

MARINE RECORD

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Modern problems in marine biodiversity records – illustrated by the case of the Caribbean *Pelia mutica* (Gibbes, 1850) confirmed in Brazil

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Abstract

This report confirms the presence of *Pelia mutica* in Brazil, extending its range by approximately 4000 km south to the southwestern Atlantic Ocean from its most southerly recorded distribution. The presence of this small ornamental marine crab with cryptic habits and native to Caribbean waters raises some challenging questions about modern problems in marine biodiversity records. This case is an excellent example in relation to the importance of diligent biodiversity monitoring. It highlights why the skills of taxonomists are paramount when identifying silent biological invasion of supposedly irrelevant alien species in a modern Anthropocene epoch within an alarming scenario of defaunation and mass extinction.

Keywords: Teardrop crab, Coastal reefs, Ornamental decapod, Silent bioinvasion, Scuba diving, Nocturnal survey, Majoidea: Pisinae

Introduction

According with Ng et al. (2008) there are six known species representing the genus *Pelia* Bell, 1836. Among them, four species were described in the Western Atlantic Ocean *Pelia deflecta* Boone, 1927, *Pelia mutica* (Gibbes 1850), *Pelia pacifica* A. Milne-Edwards, 1875 and *Pelia rotunda* A. Milne-Edwards, 1875 (Milne-Edwards, 1875; Rathbun, 1925; Boone, 1927; Williams, 1984; Melo, 1996). *P. deflecta* was only reported by Boone (1927) and the last report for *P. pacifica* was in (Rathbun, 1925). Since then, there have only been two confirmed species in the Western Atlantic Ocean, *Pelia rotunda* in South America (Melo, 1996) and *Pelia mutica* in Central and North America (Williams, 1984). These two species were theoretically isolated in different eco-regions separated by the biogeographic barrier of Amazon-Orinoco plume (Spalding et al., 2007).

Pelia mutica is a known ornamental species traded in the aquarium industry as a decorator teardrop crab

(Calado et al., 2003). It was previously reported in Brazilian waters by Gouvêa & Leite (1980) and Gouvêa (1986), however due to an absence of deposited material, morphological description or figures and a sequence of incorrect identifications within their studies this crab's presence was considered doubtful (Almeida & Coelho, 2008; Coelho et al., 2008). This is compounded by a current lack of new research focusing on ecology, phylogeny and descriptive investigations into the morphological characteristics of these species. The absence of recent scientific material on the species becomes evident when we consider that the most significant references comparing the *Pelia* species are from key identifications in the late 19th and early 20th centuries (Milne-Edwards, 1875; Rathbun, 1925).

This report confirms the presence of *Pelia mutica* in Brazil, extending its range to the southwestern Atlantic Ocean. Its presence focuses the importance of diligent biodiversity monitoring and how the skills of taxonomists are paramount when identifying biological invasion of alien species in a modern Anthropocene epoch within a scenario of defaunation and mass extinction.

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Material and Methods

The biological material was collected during nocturnal SCUBA dives in the reefs of Porto de Galinhas (8°30' S/ 35°00' W) in 2005 (Pernambuco state - Brazil). Specimens were observed and collected during nocturnal underwater visual census analysis; they were identified and deposited in the Oceanographic museum Dr. Petrônio Alves Coelho at Federal University of Pernambuco (MOUFPE) and previously used in a PhD thesis (Giraldes, 2012) and in a scientific article (Giraldes et al., 2012). It was erroneously identified in those first reports as *Pelia rotunda*.

Reviewing taxonomic references about decapod species (Milne-Edwards, 1875; Rathbun, 1925; Williams, 1984; Melo, 1996) noted some morphological features and habitat preferences which drew attention to the deposited species which were re-analysed and re-identified as *Pelia mutica*.

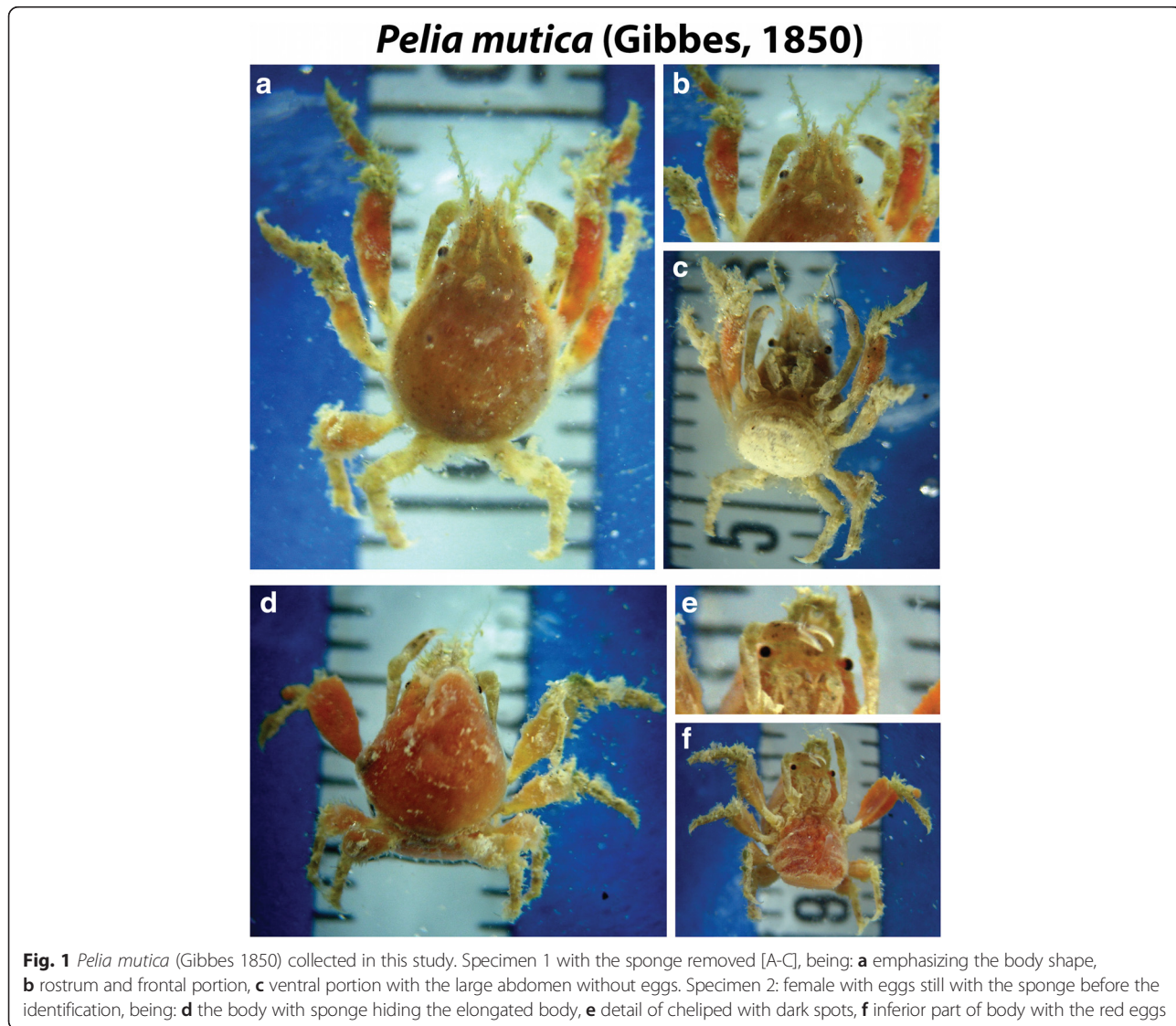
In an attempt to assist in the collation of information for this species some morphological differences among the existing species of genus *Pelia* in the West Atlantic Ocean are presented.

Results

Infraorder Brachyura Linnaeus 1758
 Superfamily Majoidea Samouelle 1819
 Family Epialtidae Macleay 1838
Pelia mutica (Gibbes 1850)
 Figure 1

References

Milne-Edwards, 1875:73; Rathbun, 1925:278; Lemaitre, 1981:246; Williams, 1984:321; Abele & Kim, 1986:553; Hernández-Ávila et al., 2007:39.



Material examined

1 Female with eggs, (Carapace Length: 6.3 mm/Carapace width: 3.8 mm) and 1 Female (Carapace Length: 7 mm/Carapace width: 4.8 mm) shallow reef Station of Porto de Galinhas beach (8°30' S/35°00' W) 1 m deep, collected 23.April.2005 (MOUFPE – 15.030 as *Pelia rotunda*).

Material observed

Two specimens on the reef edge at 1 m deep on encrusted orange sponge covered by the same sponge 23.April.2005 (the specimens captured for identification in laboratory); 1 specimen on an encrusted orange sponge (covered by the same sponge) on one an outcrop of reef at 3 m deep 24.April.2005; 1 specimen on the reef edge at 0.5 m deep on the hydrocoral *Millepora alcicornis* Linnaeus, 1758 covered by orange sponge, 25.April.2005; 1 specimen on encrusted black sponge on the reef edge at 1.5 m deep 26.April.2005. All specimens were observed during night dives on the reefs of Porto de Galinhas beach (8°30' S/35°00' W).

Distribution

Western Atlantic Ocean: from North America and Central America to the north coast of South America. More specifically from Buzzards Bay and Vineyard Sound in Massachusetts (northern record), including Port Mansfield, Willacy in Texas, Cuba, Puerto Rico and St. Thomas in the US Virgin Islands to the coast of Cartagena in Colombia and Cubagua Island in Venezuela (southern record).

Comparison of species within genus *Pelia* in Brazil

The main morphological characteristics in the key identification, which differentiate between *P. rotunda* and *P. mutica* were reported in Milne-Edwards (1875:73) and Rathbun (1925:278). Those distinctive characteristics are the length and convexity of carapace, larger and more convex in *P. rotunda* (almost as long as large); carapace surface is more flat in *P. mutica* and outstanding in gastric and cardiac areas in *P. rotunda*; with the rostrum shape smaller and more deflexed directed downward in *P. rotunda* (Fig. 2). Another morphological difference not included in the key identification is the proportion

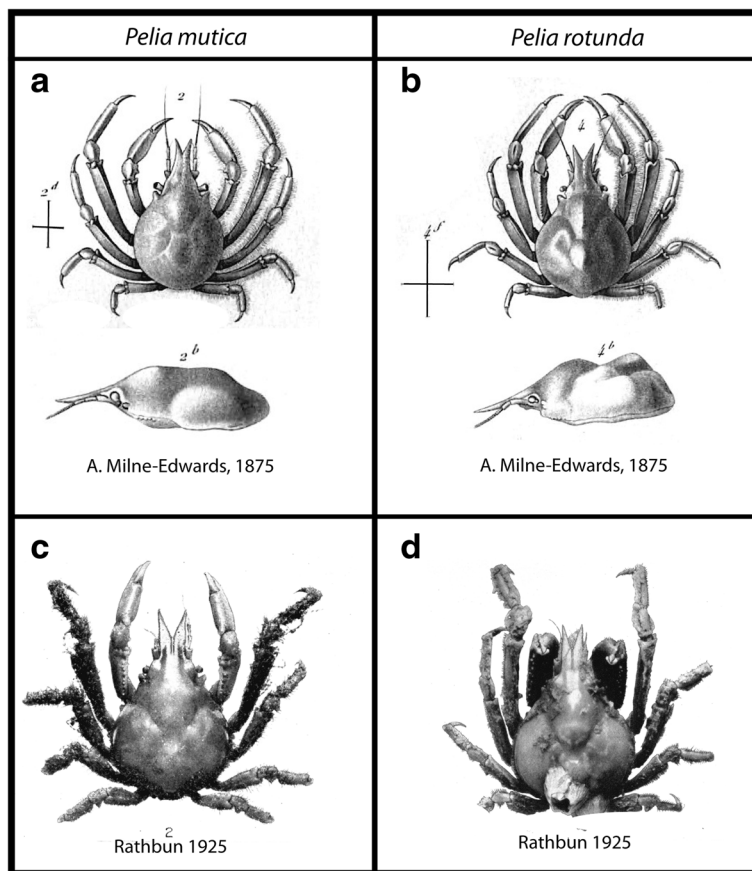


Fig. 2 Comparative table with (a, c) *Pelia mutica* (Gibbes, 1850) and (b, d) *Pelia rotunda* A. Milne-Edwards, 1875 with the images reported by Milne-Edwards (1875) in plate 16 and in Rathbun (1925) plate 98 and plate 100 respectively

of the pereopods where the 2° and 3° are much longer than 4° and 5° in *P. mutica* (see description and picture in Williams, 1984:321 and Fig. 1 here) while in *P. rotunda* the pereopods slowly decrease in length (see Melo, 1996:265 and Braga et al., 2005:14). *Pelia mutica* sampled here like the descriptions reported by Williams 1984 presents dark spots in the propod of chelipeds (Fig. 1) even when conserved in alcohol; however this characteristic is not reported for *P. rotunda* (Melo 1996) and is absent in the figure in Braga et al. (2005:14 fig. 20). This therefore can be considered as one of the characteristics for visual differentiation. There are also some important differences in habitat preference, as *P. rotunda* has been reported in soft substrates in the south-western Atlantic (Fransozo et al., 1992; Melo, 1996; Bertini et al., 2004; Braga et al., 2005) and *P. mutica* has been reported as inhabiting reef environments in north-western Atlantic (Williams, 1984; Lindberg & Stanton, 1988), as well as reported here in this study.

Remark

The present record confirms the presence of *P. mutica* along the Brazilian Coast; extending its range approximately 4000 km south (8°30' S - 35°00' W) from its most southerly recorded distribution (Cubagua Island - Venezuela) following the coastal contours between both reference points. This confirmation increases to 2 species within the genus *Pelia* in Brazil. Occurrences have previously been reported off the coast of Brazil in Bahia State (Gouvêa & Leite, 1980; Gouvêa, 1986), however, according to Coelho et al. (2008) and Almeida & Coelho (2008) several decapods reported in those first mentioned articles were incorrectly identified and there are no species deposited in marine collection to support the species occurrence. Because of this, the presence of *Pelia mutica* in Brazil has been considered doubtful before this study.

Discussion

The human impact on all life on earth, in both terrestrial and marine ecosystems, has been so intense that several scientists have now recognized this period of time as a new geological epoch, the Anthropocene (Zalasiewicz et al., 2010; Steffen et al., 2011; Smith & Zeder, 2013). In marine ecosystems this era is typified by a defaunation and mass extinction of species driven by human initiated impact factors such as; overfishing with resulting trophic cascade effects, by the introduction of pollutants and alien invasive species (Pinnegar et al., 2000; Shears & Babcock, 2003; Smith et al., 2011; Stigall, 2012; Säterberg et al. 2013; McCauley et al., 2015). This last factor, the biointroduction of invasive species has been identified as the main reason leading to the great mass extinction during the late Devonian in the Phanerozoic (Stigall,

2012). The implications of which were the breaking of the allopatric barriers and vicariance effects thereby excluding non-generalist species. Large and easy identifiable bioinvasive species like the lion fish *Pterois volitans* (Linnaeus, 1758) in the Caribbean Sea have received a great deal of attention from the scientific community due its easily identifiable deleterious effects on native reef fish communities (Albins & Hixon, 2008). However small and supposedly irrelevant alien species within a new ecosystem often start as a silent or unnoticed bio-invader with the potential to quickly spread and impact the associated ecosystem. This pattern of events has been witnessed previously during the supposed insignificant invasion of several species for example; the golden mussel *Limnoperna fortunei* (Dunker, 1857) in the lakes of south America (Boltovskoy & Correa, 2015), the zebra mussel *Dreissena polymorpha* (Pallas, 1771) in Europe (Nalepa & Schloesser, 1992), the sun coral *Tubastraea coccinea* (Lesson 1830) in Americas rocky reefs (Sammarco et al., 2010; Da Silva et al., 2014) and the shrimp *Litopenaeus vannamei*, (Boone, 1931) globally (Liao et al. 2011). The influence of an alien species can reach beyond that of mere competition within a delicately balanced indigenous marine community. In North America in estuaries along the Pacific coast established non-indigenous setting competitor species depressed the survival of the native Olympia oyster *Ostrea lurida* Carpenter, 1864 by 50 % and retarded its growth by 20 % (Trimble et al., 2009).

In the case of *Pelia mutica*, it may have been introduced by ballast water or possibly as a result of its popularity with aquarists. As it is was a common ornamental species commercially traded within the aquaria industry (Calado et al., 2003). Another explanation to its presence is that of natural dispersion through the counter-flowing North-Brazilian current, which crosses the biogeographic barrier of the Amazon-Orinoco plume. However large dispersions such as this seems improbable for a small cryptobenthic crab, inhabiting a shallow water niche (Williams, 1984). Floeter et al. (2008) revealed that species with similar characteristics tend to be highly sensitive to sediment discharge and Amazonian freshwater. However several species of reef fish have recently been reported as crossing this biogeographic barrier (Rocha et al., 2007; Rocha et al., 2008; Floeter et al., 2008; Luiz et al., 2013) and it has been shown that other species have migrated south from the Caribbean to Brazil millions of years ago as a result of a weakened current speed in the Amazon-Orinoco barrier (Rocha et al., 2007; Floeter et al., 2008).

It is also quite probable that this insignificant species was simply overlooked and has occurred in Brazil for a period of time, being misidentified as *Pelia rotunda*, as this is the only species of the genus described in Brazil

(Melo, 1996). The lack of nocturnal dive surveys when *P. mutica* is most active (Williams, 1984) may also be a reason for its non-identification. Gouvêa & Leite (1980) and Gouvêa (1986) identification of *Pelia mutica* in Bahia state which was considered unconfirmed by Coelho et al. (2008) and Almeida & Coelho (2008) as there was a lack of preserved and catalogued voucher samples in a recognised marine collection, following the traditional taxonomic methods. This episode of events highlights another current dilemma within all marine biological science, the shortage of skilled taxonomists (Boero, 2010; Pearson et al. 2011). The lack of new and correct systematic identification and the maintenance of relevant species check lists and conserved specimens deposited in marine collections have contributed to the concealment of some inexpressive bio-invasive species. These problems have been exacerbated by the lack of investment in the field of taxonomy with funding focusing on other fields within biological science which are considered more current.

Disregarding the factors as to how *P. mutica* appeared in Brazilian waters, its presence highlights negligence within the scientific community particularly in relation to the silent bio-invasion of species. Indeed several bioinvasive species have been recorded recently in Brazil such as the Mediterranean golden shrimp *Stenopus spinosus* Risso, 1827 in (Giraldes & Freire, 2015), the Indo pacific swimming crab *Charybdis hellerii* (A. Milne Edwards, 1867) in Tavares & Mendonça Jr, (1996), the sun coral *Tubastraea coccinea* (Lesson 1830) and *Tubastraea micranthus* (Ehrenberg 1834) in Sammarco et al. (2010) and Da Silva et al. (2014). Unfortunately this is a global problem reported in several marine ecoregions of the world (Bax et al., 2003; Molnar et al., 2008). If the previous extinctions of the Devonian are no to be repeated it will be necessary to direct a concerted effort into traditional taxonomic studies and the constant close monitoring of biodiversity species lists.

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Authors' contributions

BWG is the main responsible for the idea and results of this manuscript. DS participate in the discussion and concept of the idea. MC carried out the English revision, the editorial adjustments and some ideas to increase the quality of the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interest.

Declaration

- The manuscript was self-funded by authors.
- All authors agree to share data but there are no special extra data that makes necessary share a link or citations. Not Applicable.
- None relevant abbreviation was used in the manuscript. Not Applicable.

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