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## First record of *Pisa carinimana* (Decapoda: Epialtidae) from Madeira Island (Northeastern Atlantic Ocean) \*\*

With 4 figures

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**ABSTRACT:** The crab *Pisa carinimana* (Crustacea, Decapoda, Epialtidae) is an Eastern Atlantic species, with a previously recorded range from Malaga in the south of Spain to Angola along the west coast of Africa. As part of a field survey to monitor marine non-indigenous species in several marinas and ports of the archipelago of Madeira, Portugal, a specimen of *Pisa carinimana* was found. It was a fully grown ovigerous female with a carapace length of 7 mm collected inside the Port of Funchal in November 2013. This species is recorded for the first time from the island of Madeira.

**Keywords:** Madeira Island, *Pisa carinimana*, crustacean, artificial habitat collector, new record.

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**RESUMO:** O caranguejo *Pisa carinimana* (Crustacea, Decapoda, Epialtidae) é uma espécie do oceano Atlântico oriental, encontrada desde Málaga, no sul de Espanha, até Angola, ao longo da costa ocidental de África. Na sequência de um estudo de monitorização das espécies não indígenas realizado em vários portos e marinas do arquipélago da Madeira, Portugal, um exemplar de *Pisa carinimana* foi encontrado. Trata-se de uma fêmea ovada com 7 mm de comprimento de carapaça e foi colhida no interior do porto do Funchal em Novembro de 2013. Esta espécie é aqui assinalada pela primeira vez para o arquipélago da Madeira.

**Palavras-chave:** Ilha da Madeira, *Pisa carinimana*, crustáceos, coletor artificial, novo assinalamento.

## INTRODUCTION

With more than 6,500 species (AHYONG *et al.*, 2007) divided into 93 families (NG *et al.*, 2008), true crabs of the infraorder Brachyura are one of the most diverse and well-studied groups of decapod crustaceans (e.g. (NG *et al.*, 2008)). Their colonization success as introduced species is well documented in almost every marine and terrestrial habitat, even in areas where salinity and temperatures can fluctuate significantly (NG *et al.*, 2008).

The genus *Pisa* is distributed in the eastern Atlantic and Mediterranean Sea and is currently represented by a total of nine species: *P. armata*, *P. calva*, *P. carinimana*, *P. hirticornis*, *P. lanata*, *P. muscosa*, *P. nodipes*, *P. sanctaehelenae*, and *P. tetraodon* (NG *et al.*, 2008).

*Pisa carinimana* was first described by MIERS (1879) from the Canary Islands, but this eastern Atlantic species is distributed along the west coast of Africa, from the Canaries and Spanish Sahara down to Angola, including Melilla in the Mediterranean (ZARIQUIEY ALVAREZ, 1968). It has been recorded from numerous localities between Mauritania and Gabon by MONOD (1956) and is found living in relatively shallow water down to 50 m of depth along the West African coast (ZARIQUIEY ALVAREZ, 1968). A few specimens have been reported in deeper waters, specifically 85 and 100 m off Ghana (CAPART, 1951; GAULD, 1960). This species appears to have a preference for soft bottom habitats characterized by sand, mud, or mud with bryozoans (MANNING & HOLTHIUS, 1981). Many authors have recorded ovigerous females throughout the year (CAPART, 1951; MONOD, 1956; FOREST & GUINOT, 1966; ZARIQUIEY ALVAREZ, 1968; GARCIA RASO, 1981; MANNING & HOLTHIUS, 1981).

*P. carinimana* was first recorded from the Mediterranean waters of the Iberian Peninsula by GARCIA RASO (1981), with eight specimens collected in Malaga in the 1980's and this is the first record of this species from Europe. The present paper represents the first record of *Pisa carinimana* Miers, 1879 from the Island of Madeira, Northeastern Atlantic Ocean.

## MATERIALS AND METHODS

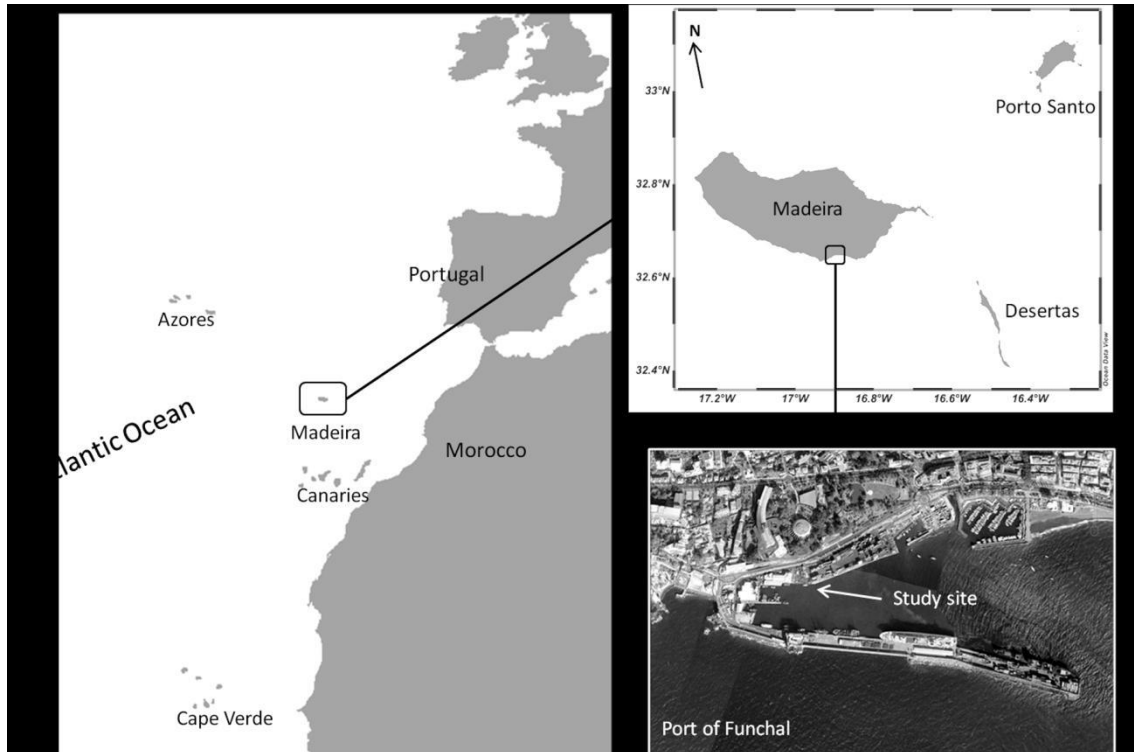
### Study site

Madeira is a volcanic island located southwest of continental Europe and 700 km off the Moroccan coast with a surface area of 758.5 km<sup>2</sup>. This study was done inside the harbour of Funchal, located on the south coast of Madeira (32° 38' 33" N, 16° 54' 56" W) (Fig. 1). The port has a total area of approximately 0.18 km<sup>2</sup> of surface water and total docking port length of 1.5 km. Historically, Funchal has been an important passage route for many ships traveling between Europe and the African and American continents because of its strategic position in the Atlantic Ocean. Today most of the maritime traffic arises from touristic cruise ships from different parts of the world (APRAM, 2014).

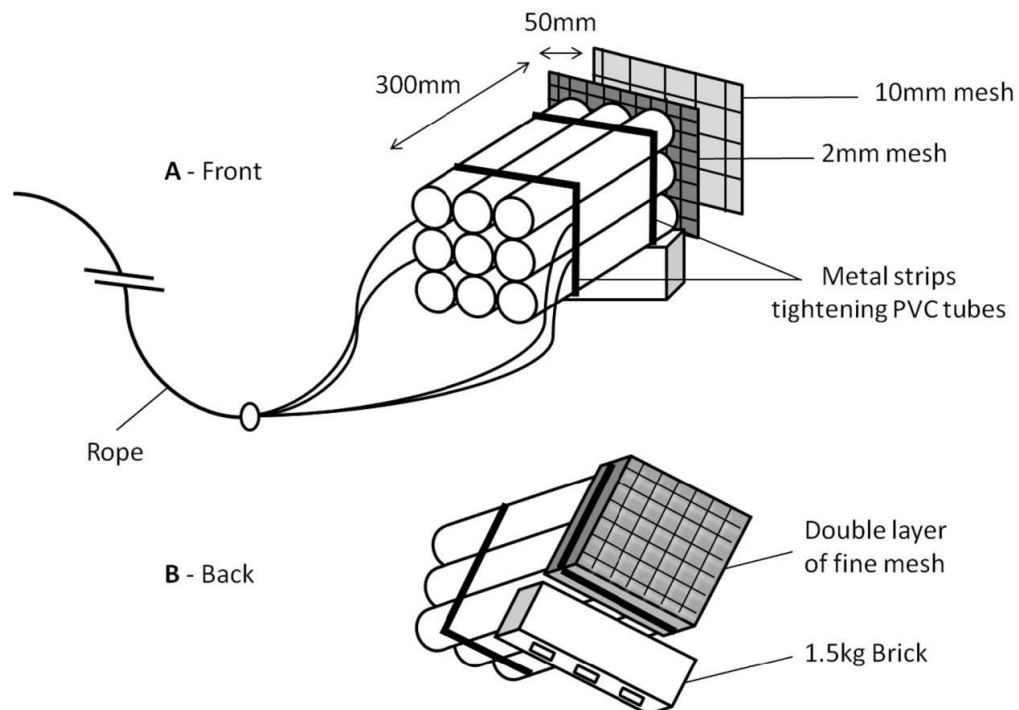
In the framework of a monitoring programme of marine non-indigenous species in Madeiran waters, in summer 2013, we deployed artificial habitat collectors (hereafter named collectors) (Fig. 2) for small mobile organisms to survey every major port and marina of the archipelago of Madeira on a regular basis. The present study started on 30 October 2013 with five collectors deployed inside the port of Funchal at approximately 10 meters depth. The minimum distance between the collectors was seven meters, and these collectors were submerged for a period of four weeks before retrieval.

These artificial habitat collectors are non-baited collectors and are an alternative to baited collectors built to attract organisms by providing shelter within an organism's natural habitat. VELDHUIZEN (2000), for Chinese mitten crabs baited collectors only had a success rate of <1% capture while non-baited collectors had a success rate of 74%. Hence

smaller crab species are less likely to choose baited collectors since predation and cannibalism are common inside these collectors (GUILLORY, 1993; GUILLORY *et al.*, 2001). Sediment collected within collectors was mostly composed by sand, mud and gravel.



**Fig. 1** – Location of the study site inside the port of Funchal on the southern coast of Madeira, Portugal.



**Fig. 2** – Collector used in the port of Funchal on Madeira Island. (A) Front; (B) Back.

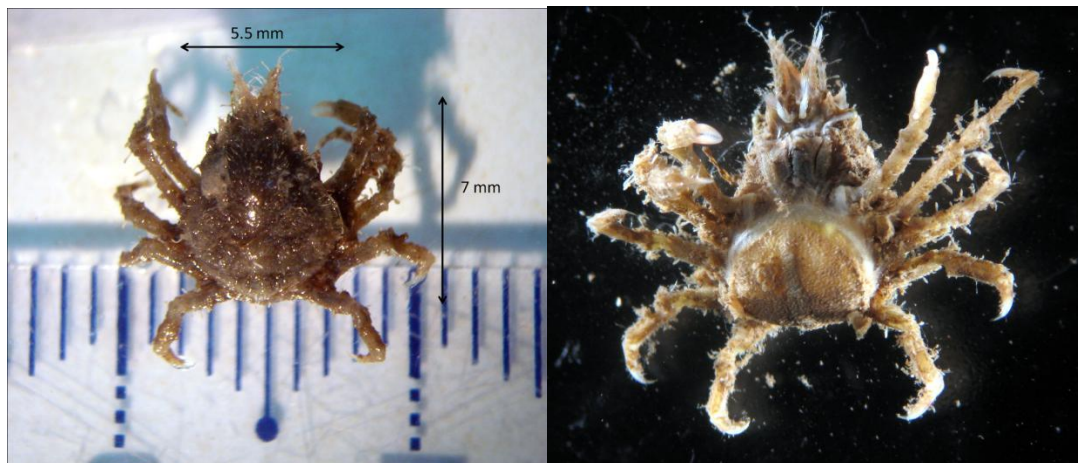
## Artificial collectors

Collectors used in the present study were built based on the ones employed by HEWITT & McDONALD (2013) from an original design by VELDHIJZEN (2000). Collectors were made from nine PVC tubes 30 cm long and 5 cm diameter arranged in a square matrix of 3 x 3, which was secured and tightened, with the support of two metal strips around it forming a single solid structure. One of the ends of the PVC matrix was covered with the use of two layers of fine mesh (2 mm inside layer / 10 mm outside layer) to prevent organisms from falling out when retrieving the collector (Fig. 2A). The other end of the matrix served as the entrance point for the organisms. A 1.5 kg brick was attached to one side of the structure end next to the layers of fine mesh to create sinking weight into its upright position (horizontally) at the bottom of the sea bed (Fig. 2B), and consequently, making the other end touching the bottom and also creating a ramp at the entrance point for any crawling organisms. Collectors were fastened and secured with cable ties and a rope was attached to the metal strip near the entrance in order to retrieve it vertically from the bottom and avoid losing any organisms inside the collector.

Collectors were retrieved from the water vertically using the attached rope, and its content was carefully placed into a plastic bucket with a lid. Each collector was placed in its own bucket. Within 20 minutes, the buckets were brought to the lab for taxonomic analysis under a stereomicroscope and digital photographs were taken.

## RESULTS

A single specimen of *Pisa carinimana* Miers, 1879 (Fig. 3) was collected inside Funchal port in November 2013 and has been deposited at the Museu de História Natural do Funchal, Madeira, and registered as MMF 42827. The specimen collected is an ovigerous female (Fig. 3, ventral view) with a carapace width of 5 mm and a carapace length of 7 mm. Other invertebrates were also present in collectors, but, for the purpose of this paper, we only report the presence of *P. carinimana*.



**Fig. 3** – *Pisa carinimana* Miers, 1879, ovigerous female, MMF 42827, CL 5.5 mm, CW 7 mm. Left: dorsal view; Right: ventral view.

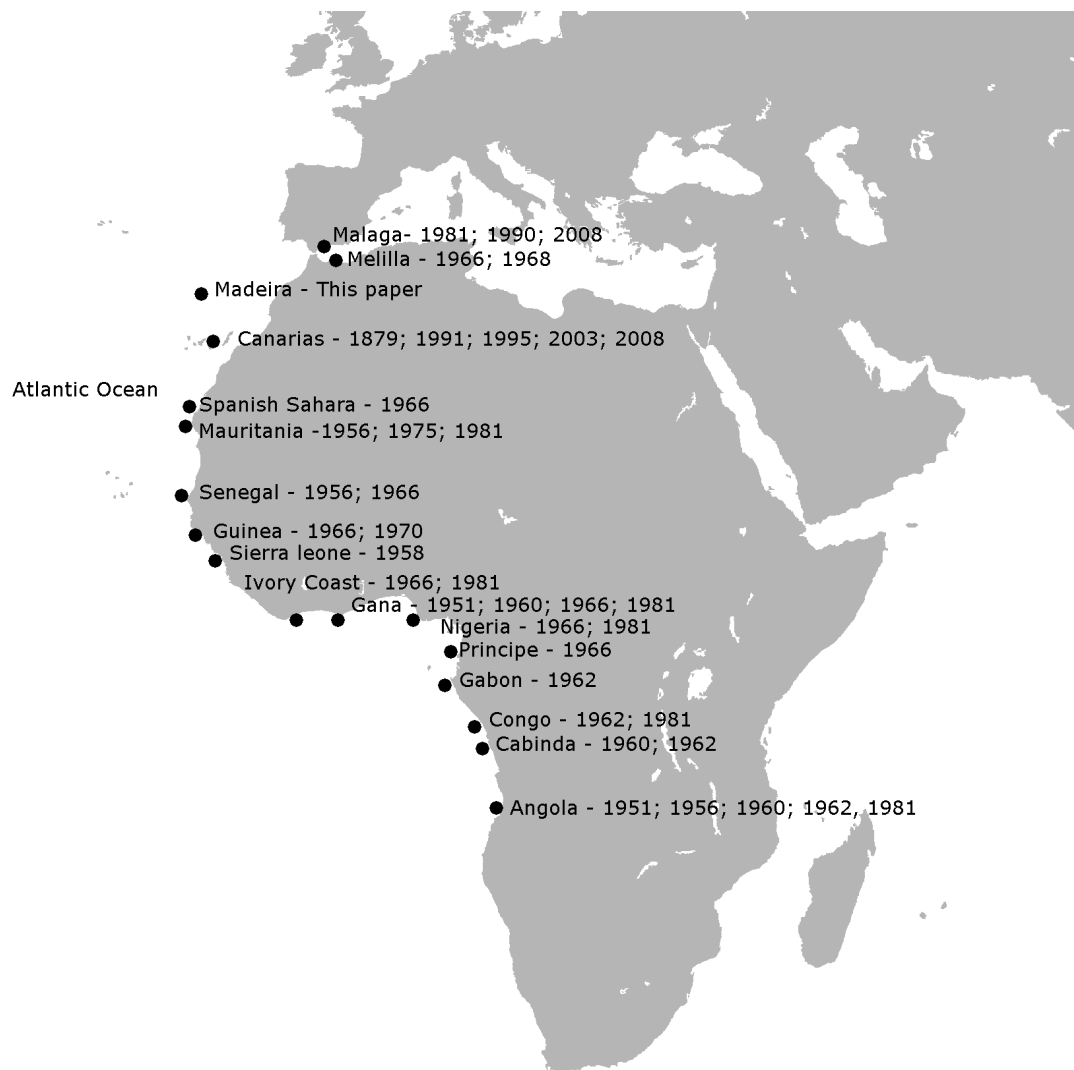
## DISCUSSION

*Pisa carinimana* was first described by MIERS in 1879 from the Canary Islands, and since then, several records have been reported for West Africa (Fig. 4). After its discovery in the Canaries, this species was found in the same Archipelago during two scientific expeditions (FRANSEN, 1991; GONZÁLEZ PÉREZ, 1995; MORO *et al.*, 2003). Seventy years after its discovery, it was found in Ghana and Angola during the Belgium Oceanographic Expedition, aboard the *Noordende III* (CAPART, 1951). Later MONOD (1956) in his account on the West African Brachyura, records *P. carinimana* from the coast of

Mauritania, Senegal, and Angola. As a result of several scientific campaigns in West Africa during the 1960's, specimens of *P. carinimana* were also recorded from Melilla, the Spanish Sahara, Senegal, Guinea, the Ivory Coast, Ghana, Nigeria, Principe, Sierra Leone, Gabon, Congo, and Cabinda (LONGHURST, 1958; GAULD, 1960; GUINOT & RIBEIRO, 1962; ROSSIGNOL, 1962; FOREST & GUINOT, 1966). ZARIQUIEY ALVAREZ (1968) gives the species distribution along the Alboran Sea for the Spanish region of Melilla, located on the North coast of Africa, whereas TÜRKAY (1975) lists *P. carinimana* from Mauritania during an expedition of the F. S. "Meteor" in 1972. Finally, *P. carinimana* was reported for the first time in European waters (Southern Spain) during the early 1980's by GARCIA RASO (1981). Other studies have found additional records of *Pisa carinimana* for the same countries along the West African coast (see USCHAKOV, 1970; ANADON, 1981; MANNING & HOLTHIUS, 1981; GONZÁLEZ GORDILLO *et al.*, 1990, GARCÍA MUÑOZ *et al.*, 2008) (Fig. 4).

*P. carinimana* is known to have a preference for soft-bottom habitats, mostly sand and mud with bryozoans or foraminifera (MANNING & HOLTHIUS, 1981) at a depth range between 4 and 100 meters (CAPART, 1951; GAULD, 1960; FRANSEN, 1991). Carapace lengths for females range between 3-17 mm (MANNING & HOLTHIUS, 1981), whereas males could reach up to 23 mm (MONOD, 1956). The eggs of ovigerous females have sizes between 0.30 to 0.33mm (ZARIQUIEY ALVAREZ, 1968).

This paper represents the first record of *Pisa carinimana* from Madeira Island, but it remains uncertain when this species arrived. Observing and collecting this species can be tricky because of its small size and its propensity to decorate itself with clumps of seaweeds to avoid predation. Finally, the use of inappropriate collectors and the lack of sampling inside Funchal port have probably contributed to overlooking this species.



**Fig. 4** – Overall distribution of *Pisa carinimana* showing locations and dates when the species was recorded, as obtained from the available literature.

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