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Confirmation of the presence of *Janicea antiguensis* (Chace, 1972) (Decapoda: Barbouriidae) in northeastern and eastern Brazil

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Abstract

The barbouriid shrimp *Janicea antiguesis* (Chace, 1972) is reported from Porto de Galinhas and Tamandaré in Pernambuco and Guarapari in Espírito Santo, Brazil. These records confirm the presence of *J. antiguensis* in northeastern and eastern Brazil, considerably extending its Brazilian range from Fernando de Noronha to southern Espírito Santo and also representing the first record of this species from mainland coastal reefs. In Brazil, *J. antiguensis* occurs in or near marine reef caves, typically at depths between 5 and 15 m, and can be most easily observed while scuba diving at night. Colour photographs of *J. antiguensis* from various Atlantic localities are provided and its colour pattern is compared to that of the closely related Indo-West Pacific barbouriid shrimp, *Parhippolyte misticia* (Clark, 1989). Some *in situ* observations are provided for the Porto de Galinhas population of *J. antiguensis*. Multiple observations of pairs with both individuals brooding embryos at different developmental stages suggest protandric simultaneous hermaphroditism in *J. antiguensis*.

Key words: Caridea, hermaphroditism, marine cave, new records, shrimp.

Introduction

The marine cave shrimp *Janicea antiguensis* (Chace, 1972) belongs to the family Barbouriidae Christoffersen, 1987, a morphologically relatively homogeneous group of three genera and seven species: *Barbouria cubensis* (von Martens, 1872), *B. yanezi* Mejía, Zarza and López, 2008, *J. antiguensis* (Chace, 1972), *Parhippolyte uveae* Borradaile, 1899, *P. misticia* (Clark, 1989), *P. cavernicola* Wicksten, 1996 and *P. sterreri* (Hart and Manning, 1981) (De Grave and Fransen, 2011). All barbouriid shrimps are associated with relatively shallow marine and anchialine caves and similar crevicular habitats (Manning and Hart, 1984; Wicksten, 1996).

Janicea antiguensis was originally

described by Chace (1972) as *Barbouria antiguensis* from Antigua, where it was found at night a meter or so below the water surface on algae-covered seawalls. Subsequently, *J. antiguensis* was recorded from marine caves and wall crevices from several localities on both sides of the Atlantic Ocean, including Bermuda, Cozumel and Mexico's Yucatan Peninsula, São Tomé and Príncipe, Cape Verde, and Fernando de Noronha off northeastern Brazil (Iliffe *et al.,* 1983; Manning and Hart, 1984; Kensley, 1988; Iliffe, 1993; Ramos-Porto and Coelho, 1993; Hobbs III, 1994; d'Udekem d'Acoz, 2000; Wirtz, 2004; Coelho *et al.*, 2006; Alves *et al.*, 2008).

Over a period of several years (2004–2011), approximately 230 individuals of a caridean shrimp that by its general appearance and colour pattern matched *J. antiguesis* (cf. Wirtz and Debelius, 2003) were observed at night inside caves while scuba diving on shallow reefs off Porto de Galinhas, south of Recife, Pernambuco, northeastern Brazil. Six specimens of this shrimp were collected in March 2011 and after a morphological examination confirmed to be *J. antiguensis*. These specimens confirm the presence of *J. antiguensis* in Brazil and also constitute the first records of this species for the Brazilian mainland and for the state of Pernambuco. In addition, eight individuals of *J. antiguensis* were observed during nocturnal dives on the reefs of Tamandaré, 40 km south of Porto de Galinhas. Finally, Peter Wirtz (Universidade do Algarve, Portugal) kindly informed us that a specimen of *J. antiguensis* from Guarapari, Espírito Santo, was deposited in the collections of Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZUSP), representing the southern-most record of this species in the southwestern Atlantic Ocean.

Material and Methods

The nocturnal visual surveys were conducted on the reefs off Porto de Galinhas (08º30'00" - 08º33'33"S / 35º00'27" - 34º59'00"W) and Tamandaré (08º47'20"S / 35º06'45"W), Pernambuco, northeastern Brazil, in June 2004 to May 2005, October to November 2008, and February to March 2011. The six specimens of *J. antiguensis* collected manually off Porto de Galinhas in March 2011 were transported alive to Laboratório de Carcinicultura, Universidade Federal de Alagoas, Penedo, for photography and confirmation of identification using accounts of Chace (1972: 107) and Manning and Hart (1984: 657). The Pernambuco material was preserved in 70% ethanol and deposited in the crustacean collection of the Museu de Oceanografia, Departamento de Oceanografia, Universidade Federal de Pernambuco, Recife, Pernambuco, Brazil (MOUFPE). Additional material from Fernando de Noronha and Espírito Santo (MZUSP) was also briefly examined. Drawings were made under a stereo-microscope with the aid of a drawing tube. Carapace length (CL, in mm) was measured with a digital vernier calliper (0.01 mm) from the base of the rostrum to the posterior margin of the carapace.

Results

Systematics

Family Barbouriidae Christoffersen, 1987
Genus *Janicea* Manning and Hart, 1984
Janicea antiguensis (Chace, 1972)
(Figs. 1, 2A–D)

Barbouria antiguensis Chace, 1972: 107, figs. 41–42; Hobbs III, 1978: 99; Hart and Manning, 1981: 441; Iliffe *et al.* 1983: 141.

Janicea antiguensis – Manning and Hart, 1984: 657, fig. 2; Kensley, 1988: 698; Hobbs III, 1994: 98; d'Udekem d'Acoz, 2000: 1163, fig. 1; Wirtz, 2004: 84; Coelho *et al.*, 2006: 53; Mejía-Ortiz *et al.*, 2006: 13; Alves *et al.*, 2008: 50.

Material examined: Brazil. 2 non-ovigerous specimens (CL 7.7 and 9.74 mm), 4 ovigerous specimens (CL 10.50–11.86

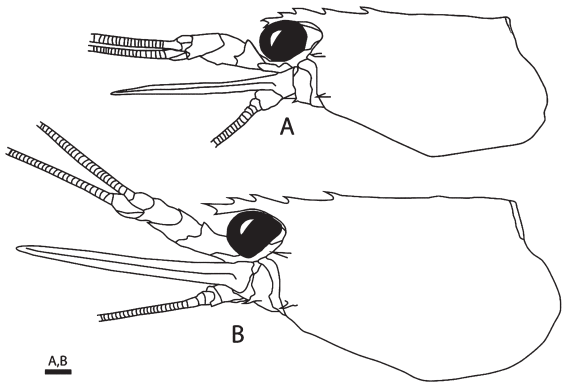

Figure 1. *Janicea antiguensis* (Chace, 1972) from reef caves off Porto de Galinhas, Pernambuco, northeastern Brazil, anterior part of the body of two specimens (MOUFPE 15014): (A) non-ovigerous specimen (CL 7.7 mm); (B) ovigerous specimen (CL 11.12 mm).

mm), Pernambuco, off Porto de Galinhas, 08º30'00"–08º33'33"S / 34º59'00"–35º00'27"W, marine reef, on cave walls and roofs, depth 5–10 m, leg. B.W. Giraldes *et al.*, 17 March 2011, MOUFPE 15014, MOUFPE 15015; 1 ovigerous female (CL not measured), Guarapari, Espírito Santo, leg. P. Wirtz, vi.2006, depth 30 m, MZUSP 17014; 1 non-ovigerous specimen and 1 ovigerous specimen (CL not measured), Fernando de Noronha, vii.1969, MZUSP 8967 (P.A. Coelho det. *Barbouria antiguensis*).

Diagnosis (modified from Manning and Hart, 1984): Carapace with antennal and branchiostegal teeth; rostrum slender, about five times as long as high, short, extending to about end of basal article of antennular peduncle, with three to four dorsal (one or two postorbital) teeth and one ventral tooth. Eyes large, well-pigmented, cornea broader than eyestalk. Anterior four pleura rounded, fifth pleuron acute posteroventrally. Telson with two pairs of dorsal spines and three pairs of terminal spines, mesial spines longest. Mandible lacking incisor process, with three-jointed palp. First and second pereopods chelate; merus, carpus, and propodus of second pereopod multiarticulate; third to fifth pereopods with carpus and propodus multiarticulate. Endopod of male first pleopod without appendix interna, with distal coupling hooks; endopod of male second pleopod with appendix masculina longer than appendix interna. Gill/exopod formula: six epipods (on coxae of Mxp2, Mxp3, P1–4); five pleurobranchs (above P1–5); two arthrobranchs (Mxp3); 1 podobranch (Mxp2).

Colour pattern: Carapace, abdomen and tail fan semi-transparent, with some red or orange-red chromatophores present between pleopods and walking legs; each pleuron with relatively narrow, red band running transversely along posterior margin, but not extending to ventral margin; third to fifth abdominal segments also with small patch of white chromatophores dorsally; antennular and antennal peduncles semi-transparent, with reddish lateral margins, lateral antennular and antennal flagella reddish; mesial antennular flagella mostly whitish with some red colour; third maxilliped and first and second pereiopods reddish; third to fifth pereopods mostly white, with some reddish chromatophores proximally; telson and uropods semi-transparent, with reddish margins; fresh eggs pale olive-green (Fig. 2A). Individuals kept in aquariums with artificial lighting (photoperiod 12:12 h) displayed essentially the same colour pattern as individuals observed *in situ* in semi-dark caves. The individuals from Espírito Santo, Cape Verde and Canary Islands are very similar in the general colour pattern (Figs. 2B–D), although freshly laid eggs tend to be yellow in the eastern Atlantic individuals (Figs. 2C, D) and not green as in some western Atlantic individuals, e.g., those from Pernambuco (Fig. 2A).

Distribution: Amphi-Atlantic (Fig. 3); Eastern Atlantic: São Tomé and Príncipe (Wirtz, 2004); Cape Verde Islands (d'Udekem d'Acoz, 2000); Canary Islands (based on coloured photographs, Fig. 2C; see also Wirtz, 2004); Western Atlantic: Antigua (Chace, 1972); Bermuda (Hart and Manning, 1981; Iliffe *et al.*, 1983); Cozumel Island and Yucatan Peninsula (Kensley, 1988; Iliffe, 1993; Hobbs III, 1994; Mejía-Ortiz *et al.*, 2006); Bonaire (A. Anker, pers. obs. based on colour photographs);

Figure 2. *Janicea antiguensis* (Chace, 1972) [A–D] and *Parhippolyte misticia* (Clark, 1989) [E, F]: (A) ovigerous individual from reef caves off Porto de Galinhas, Pernambuco, northeastern Brazil, photographed in a laboratory aquarium; (B) non-ovigerous individual from Guarapari, Espírito Santo, eastern Brazil, photographed in a plastic bag after capture; (C) ovigerous individual *in situ* off Sal, Cape Verde; (D), ovigerous individual *in situ* off Tenerife, Canary Islands; (E, F), non-ovigerous individuals from Kimbe Bay, Papua New Guinea, *in vitro* (E) and *in situ* (F). Photographic credits: A, Bruno Giraldes; B, C, Peter Wirtz; D, Sergio Hanquet; E, F, Antonio Baeza.

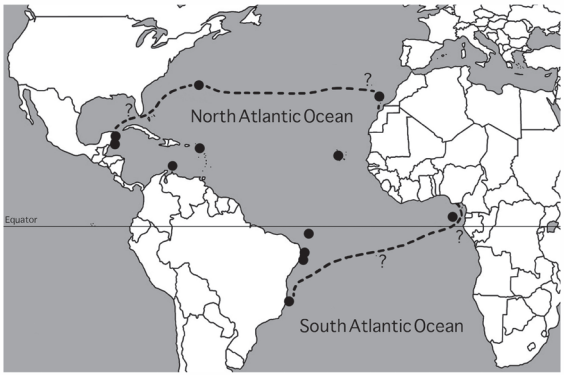

Figure 3. Distribution of *Janicea antiguensis* (Chace, 1972) based on previous and present confirmed records (Antigua, Bermuda, Yucatan, Cozumel, Fernando de Noronha, Pernambuco, Espírito Santo, São Tomé, Cape Verde), and underwater photographs (Bonaire, Canary Islands).

Brazil: Fernando de Noronha, Pernambuco and Espírito Santo (Ramos-Porto and Coelho, 1993; present study); in Pernambuco presently known from coastal reefs off Porto de Galinhas and Tamandaré, but most likely occurring on all reefs of the Brazilian "coral coast" extending from about 6°S to 10°S (Maida and Ferreira, 1997); in Espírito Santo known from coastal reefs off Guarapari, ~20°S (material collected by P. Wirtz).

Habitat: The reefs off Porto de Galinhas (main study area) run in lines parallel to the coast, serving as substrate for development of hermatypic corals and seaweeds (Manso *et al.*, 2003). The depth between the reef formations rarely exceeds 10 m. The reef walls have an abundance of smaller cavities and larger caverns and caves, many of them interconnecting beneath the reef flat, thus forming a maze of galleries and chambers of different sizes (Laborel, 1970; Dominguez *et al.,* 1990; Maida and Ferreira, 1997). The cave openings to the outside are rarely higher than 5 m.

Janicea antiguensis was observed only at night, mainly on the roof, walls and floor of the inner, narrower (diameter 1–2 m) areas of larger, semi-dark caves, but also on the outer areas, near the cave openings. Other shrimps inhabiting these caves are the rhynchocinetid *Cinetorhynchus rigens* (Gordon, 1936), which typically occurs in small groups, and the palaemonid *Brachycarpus biunguiculatus* (Lucas, 1846), which is usually living solitarily.

The reef structure of southern Espírito Santo (Guarapari) is geologically different compared to that of Porto de Galinhas. These are mostly rocky reefs patchily covered with algae, sponges, and some corals. However, these reefs are also rich in shallow submarine canyons and ledges with crevices and caverns that are suitable as shelters for *J. antiguensis*. Elsewhere in the Atlantic Ocean, *J. antiguensis* occurs in similarly shelter-rich, hard bottom habitats, e.g., in crevices among large rocks, on seawalls, in shipwrecks, in anchialine caves, and in semi-dark marine caves (Hobbs III, 1994; d'Udekem d'Acoz, 2000; Wirtz and Debelius, 2003).

Biology: At the main study area off Porto de Galinhas, almost all individuals of *J. antiguensis* were observed in pairs, in many of which both partners had eggs (developing embryos) at different stage of maturation, thus suggesting a simultaneous hermaphroditism (see below). *Janicea antiguensis* is a timid shrimp, reacting to dive lights immediately by escaping into deep reef crevices or deeper cave areas. To do so the shrimps typically use their pleopods to swim close to the bottom, while groping the surface with their long walking legs. In complete darkness, the shrimps usually sustain themselves on their walking legs; if touched, they react with a swift abdominal contraction to escape. The diet of *J. antiguensis* remains to be studied, although some individuals we observed killing and feeding on hinge-beak shrimps (*C. rigens*) of various sizes.

Discussion

Despite the fact that *J. antiguensis* is widely distributed in the Atlantic Ocean, ranging from Mexico to Bermuda, São Tomé and Brazil (Fig. 3), the populations of this shrimp appear to be rather localised. This is certainly due to very specific habitat requirements of this species, which like all other barbouriids is confined to habitats rich

in crevices and caves.

In Brazil, *J. antiguensis* is currently known from only tree localities: 1) the oceanic islands of Fernando de Noronha (Ramos-Porto and Coelho, 1993; Coelho *et al.*, 2006; Alves *et al.*, 2008; present study); 2) the mainland reef off Porto de Galinhas, in Pernambuco; and 3) the reefs off Guarapari - Espírito Santo (present study). The finding of *J. antiguensis* in Pernambuco and Espírito Santo extends the geographic range of this species more than 2000 km south from the hitherto known southern limit. It is also the most-southern record of the family Barbouriidae in the Atlantic Ocean.

The colour pattern of *J. antiguensis* is remarkably similar to that of the Indo-West Pacific barbouriid *Parhippolyte misticia* (originally described as *Koror misticius*), which also occurs in marine caves (Clark, 1989) (Figs. 2E, F). However, in *P. misticia* the transverse red bands on the abdomen appear to be broader than in *J. antiguensis*, and in addition, in *P. misticia*, the uropods have several well-defined patches of white chromatophores, which are lacking in *J. antiguensis* (cf. Figs. 2A–D and 2E, F). In contrast, the colour patterns of the western Atlantic *P. sterreri* and the Indo-West Pacific *P. uveae* are clearly different from the patterns of *P. misticia* and *J. antiguensis* (A. Anker, pers. obs.). Noteworthy, in *P. uveae*, Wear and Holthuis (1977) found differences in the colour intensity among individuals subjected to different lighting conditions, which were intensely red by day and almost transparent at night. In contrast, no significant differences in colour intensity were found between shrimps in the caves at night and shrimps kept in aquaria in the laboratory, under artificial lighting.

The presence of eggs at different stages of development in both individuals of mated pairs of *J. antiguensis* (usually one individual with freshly laid, pale-green eggs and the other with more advanced embryos approaching spawning), suggests a protandric simultaneous hermaphroditism. This type of hermaphroditism has been demonstrated in at least one other barbouriid shrimp, *Parhippolyte misticia* (Onaga *et al.*, 2012), and in a number of species of the more distantly related hippolytid genera *Lysmata* Risso, 1816 and *Exhippolysmata* Stebbing, 1916 (Bauer and Holt, 1998; Bauer, 2000; Baeza and Bauer, 2004; Baeza, 2006; Braga *et al.*, 2009; Fiedler *et al.*, 2010). The morphological and anatomical details of the presumed hermaphroditism in *J. antiguensis* remain to be investigated. According to Kensley (1988) and d'Udekem d'Acoz (2000), the presence of numerous small eggs of *J. antiguensis* suggests an extended larval development**,** which may partly explain the wide distribution of this species in the Atlantic Ocean.

Despite great morphological similarity between the eastern and western Atlantic specimens of *J. antiguensis* (d'Udekem d'Acoz, 2000), the colour of fresh eggs (embryos) appears to be quite different: green in the western Atlantic (Brazil) and yellow in the eastern Atlantic (Figs. 2A, C, D). Therefore, it will be sensible to compare genetically *J. antiguensis* from both sides of the Atlantic to investigate the degree of their genetic divergence.

The decapod diversity of the northeastern Brazilian "coral coast" remains to be explored further. Observations and collections involving scuba diving are still rather infrequent and fragmentary in Brazil. However, sampling by scuba diving is an extremely important tool in studies of the diversity and ecology of subtidal reef crustaceans, especially when combined with high quality photography of the collected material.

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