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ARTIGO

First report of the invasive swimming crab *Charybdis* hellerii (A. Milne-Edwards, 1867) (Decapoda, Portunidae) near the Great Amazon Reef System, Amapá, Brazil

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Abstract. In this paper, we report for the first time the occurrence of the swimming crab *Charybdis hellerii* (A. Milne-Edwards, 1867) on the continental shelf of Amapá State. Four specimens were collected as bycatch fauna during industrial fishing operations targeting the southern brown shrimp. The specimens have been deposited in the Carcinological Collection of the *Centro Nacional de Pesquisa e Conservação da Biodiversidade Marinha do Norte* — ICMBio/CEPNOR. The occurrence fills a knowledge gap about the distribution of the species in the northern Brazilian coast since the species was recorded in French Guyana and in the northern to southeastern regions of Brazil.

Keywords: bioinvasion, exotic species, bycatch fauna, industrial shrimp fishery, North coast.

Resumo. Primeiro registro do siri invasor *Charybdis hellerii* (A. Milne-Edwards, 1867) (Decapoda, Portunidae) próximo ao Grande Sistema de Recifes da Amazônia. Neste trabalho, relatamos pela primeira vez a ocorrência do siri *Charybdis hellerii* (A. Milne-Edwards, 1867) na plataforma continental do estado do Amapá. Foram coletados quatro exemplares como fauna acompanhante em operações de pesca industrial do camarão-rosa. Os exemplares estão depositados na Coleção Carcinológica do Centro Nacional de Pesquisa e Conservação da Biodiversidade Marinha do Norte — ICMBio/CEPNOR. A ocorrência preenche uma lacuna de conhecimento sobre a distribuição da espécie no litoral norte brasileiro, uma vez que a espécie foi registrada na Guiana Francesa e nas regiões de Norte ao Sul do Brasil.

Palavras-chave: bioinvasão, espécie exótica, fauna acompanhante, pesca industrial camaroneira, costa norte.

Introduction

The establishment of exotic species in marine waters has advanced at an accelerated rate. These invasions are the consequence of anthropic actions such as maritime transport, the opening of channels connecting seas and oceans, the release of exotic biodiversity into the environment and abiotic modifications of ecosystems caused by climate change (Dahl & Patterson III, 2013, Phillips & Kotrschal, 2021).

The Great Amazon Reef System (GARS; see Francini-Filho *et al.*, 2018) had its existence indicated by Collette and Rützler (1977) and confirmed by Moura *et al.* (2016). The GARS is composed of great complexity and diversity of habitats (Francini-Filho *et al.*, 2018).

Currently, in tropical waters, one of the main bioinvasive agents in coastal marine environments is the swimming crab *Charybdis hellerii* (A. Milne-Edwards, 1867), which belongs to the family Portunidae Rafinesque, 1815 (Wee & Ng, 1995). *Charybdis hellerii* is native from warm waters of the Indo-Pacific and widely distributed in the Red Sea, Somalia, South Africa, Madagascar, Persian Gulf, India, Philippines, Indonesia, China, Japan, Australia and Hawaii (Coelho & Santos, 2003, Tavares & Amouroux, 2003).

This species was first identified in Brazil in 1996 in the states of Alagoas, Bahia and Rio de Janeiro (Calado, 1996, Carqueija & Gouvêa, 1996, Tavares & Mendonça-Júnior, 1996), being subsequently reported in coastal regions from the north to the south of the country. Based on that, the present study aims to fill a gap in the knowledge of the distribution of *C. hellerii* in Amapá state, confirming the invasion of the species in the northernmost region of the Brazilian coast.

Material & Methods

The specimens of *C. hellerii* were collected by scientific observers under the supervision of the *Centro Nacional de Pesquisa e Conservação da Biodiversidade Marinha do Norte* (ICMBio/CEPNOR) in the industrial fisheries targeting the southern brown shrimp in the northern Brazilian coast (Amapá State), between the depths of 20 and 90 m (Figure 1). On board, the specimens of *C. hellerii* were photographed, measured in Carapace Length (CL) and Carapace Width (CW) with a caliper (0.01 mm), packaged in suitable containers and stored in a cold chamber.

After sampling, the individuals were transported to the Crustacean Laboratory (LABCRUS) at CEPNOR and *Universidade Federal Rural da Amazônia* (UFRA), where the specimens were identified and sexed (Wee & Ng, 1995), preserved in ethyl alcohol 70%, and later deposited in the Carcinological Collection of the Crustacean Laboratory, under the voucher numbers: 20.4.1 A, 20.4.1 B and 20.4.1 C.

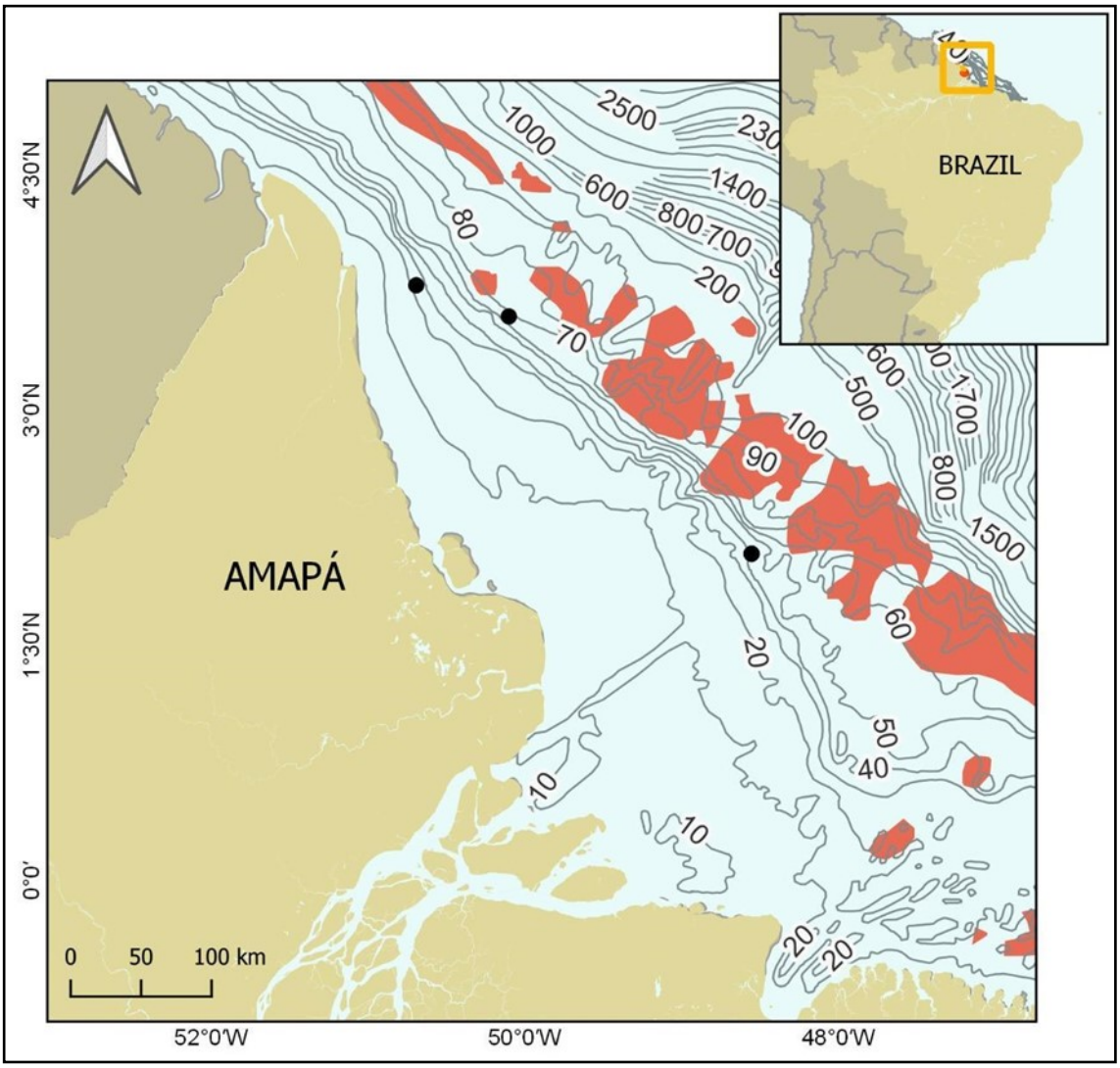

Figure 1. Map of the continental shelf of Amapá State, Brazil, showing occurrence points of *Charybdis hellerii* (A. Milne-Edwards, 1867) (black circles) in the southern brown shrimp fishery. Great Amazon Reef System (red area) shape according to Moura *et al.* (2016) and Francini -Filho *et al.* (2018). Image: Modified from Cintra *et al.*, 2023.

Results

Family Portunidae Rafinesque, 1815

Genus *Charybdis* De Haan, 1833

Charybdis hellerii (A. Milne-Edwards, 1867)

(Figure 2 A - D)

Examined material - We analyzed three females and one male: 1 female, CL 30.1 mm, CW 47.2 mm; Brazil, industrial bottom shrimp trawling area, Amapá state, 03°47'47"N 050°41'36"W, depth of 30 m; June 23rd, 2006, Figure 2-A, voucher number 20.4.1 B; 1 female, CL 22.4 mm, CW 43.4 mm; Brazil, industrial bottom shrimp trawling area, Amapá state, 02° 05'00"N 048°33'15"W, depth of 45 m; June 22nd, 2010, Figure 2-B, voucher number 20.4.1 A; 1 male, CL 31.1 mm, CW 48.7 mm; Brazil, industrial bottom shrimp trawling area, Amapá state, 02°05'00"N 048°33'15"W, depth of 45 m; July 16th, 2010, Figure 2-C, voucher number 20.4.1 A; 1 female, TL 31.1 mm, CW 48.7 mm; Brazil, industrial bottom shrimp trawling area, Amapá state, 03°35'52"N 050°06'09"W, depth of 50 m; April 14th, 2013, Figure 2-D, voucher number 20.4.1 C.

Diagnosis - See Wee & Ng (1995).

Chronology of records by State/Brazil (Figure 3) - **Alagoas**: Calado (1996). **Bahia**:

Figure 2. Phenotypic variation of *Charybdis hellerii* (A. Milne-Edwards, 1867) color, caught at the continental shelf of Amapá State, Brazil. A: female, CL 30.1 mm, CW 47.2 mm; B: female, CL 22.4 mm, CW 43.4 mm; C: male, CL 31.1 mm, CW 48.7 mm; D: female, CL 31.1 mm, CW 48.7 mm. Scale bar: 1 cm.

Carqueija & Gouvêa (1996), Almeida *et al.* (2003), Almeida *et al.* (2006). **Rio de Janeiro**: Tavares & Mendonça-Júnior (1996). **São Paulo**: Negreiros-Fransozo (1996), Mantelatto & Souza-Carey (1998), Mantelatto & Dias (1999), Mantelatto & Fransozo (2000), Mantelatto & Garcia (2001); Mantelatto *et al.* (2003), Bertini *et al.* (2004), Reigada *et al.* (2006), Bernadochi *et al.* (2012), Sant'Anna *et al.* (2012), Watanabe *et al.* (2015). **Santa Catarina**: Mantelatto & Dias (1999), Boos *et al.* (2010), Abbud *et al.* (2018). **Rio Grande do Norte**: Ferreira *et al.* (2001), Ferreira & Sankarankutty (2002). **Pernambuco**: Coelho & Santos (2003), Santos & Coelho (2007), Siqueira *et al.* (2021). **Ceará:** Bezerra & Almeida (2005). **Maranhão**: Feres *et al.* (2007). **Paraná**: Frigotto & Serafim-Junior (2007), Occhi *et al.* (2019). **Piauí**: Lima-Júnior *et al.* (2008). **Espírito Santo:** Musiello-Fernandes *et al.* (2011). **Pará**: Bentes *et al.* (2013).

Discussion

The first occurrence of *C. hellerii* on the northern Brazilian coast was reported 10 years ago by Bentes *et al.* (2013), but the species occurrence in French Guiana was reported in 2003 by Tavares & Amouroux (2003). So, the occurrence reported here, in the State of Amapá, fills a gap in knowledge about the distribution of the species on the Brazilian coast.

The bioinvasion of *C. hellerii* is considered an example of successful introduction of a marine exotic species in the Atlantic Ocean (Tavares & Amouroux, 2003). Although it was recorded in Brazil only in the 1990s, *C. hellerii* was captured for the first time in Ilha Grande, State of Rio de Janeiro, in 1965 (Tavares & Rössener, 2019).

This invasion may have been favored by the larval phase duration of around 44 days

Figura 3. Chronology of records of *Charybdis hellerii* (A. Milne-Edwards, 1867) by State in Brazil. 1. Alagoas; 2. Bahia; 3. Rio de Janeiro; 4. São Paulo; 5. Santa Catarina; 6. Rio Grande do Norte; 7. Pernambuco; 8. Ceará; 9. Maranhão; 10. Paraná; 11. Piauí; 12. Espírito Santo; 13. Pará; 14. Amapá: Present study. Image: Modified from Google® Earth.

(Dineen *et al*., 2001), a period longer than needed to cross the Atlantic Ocean in ballast water of ships or larval transport via coastal currents. According to Negri *et al*. (2018) the Mediterranean Sea represented the main origin of the Western Atlantic populations.

For the coastal Brazilian States, there is no occurrence record of *C. hellerii* in Paraíba, Sergipe and Rio Grande do Sul. As there is no abiotic or biotic barrier explaining the non-establishment of this species in these States, we believe it is already present at these coastal states, except in Rio Grande do Sul, where lower water temperatures may limit its southern distribution.

The specimens caught presented carapace color varying from greenish to brown/reddish, with a mottled pattern (Figure 2). These phenotypic variations are observed in other Brachyura and it may be related to camouflage in the micro-habitat, reducing predation effects. As observed by Watanabe *et al*. (2015), color may also vary with size or sexual maturation stage.

Southern brown shrimp [(*Penaeus subtilis* (Pérez-Farfante, 1967) and *Penaeus brasiliensis* (Latreille, 1817)] fishing is performed at the Brazilian northern coast between the depths of 20 and 90 m, using bottom trawl. This fishing activity is harmful to the aquatic environment because there is a diverse bycatch fauna associated with the fishery, whose removal disrupts the local marine communities. This may favor the establishment of opportunistic species such as the invasive swimming crab *C. hellerii*.

The report of *C. hellerii* in Amapá confirms the northernmost occurrence in Brazil of this swimming crab and its adaptability to different ecosystems, once we find variations in climate and physicochemical conditions of the water masses along the coastal zones, as observed in the Amazon River discharges.

This invasive swimming crab is well established in estuaries and shallow intertidal rocky shores (Sant'Anna *et al*., 2012, 2015). The record of its occurrence near the GARS, at depths of 30 to 50 meters, contributes to the understanding of the extent of its invasion and resulting impacts.

In addition to *C. hellerii*, the alien species *Ophiothela mirabilis* (Verrill, 1867), an alien brittle star from the Pacific Ocean (Moura *et al*., 2016), and the lionfish *Pterois volitans* (Linnaeus, 1758) (Cintra *et al*., 2022, 2023) have already been found in GARS.

An example of the impact of alien species on other species is food competition. In the case of the diet of *C. hellerii*, it is similar to that of other native crabs which feed on crustaceans, molluscs, polychaetes and algae, among

others (Sant'Anna *et al*., 2015).

Considering this and other impacts generated, it is essential to carry out efforts to monitor and control alien species, especially in priority environments for conservation such as GARS.

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