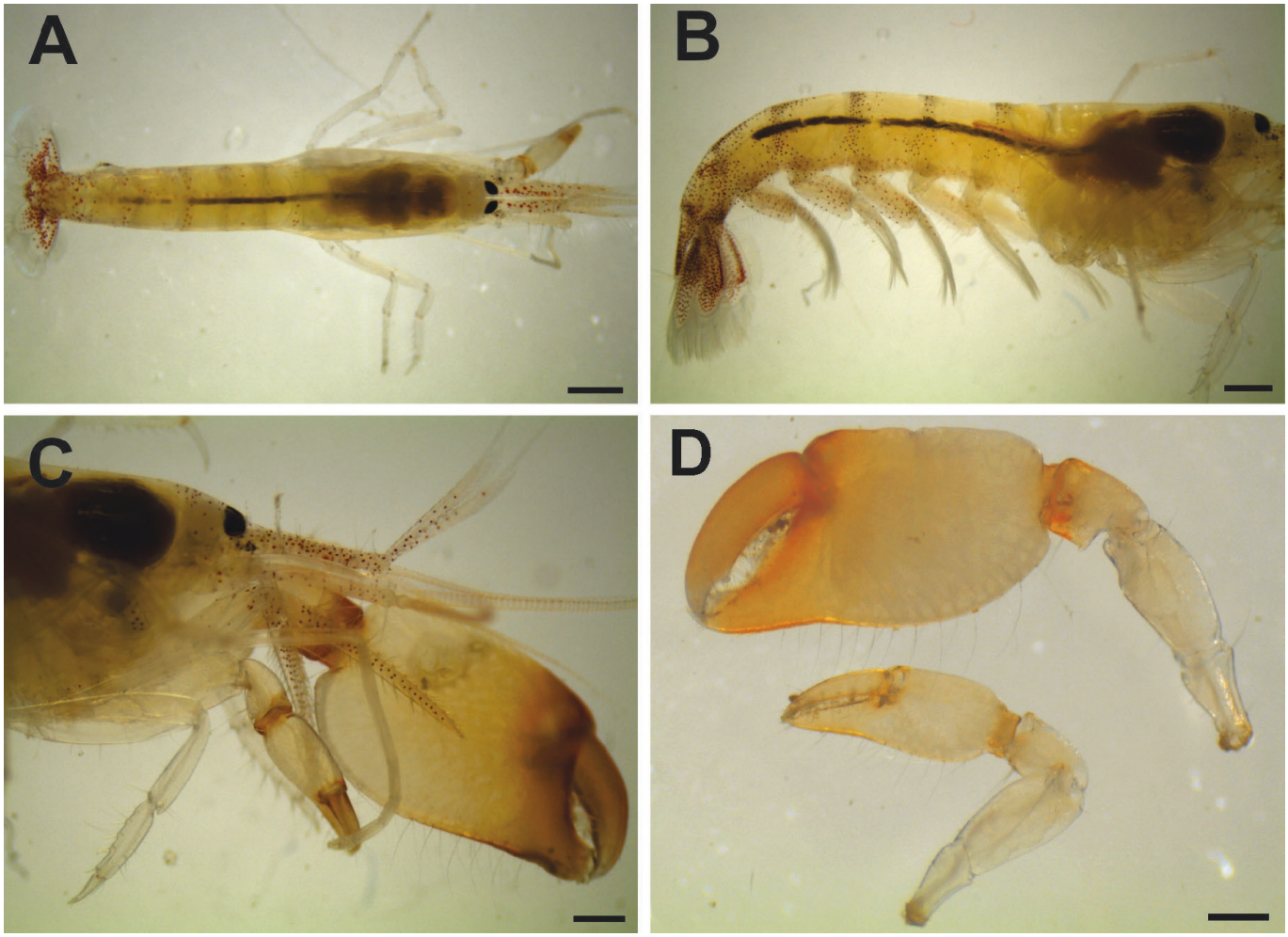

Figure 2. *Automate* cf. *dolichognatha* De Man, 1888, non-ovigerous specimens, Itacaré, Bahia, Brazil (UESC 1565). A, habitus, dorsal view; B, habitus, lateral view; C, anterior region, lateral view; D, major chela (above), minor chela (below), lateral view. Scale bars: 1 mm.

14, burrows in mud (UESC 1552).
Distribution: Western Atlantic – Florida and Brazil (Pernambuco, Bahia and São Paulo) (Dworschak and Coelho 1999; Anker *et al.* 2006a; Almeida *et al*. 2012).

Previous records from Ilhéus: none.

Salmoneus carvachoi Anker, 2007

Material examined: 1 nov, Cachoeira River, Banco da Sapetinga, confluence of Cachoeira and Fundão rivers (14°48'36.0"S, 39°02'38.9"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 19.IV.2011, salinity 2, burrows in mud (UESC 1541); 4 ovf, Cachoeira River, Av. Lomanto Jr. (14°°48'31.1"S, 39°02'08.3"W), coll. A.O. Almeida, G.O. Soledade, P.S. Santos and A.C. Costa-Souza, 18.IV.2011, salinity 14, burrows in mud (UESC 1549).

Distribution: Western Atlantic – Mexico (Yucatan), Guadeloupe and Brazil (Paraíba, Pernambuco, Bahia, São Paulo and Paraná) (Anker 2007; 2010).

Previous records from Ilhéus: none.

Synalpheus fritzmuelleri Coutière, 1909

Material examined: See material reported by Almeida *et al*. (2006).

Distribution: Western Atlantic – Bermuda, North Carolina to Florida, Gulf of Mexico, Bahamas, Caribbean Sea (Yucatan to Venezuela) and Brazil (São Pedro and São Paulo Archipelago, Atol das Rocas, Ceará to Santa Catarina). Central Atlantic – Ascension and Saint Helena islands (Christoffersen 1979, 1998; Holthuis *et al.* 1980; Manning and Chace 1990; Anker *et al*. 2012).

Previous records from Ilhéus: estuaries: Almeida *et al.* (2006, 2012).

Family Hippolytidae Spence Bate, 1888

Latreutes parvulus (Stimpson, 1871)

Material examined: 1 f, Ilhéus, Cachoeira River, Station 8, Pontal, trawl (14°48'10"S, 39°02'12.3"W), coll. A.O. Almeida, J.T.A. Santos, N.R. Ferraz and C.S. Soares, 18.IX.2004 (UESC 589).

Distribution: Western Atlantic – New Jersey, USA, to Buenos Aires, Argentina. Eastern Atlantic – Western Sahara to Congo (Christoffersen 1982).
Previous records from Ilhéus: estuaries: Almeida *et al.* (2012).

Merguia rhizophorae (Rathbun, 1900)

Material examined: 4 nov, Cachoeira River, Maramata Beach (14°48'28.7"S, 39°01'33.3"W), coll. A.O. Almeida, A.M. Cunha, G.O. Soledade, M.V. Oliveira and P.S. Santos, 23.III.2011, salinity 7.5 (UESC 1560). See also material reported by Almeida *et al*. (2006).

Distribution: Western Atlantic – Panama, Suriname and Brazil (Piauí to Bahia). Eastern Atlantic – Niger Delta in Nigeria (Chace 1972; Bruce 1993; Christoffersen 1998; Almeida *et al.* 2006).

Previous records from Ilhéus: estuaries: Almeida *et al.* (2006, 2012).

Family Ogyrididae Holthuis, 1955
Ogyrides alphaerostris (Kingsley, 1880)

Material examined: 1 f, mouth of Acuípe River (15°04'59.9"S, 38°59'55.9"W), coll. A.O. Almeida, G.O. Soledade and P.S. Santos, 23.VII.2009, on mud (UESC 1554).

Distribution: Western Atlantic – Virginia to Brazil (Amapá, Pará, Paraíba to Alagoas, Rio de Janeiro to Rio Grande do Sul) (Williams 1984; Christoffersen 1998; Coelho *et al*. 2006).

Previous records from Bahia: none.

Key for identification of estuarine caridean shrimps from Ilhéus:

1. Carpus of the second pereiopod not subdivided (Palaemonidae) 2
1'. Carpus of the second pereiopod subdivided 5

2. Carapace with hepatic spine. *Macrobrachium acanthurus*
2'. Carapace without hepatic spine 3

3. Branchiostegal groove between antennal and branchiostegal spines absent; endopod of male first pleopod with well-developed appendix interna; propodus of fifth pereiopod without transverse rows of grooming setae on distal part of posterior margin. .. *Leander paulensis*
3'. Branchiostegal groove between antennal and branchiostegal spines present; endopod of male first pleopod without appendix interna; propodus of fifth pereiopod with transverse rows of grooming setae on distal part of posterior margin 4

4. Carpus of second pereiopod as long as chela; rostrum with 3-4 teeth on ventral margin ..... *Palaemon northropi*
4'. Carpus of second pereiopod twice as long as chela; rostrum with 5-8 teeth (rarely 9) on ventral margin ..... *Palaemon pandaliformis*

5. Eyestalks very long, reaching nearly to distal margin of antennular peduncle; first pereiopods about as robust as second pereiopods (Ogyrididae) ..... *Ogyrides alphaerostris*
5'. Eyestalks not unusually long, not reaching beyond distal margin of first segment of antennular peduncle, sometimes covered by carapace; first pereiopods more robust than second pereiopods 6

6. Carapace without cardiac notch on posterior margin; first pereiopods usually equal, not swollen; eyes totally exposed and freely movable; rostrum well-developed, toothed (Hippolytidae) 7
6'. Carapace with cardiac notch on posterior margin; first pereiopods often unequal and swollen; eyes often totally or partially covered by ocular hoods; rostrum relatively short, smooth-edged (Alpheidae) 8

7. Merus of second pereiopod not subdivided, carpus subdivided into three segments ..... *Latreutes parvulus*
7'. Merus and carpus of second pereiopod multiarticulate (24-27 and 10-14 segments,respectively ..... *Merguia rhizophorae*

8. Posterolateral angle of sixth abdominal segment with movable triangular plate ..... *Leptalpheus axianassae*
8'. Posterolateral angle of sixth abdominal segment without movable triangular plate 9

9. Eyes not concealed in anterior view; dactylus of major chela without a large molar tooth (plunger) fitting in deep fossa on pollex 10
9'. Eyes totally covered by ocular hoods from all but anteroventral view; dactylus of major chela with a large molar tooth (plunger) fitting in deep fossa on pollex 11

10. Eyes, including peduncle, totally exposed dorsally; rostral projection not reaching beyond anterolateral margin of carapace ..... *Automate* cf. *dolichognatha*
10'. Eyes covered in dorsal view; distal tip of rostrum reaching beyond anterolateral margin of carapace ..... *Salmoneus carvachoi*

11. Pereiopods without epipods; second pleopod of male without appendix masculina; ocular hoods with tooth on anterior margin (front tridentate) ..... *Synalpheus fritzmuelleri*
11'. Pereiopods 1-4 with epipods; second pleopod of male without appendix masculina; ocular hoods without tooth on anterior margin (rounded) 12

12. Rostrum dorsally flat; ocular hoods with tooth arising from surface of mesial slope, overhanging adrostral furrows ..... *Alpheus intrinsecus*
12'. Rostrum rounded or carinate in dorsal midline, not flattened; ocular hoods unarmed 13

13. Merus of chelipeds unarmed at distal end of ventromesial margin 14
13'. Merus of first chelipeds armed with sharp tooth at distal end of ventromesial margin 19

14. Dactylus of third and fourth pereiopods conical 15
14'. Dactylus of third and fourth pereiopods usually subspatulate 17

15. Dorsal groove of major chela palm not extending posteriorly on mesial surface ..... *Alpheus bouvieri*
15'. Dorsal groove of major chela palm extending posteriorly on mesial surface 16

16. Rostral carina slightly broadening posteriorly; ventromesial carina of first segment with acute tooth, directed forward (hook-shaped); fingers of minor chela without balaeniceps setae in male; female minor chela more robust (propodus approx. 2.7 times as long as broad) ..... *Alpheus nuttingi*
16'. Rostral carina not broadening posteriorly; ventromesial carina of first segment with rounded tooth; fingers of minor chela with balaeniceps setae in male; female minor chela more slender (propodus approx. 4 times as long as broad) ..... *Alpheus* sp.

17. Distal margin of pollex of major chela with rounded ending; fingers of minor chela with balaeniceps setae

in males; uropodal exopod with two sharp teeth on posterolateral margin, one on each side of spiniform setae ..... *Alpheus pontederiae*
17'. Distal margin of pollex of major chela distinctly truncate; fingers of minor chela without balaeniceps setae in both males and females; uropodal exopod with one sharp tooth on posterolateral margin, lateral to spiniform setae 18

18. Fingers of minor chela distinctly longer than palm; antepenultimate segment of third maxilliped broadly enlarged ..... *Alpheus chacei*
18'. Fingers of minor chela as long as palm; antepenultimate segment of third maxilliped not enlarged ..... *Alpheus estuariensis*

19. Adrostral furrows shallow, not sharply delimited; fingers of minor chela of male with balaeniceps setae ..... *Alpheus buckupi*
19'. Adrostral furrows deep, sharply delimited; fingers of minor chela of male without balaeniceps setae 20

20. Major chela with dactylus plunger relatively short, its proximal height at most 0.6 length of distolateral margin; dactylus plunger orange-colored mesially (fresh specimens) ..... *Alpheus brasileiro*
20'. Major chela with dactylus plunger relatively long, its proximal height more than 0.7 length of distolateral mar gin; dactyls plunger whitish mesially (fresh specimens) 21

21. First and second abdominal sternite with strong median process in males; fifth pereiopod ischium with or without spiniform seta on ventrolateral surface ..... *Alpheus carlae*
21'. First abdominal sternite with small median process, second abdominal sternite unarmed in males; fifth pereiopod ischium always unarmed on ventrolateral surface ..... *Alpheus angulosus*

Discussion

The list of caridean shrimps from estuaries of Ilhéus currently comprises 22 species in four families. It is difficult to compare species richness among estuaries because the number of species recorded in surveys may vary depending on several factors such as the size of the study area, climate and oceanographic conditions, sampling effort, diversity of substrata available, type(s) of substrata sampled, method(s) of sampling, and the experience and taxonomic group of expertise of the collector(s), among others.

The number of caridean species obtained in this study is high compared to the numbers obtained in some quantitative studies carried out in estuaries or other shallow-water coastal areas in both warm and cold temperate areas (*e.g.*, Gore *et al*. 1981; Able *et al*. 2002; Neves *et al.* 2007) (see Table 1). This result was expectable, since there is a general trend toward a decrease in the number of caridean species at higher latitudes (d'Udekem d'Acoz 1999; Boschi 2002; Clarke and Crame 2010), as observed for other marine groups. With a total of 14 species, the alpheids were the most prominent family with respect to species richness. Indeed, alpheid shrimps are highly diverse in tropical regions, where they occupy a wide variety of marine and estuarine habitats, living on various types of bottom and in association with other phyla of invertebrates as well as with fish (Anker *et al*. 2006b). In contrast, the richness of palaemonids and hippolytids is proportionally higher in shallow-water environments in temperate areas, especially in areas covered with vegetation (Hooks *et al*. 1976; Gore *et al*. 1981; López de la Rosa *et al*. 2002; Glancy *et al*. 2003).

The number of species recorded in estuaries of Ilhéus is lower than that reported by Carvacho (1979) (n=29) in mangroves from Guadeloupe (Antillean Province, see Boschi 2000) and higher than the numbers reported by Hendrickx (1984) (n=4) and Echeverría-Sáenz *et al*. (2003) (n=11) in estuaries of the Mexican and Costa Rican Pacific coasts (Panamic Province, see Boschi 2000) (see Table 1). The number of species reported by Carvacho (1979) would be expected to outnumber those in the present study, because the Antillean Province is the richest in number of decapod species among all the zoogeographic marine provinces of the Americas (see Boschi 2000).

The estuarine caridean fauna along the northern and northeastern Brazilian coast has been very little studied. The epibenthic carideans (*e.g.*, most palaemonids and hippolytids) are in general well documented. On the other hand, the (ecologically) cryptic fauna is especially little known, especially the soft-bottom infauna. The difficulties of collection and accurate taxonomic identification partly explain this situation, which is not exclusive to this area. The number of species recorded here is much higher than the numbers found in the vast majority of surveys that have been carried out along the Brazilian coast (*e.g.*, Ramos-Porto 1980, Ilha de Itamaracá, Pernambuco; Coelho-Santos and Coelho 2001, Paripe River, Pernambuco; Calado and Sousa 2003, Alagoas; Ferreira and Sankarankutty 2003, Rio Grande do Norte), most of them general studies on decapod fauna. The sampling effort concentrated on carideans, allied to recent advances in the taxonomy of certain taxa (*e.g*. Anker 2012; Almeida *et al*. 2013) are the main factors responsible for this relatively long species list. Systematic surveys in other estuaries along this stretch of the Brazilian coast are likely to reveal local caridean faunas as rich as or richer than that recorded from Ilhéus. Sampling of the infauna is especially likely to result in the discovery of new records and new taxa for science.

Table 1. Comparison of the composition of the caridean fauna in several estuarine regions.

STUDY AREA	NUMBER OF SPECIES	REFERENCE
Térraba-Sierpe mangrove system, Costa Rica, Pacific side	11 (1 atyid, 6 palaemonids, 4 alpheids)	Echeverría-Sáez *et al*. (2003)
Estero El Verde, Sinaloa, Mexico, Pacific side	3 (2 palaemonids, 1 alpheid)	Hendrickx (1984)
Cape Cod estuary, Massachusetts, USA	3 (1 palaemonid, 1 crangonid, 1 hippolytid)	Able *et al*. (2002)
Indian River Lagoon estuary, Florida, USA	13 (3 palaemonids, 4 alpheids, 4 hippolytids, 2 processids)	Gore *et al*. (1981)
off mouths of Encofina and Fenholloway rivers, Apalachee Bay, Florida, USA	19 (7 palaemonids, 5 alpheids, 6 hippolytids, 1 processid)	Hooks *et al*. (1976)
Mangroves from Guadeloupe, the Caribbean	29 (1 atyid, 9 palaemonids, 11 alpheids, 1 ogyridid, 5 hippolytids, 2 processids)	Carvacho (1979)
Estuaries of Casqueira, Conceição and Potengi rivers, Rio Grande do Norte, Brazil	12 (4 palaemonids, 4 alpheids, 1 hippolytid, 1 ogyridid, 1 processid)	Ferreira and Sankarankutty (2002)
Ilha de Itamaracá, Pernambuco, Brazil	14 (1 atyid, 6 palaemonids, 3 alpheids, 4 hippolytids) (only estuarine species)	Ramos-Porto (1980)
Paripe River estuary, Pernambuco, Brazil	11 (1 atyid, 6 palaemonids, 3 alpheids, 1 hippolytid)	Coelho-Santos and Coelho (2001)
Mundau/Manguaba estuary-lagoon system, Alagoas, Brazil	13 (1 atyid, 6 palaemonids, 6 alpheids)	Calado and Sousa (2003)
Camamu Bay, Bahia, Brazil	22 (1 pasiphaeid, 5 palaemonids, 11 alpheids, 5 hippolytids)	Almeida *et al*. (2007b)
Estuaries of Ilhéus, Bahia, Brazil	22 (4 palaemonids, 15 alpheids, 2 hippolytids, 1 ogyridid)	Present study
Sado estuary, Portugal	6 (2 palaemonids, 1 alpheid, 1 hippolytid, 1 processid, 1 crangonid)	Neves *et al*. (2007)
Valdelagrana Beach, off Guadalete River mouth, Bay of Cadiz, Spain	20 (3 palaemonids, 1 alpheid, 6 hippolytids, 1 ogyridid, 5 processids, 4 crangonids)	López de la Rosa *et al*. (2002)

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