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SHORT COMMUNICATION

A case of bilateral hypertrophy in the chelae of a male specimen of *Minuca rapax* (Smith, 1870) (Decapoda, Brachyura, Ocypodidae)

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ABSTRACT

The present study describes the first record of bilaterally hypertrophied chelipeds in a male fiddler crab, *Minuca rapax* (Smith, 1870), collected in the mangrove area near the city of Jaguaribe, located in the northern portion of Itamaracá Island in Pernambuco, Brazil. This particular specimen was captured by hand as it emerged from its burrow. Of the total 126 individuals (48 females and 78 males) of the genus *Minuca* Bott, 1954 captured, only one presented chelipeds similar in size and shape. Some of the causes of malformation in decapods have been attributed to a double generation of growth areas or non-synchronous regenerative coordination in wound healing. Due to the lack of studies on the definitive cause of these abnormalities and deformations, further investigations are required to determine the roles of individuals with abnormalities within populations as well as the principal causes of these abnormalities.

KEY WORDS

Anomalous crustacean, abnormality, marine invertebrates, Brachyura

Deformations, also referred to as anomalies, are morphological aberrations that appear during development. These deformations produce body parts of disproportionate sizes, irregularly shaped body segments and/or additional appendages (Araújo and Calado, 2012). The occurrence of these deformations is not especially uncommon, having been documented by Benetti and Negreiros-Fransozo (2003) in a case study of cheliped symmetry in *Uca burgersi* [= *Minuca burgersi* (Holthuis, 1967)]. Pinheiro and Toledo (2010)

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recorded cheliped malformation in a specimen of *Ucides cordatus* (Linnaeus, 1763), Fransozo *et al.* (2012) described external morphological abnormalities in marine crabs (Decapoda, Brachyura) on the northern coast of the state of São Paulo, and Lira e*t al.* (2013) recorded a case of malformation in the third maxilliped for a fiddler crab violinist *Uca rapax* [= *Minuca rapax* (Smith, 1870)]. Recently, Zambrano (2017) recorded the first case of malformation in *Ucides occidentalis* (Ortmann, 1897) for 11 specimens in the Gulf of Guayaquil, Ecuador.

Several authors have reported possible causes of malformations. These external changes occur naturally as a result of ecdysis (Zanata *et al.,* 2008), or caused by factors such as abnormal regeneration (Rasheed *et al.,* 2014; Purohit and Vachhrajani, 2016), parasitic diseases, mutations (Von Vaupel Klein and Koomen, 1993) or exposure to extreme environmental conditions (Kurihara, 2008; Pandourski and Evtimova, 2009).

Fiddler crabs are found on every continent, with the exception of Antarctica, and are among the most familiar and abundant inhabitants of mangrove forests and estuaries in tropical, subtropical and temperate areas throughout the world (Thurman *et al.,* 2013). With ten species inhabiting the western coast of the South Atlantic ocean and occurring all along the Brazilian coast (Bezerra, 2012; Thurman *et al.*, 2013), these crabs present one of the highest degrees of sexual dimorphism found among decapods (Rosenberg, 2001). Males show a high level of body asymmetry, presenting a specialized cheliped for behavioral display (cutting, agonistic behaviors and defense) in addition to a smaller cheliped adapted for capturing food. Females present small, symmetrical chelipeds, which are morphologically adapted for feeding (Crane, 1975). The objective of this work was to record the occurrence of high degree of development in the two chelipeds of a male specimen of violinist crab captured in the region of Itamaracá Island, northern coast of the state of Pernambuco, Brazil.

All crabs were manually collected monthly between December 2016 and April 2017, totaling 126 individuals (48 females and 78 males) of the genus *Minuca* Bott, 1954 as part of a study aimed to analyze the morphometrics of Ocypodidae. The specimen with the anomaly was captured by hand as it emerged from its burrow. It was encountered in a mangrove area that had been significantly altered through shrimp farming, located near the city of Jaguaribe, on the northern portion of Itamaracá Island in Pernambuco, Brazil (7°45’S 34°50’W).

Once captured, all the specimens were stored in a plastic pot for later analysis. After being cryoanesthesized at -10°C, the specimens were identified according to the keys proposed by Bezerra (2012) and Shih *et al.* (2016), photodocumented and measured using precision calipers (0.01 mm), carapace width (CW), carapace length (CL), body height (BH), front width (FW), right chela height (RCH), left chela height (LCH), right chela length (RCL), left chela length (LCL), right dactylus length (RDL), and left dactylus length (LDL).

A total of 78 male fiddler crabs of the species *M. rapax* were collected. Among these specimens, only one individual presented bilateral hypertrophy in chelae (Fig. 1). The dimensions of this individual were: (CW) 15.6 mm; (CL) 10.1 mm; (RCH) 8.0 mm; (LCH),

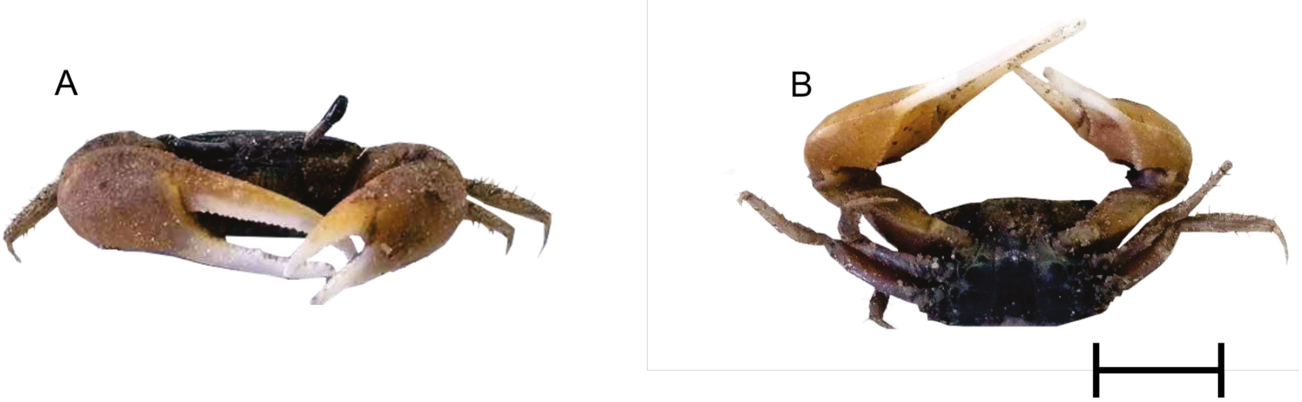

Figure 1. Male of *Minuca rapax* presenting bilateral hypertrophy in chelae, captured near to Jaguaribe municipality, northern region of Itamaracá Island, Pernambuco, Brazil. A, frontal view; B, ventral view with the smaller cheliped in front. Scale bar: 10 mm.

7.1 mm; (RCL) 23.8 mm; (LCL) 15.9 mm; (BH) 7.7 mm; (FW) 4.0 mm; (RDL) 15.1mm; (LDL) 8.8 mm.

Fiddler crabs are one of the most common and abundant inhabitants of mangrove forests and estuaries throughout the world (Thurman *et al*., 2013). Only a few cases of malformation, however, have been documented amongst these species (Tab. 1). Morgan (1920) described the existence of four distinct morphotypes for fiddler crabs (right-handed; left-handed; with small claws of equal size or with two large claws). Males with two large claws developed both left and right chelipeds; however, there is little evidence to support the aforementioned hypothesis as described by Morgan (1920) (Tab. 1). Ahmed (1976) noted that some additional implications such as the presence of similar anomalies in chromosome make-up or the existence of embryological or growth disorders, are necessary for polymorphism to occur.

The chelipeds may be more likely to develop malformations due to their greater likelihood of injury from fighting behavior and their being shed during the later stages of molting process (Shelton *et al.,* 1981). Fransozo *et al.* (2012) argued that some malformation in decapods can been attributed to a double generation of growth areas. Lira *et al.* (2013) suggested that malformation of the third maxilliped in *Uca rapax* (= *M. rapax*) occurs due to errors in morphogenetic processes; Vale *et al.* (2015) analyzed the hypertrophy of chelipeds in *U. rapax* (= *M. rapax*) and stated that the collected specimen may have suffered a dysfunction of the androgenic gland, which altered the development of sexual characteristics (Tab. 2).

External factors such as temperature, lack of resources, pollution, directional selection and inbreeding can all influence gene expression, leading to extreme variations (Chippindale and Palmer, 1993). Therefore the likely hypothesis for this particular case is that the increased nutrients caused by shrimp farms in the area may have altered the gene expression of the specimen. Thus, the hypertrophy suffered by both chelipeds was possibly the result of the expression of genes, responsible for the expression of the body architecture, such as the Hox genes or the genes *sp-IAG* (Averof and Patel, 1997; Abzhanov and Kaufman, 2000). In addition, the hypertrophy arises because of the expression hormones produced by the androgenic glands that act in the development of sexual characteristics (Zhang *et al*., 2014).

Table 1. Bilateral hypertrophy in fiddler crab species (according to current generic combinations) captured in natural environments. N, number of individuals; (-), not reported; SMC, super-male chelipeds (according to Morgan, 1920).

Reference	Species	N	SMC	Country
Morgan (1920)	*Leptuca pugilator*	1648	13	United States
Ahmed (1978)	*Leptuca cumulanta* and *Minuca rapax*	640	5	Venezuela
Benetti and Negreiros-Fransozo (2003)	*Minuca burgersi*	318	4	Brazil
Lira *et al.* (2006)	*Leptuca cumulanta*	-	1	Venezuela
Vale *et al.* (2015)	*Minuca rapax*	-	1	Brazil
Present study	*Minuca rapax*	126	1	Brazil

Table 2. Hypertrophic chela dimensions (mm) in adult male fiddler crabs species according to current generic combinations. R, right cheliped; L, left cheliped

Species	Cheliped length		Cheliped height		References
	R	L	R	L	
Minuca rapax	23.80	15.90	8.00	7.10	Present study
Minuca rapax	15.40	15.80	6.90	7.20	Vale *et al.* (2015)
Leptuca cumulanta	13.83	13.83	5.50	5.17	Lira *et al.* (2006)

Due to the sporadic occurrence of these anomalies, there are few existing studies on the underlying causes of abnormalities and deformations. Further investigations are also needed to determine the role of these anomalous individuals within populations as well as the primary causes of such anomalies.

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