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A NEW MEDITERRANEAN RECORD OF THE SACOGLOSSAN *THURIDILLA MAZDA* (MOLLUSCA, GASTROPODA) WITH A REVIEW OF ITS DISTRIBUTION, BIOLOGY AND ECOLOGY

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ABSTRACT

The present note reports the second Mediterranean record of the sacoglossan Thuridilla mazda *Ortea & Espinosa, 2000. This species, originally described from the Caribbean Sea (West Atlantic), has been, in the last 20 years, reported in two areas of Macaronesia (the Azores and the Canary Islands) and in the westernmost part of the Mediterranean basin. This second Mediterranean record, occurring in the central-eastern coast of Sicily (Ionian Sea), represents another important step in the knowledge of this species. In addition, the note summarizes available information on the distribution, biology and ecology of this species.*

Key words: Ionian Sea, marine Heterobranchia, Sacoglossa, Santa Maria La Scala, Sea slugs

NUOVA SEGNALAZIONE PER IL MEDITERRANEO DEL SACOGLOSSO *THURIDILLA MAZDA* (MOLLUSCA, GASTROPODA) CON REVISIONE DELLA SUA DISTRIBUZIONE, BIOLOGIA ED ECOLOGIA

SINTESI

La presente nota riporta la seconda segnalazione per il Mediterraneo del sacoglosso Thuridilla mazda *Ortea & Espinosa, 2000. Questa specie, originariamente descritta per il Mar dei Caraibi (Atlantico occidentale), negli ultimi 20 anni è stata segnalata in due aree della Macaronesia (Azzorre e Canarie) e nella parte più occidentale del bacino Mediterraneo. Questa seconda segnalazione mediterranea, avvenuta lungo la costa centro-orientale della Sicilia (mar Ionio), rappresenta un altro importante passo avanti nella conoscenza della specie. La nota inoltre riassume le informazioni disponibili sulla distribuzione, la biologia e l'ecologia di questa specie.*

Parole chiave: mar Ionio, Heterobranchia marini, Sacoglossa, Santa Maria La Scala, lumache di mare

INTRODUCTION

One of the most striking and particular groups featured among the sacoglossans of the family Plakobranchidae Gray, 1840 is, without any doubt, the genus *Thuridilla* Bergh, 1872. Its members, unlike the majority of the Sacoglossa, are mainly characterised by flamboyant body coloration and the habit of living in open environments rather than hiding in various substrates (Jensen, 1992; Gosliner, 1995). Generally, these molluscs display black, brown or violet base coloration along with bands, spots and dots of various colour (*e.g.*, orange, red, yellow, blue, purple or green) (Jensen, 1992; 1997) which, on the whole, correspond to the chromatic patterns shared by the different species of this genus (Martín-Hervás *et al.*, 2021).

These sacoglossans have a relatively narrow head and foot, and their parapodia are never joined at the front (Schmekel & Portman, 1982). The rolled-shaped rhinophores are joined proximally on the middle-dorsal part of the head, which is smaller in size than the rhinophores (Jensen, 1992; 1997). There are 25 species of the genus Thuridilla (MolluscaBase eds., 2023), which are distributed in tropical and warm-temperate waters (Martín-Hervás *et al.*, 2021). The large part of these species inhabits the tropical Indo-West Pacific, while a distinct minority is found in the Atlantic Ocean (Martín-Hervás *et al.*, 2021). Until recently, the only species of the *Thuridilla* genus distributed in the Mediterranean basin was *T. hopei* (Vérany, 1853) (Schmekel & Portman, 1982; Trainito & Doneddu, 2014). However, in February 2021 another species of this genus, *T. mazda* Ortea & Espinosa, 2000 was found in the Alboran Sea (Orfanidis *et al.*, 2021). Being the species initially reported in Cuba and Costa Rica (Ortea & Espinosa, 2000; Valdés *et al.*, 2006), subsequently in the Bahamas (Redfern, 2002; 2013), Guadeloupe (Ortea *et al.*, 2012), Mexico (Carmona *et al.*, 2011), Florida (Martín-Hervás *et al.*, 2021), and, finally, in the area of Macaronesia (the Azores and the Canary Islands) (Malaquias *et al.*, 2012; Ortea *et al.*, 2015) (Fig. 1A-B), it took over 20 years for it to extend its known distribution towards the east, beyond the Strait of Gibraltar and into the westernmost part of the Mediterranean Sea (Orfanidis *et al.*, 2021) (Fig. 1B). The present note documents a further finding of *T. mazda* within the Mediterranean basin, reported in this case in the central-eastern coast of Sicily (Ionian Sea).

MATERIAL AND METHODS

The finding of *Thuridilla mazda* was made during a morning scuba dive taken on 8 November 2022 in Santa Maria La Scala (37°36′46.5″ N, 15°10′31.4″ E). This site is located in the homonymous hamlet of the municipality of Acireale in the central-eastern coast of Sicily. The area is near a harbour used mainly by fishing boats throughout the year. Moreover, there are several freshwater outlets (mostly of natural origin) nearby, which flow directly into the sea. The *T. mazda* specimen was not collected, but its presence was documented by photographs made using an Olympus TG-4 underwater camera. The animal was found at 12.9 m of depth on a vertical rocky wall (water temperature: 21 °C). The examination of the photographs through comparison with the relevant scientific literature (Ortea & Espinosa, 2000; Valdés *et al.*, 2006; Malaquias *et al.*, 2012; Orfanidis *et al.*, 2021) allowed the species identification. At the same time, the depth and temperature of the water (at the time of the finding) were registered using a Suunto D6i dive computer. Based on the photographs it was also possible to determine the nature of the substrate on which the animal was found.

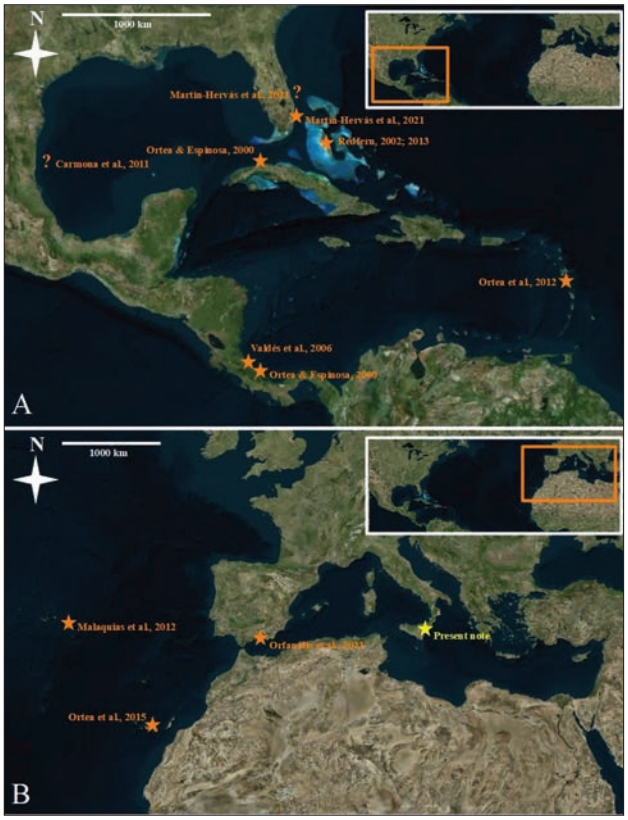

Fig. 1: Geographic distribution of *Thuridilla mazda*. ***A) Reports of this species in the Caribbean Sea (West Atlantic); B) Reports of*** *T. mazda* ***in Macaronesia (East Atlantic) and the Mediterranean Sea. The stars represent records with confirmed location, while the question marks indicate reports with unspecified location. Both symbols are followed by related manuscripts.***
Sl. 1: Geografska razširjenost vrste *Thuridilla mazda*. ***A) Zapisi o pojavljanju vrste*** *T. mazda* ***v Karibskem morju (zahodni Atlantik); B) Zapisi o pojavljanju vrste*** *T. mazda* ***v Makaroneziji (vzhodni Atlantik) in v Sredozemskem morju. Zvezdice predstavljajo zapise s potrjeno lokaliteto, vprašaji pa označujejo zapise z nedoločeno lokaliteto. Simbola se nanašata na objavljene prispevke.***

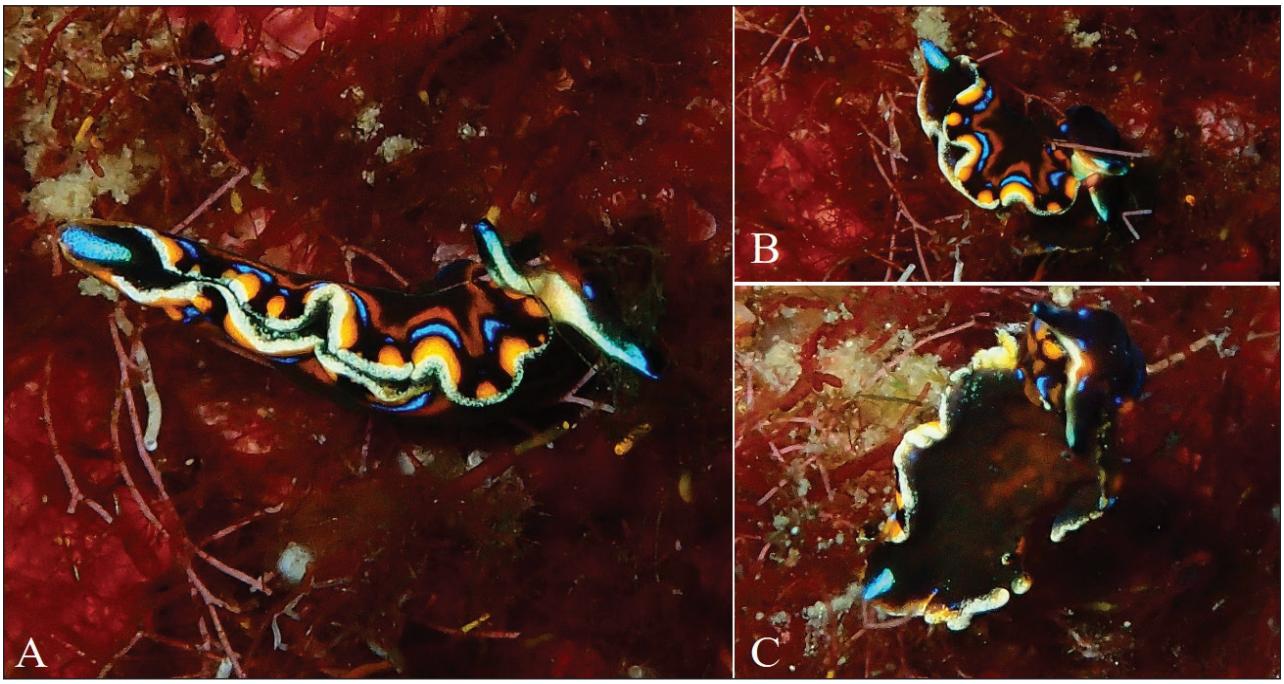

Fig. 2: The specimen of** Thuridilla mazda **found in Santa Maria La Scala; A) Dorsal view; B) Lateral view of the contracted animal; C) The specimen with the parapodia opened.
Sl. 2: Primerek vrste** Thuridilla mazda**, najden v Santa Maria La Scala; A) hrbtni pogled; B) pogled s strani na pokrčenem primerku; C) primerek z odprtimi parapodiji.

RESULTS

The animal (Fig. 2 A-C) had an elongated body with black base coloration. The parapodial margins were scattered with numerous white dots which, overall, tended to merge into a white stripe that faded slightly on the innermost side of each parapodial margin. Extending from the edge of these latter to the foot were 3 longitudinal "bands" of different colour, each continuing in an anteroposterior direction. The first band (closer to the white margin of each parapodium) had an overall black coloration alternating with striking semicircular/crescent light orange blotches. The band immediately below it was characterised by bright azure lines matching the course of the blotches of the first band. The third band was a continuous dark orange line also following the course of the two previous ones. Below this line, the flanks were black. The dorsal part of the body (normally covered by parapodia) had a uniform black-brown coloration, and on the inner side of each parapodium there were several scattered bright green dots. The dorsal surface of the tail displayed a conspicuous bright azure and longitudinally elongated blotch. The head featured a large white dorsal blotch that continued onto the surface of each rhinophore. These latter presented bright azure hues and, laterally, black colouration. The rest of the head was generally black with bright azure dots appearing in its anterior and lateral areas. The specimen was observed on a turf of filamentous Rhodophyta. Once touched by the author, the mollusc started to contract and, on further prodding, immediately unfurled the parapodia, showing the black-brown dorsum in a very evident manner.

DISCUSSION AND CONCLUSIONS

The present report of *Thuridilla mazda* is, at the moment of writing, the second for the Mediterranean basin and the first for the Ionian Sea. If we accept the hypothesis of Malaquias *et al*. (2012) that *T. mazda* is of Caribbean origin, then the present finding would represent a further important eastward progression of this sacoglossan, which would have crossed the entire Atlantic Ocean (West-East direction) over a period of about 20 years and infiltrated as far as the centre of the Mediterranean (Ortea & Espinosa, 2000; Malaquias *et al.*, 2012; Ortea *et al.*, 2015; Orfanidis *et al.*, 2021; present note). How this species would have managed to increase its presumed geographic range cannot be known with absolute certainty. *T. mazda* may have spread to new areas via both natural (e.g., currents and larval dispersal) and anthropogenic (e.g., ballast water or attached to ships' keels) pathways (Malaquias *et al.*, 2012).

Tab. 1: Known information on the distribution, biology and ecology of** T. mazda**. The question marks indicate a lack of data on the subject. In the case of Ortea et al. (2015), the asterisk suggests it was not possible to consult this publication during the writing of this note.
Tab. 1: Znani podatki o razširjenosti, biologiji in ekologiji vrste** T. mazda**. Vprašaj označuje pomanjkanje podatkov. V primeru vira Ortea et al. (2015) zvezdica označuje, da v času pisanja pričujočega prispevka ni bilo možno pregledati publikacije.

References	N° of specimen	Month and year	Location	Substrate	Depth
Ortea & Espinosa, 2000	1	September 1999	Naútico de La Habana (Cuba)	rocky reef poor in vegetation	20 m
Ortea & Espinosa, 2000	1	April 2000	Manzanillo (Costa Rica)	rocky substrate scratching	20 m
Redfern, 2002, 2013	1	June 1995	Cooperstown (Bahamas)	Algae-covered shoreline rocks	0.3 m
Valdés *et al.*, 2006	?	?	Puerto Viejo (Costa Rica)	Calcareous red algae	?
Carmona *et al.*, 2011	3	?	? [Mexico (ATL)]	?	?
Malaquias *et al.*, 2012	1	July 2011	Piscinas Naturais dos Mosteiros (Azores)	on algae	1 m
Ortea *et al.*, 2015*	*	*	* (Canary Islands)	*	*
Martín-Hervás *et al.*, 2021	1	?	Lauderdale-by-the-Sea (Florida)	?	?
Martín-Hervás *et al.*, 2021	2	?	? (Florida)	?	?
Orfanidis *et al.*, 2021	1	February 2021	Almuñécar (Spain)	turf of filamentous algae and calcareous red algae	12 m
Present note	1	November 2022	Santa Maria La Scala (Italy)	Turf of filamentous red algae	12.9 m

At the same time, it cannot be excluded that *T. mazda* may be a cryptogenic species. In fact, there are not enough data to date to support the Caribbean origin of this sacoglossan. This case is virtually identical to that recently highlighted by Trainito *et al.* (2022) in relation to the nudibranch *Okenia picoensis* Paz-Sedano, Ortigosa & Pola, 2017 in the Mediterranean basin, a species which, depending on the author, may be regarded as alien/allochthonous (Orfanidis *et al.*, 2021; Crocetta *et al.*, 2021; Lombardo & Marletta, 2021), autochthonous (Crocetta *et al.*, 2021; Trainito *et al.*, 2022) or cryptogenic (Crocetta *et al.*, 2021). *O. picoensis* is currently considered a species native to the entire Atlanto-Mediterranean region (Trainito *et al.*, 2022). It is not excluded that the same could be argued for *T. mazda*.

Furthermore, the actual distribution potential of this species is unknown, as is its colonisation potential. Indeed, apart from the scientifically documented reports of *T. mazda*, there is no information on any further occurrence or established populations of this species in the mentioned areas. Thus, there is not enough information to fully identify the area/s of origin of this sacoglossan. Even information on the ecology and biology of *T. mazda* is still very scarce (Tab. 1). The only biological and ecological data on this mollusc concern its bathymetric range (from just below the sea surface to 20 m of depth) and the substrates on which it lives (rocky environments covered by poor vegetation; turfs of filamentous algae and calcareous red algae) (Ortea & Espinosa, 2000; Redfern, 2002; 2013; Valdés *et al.*, 2006; Malaquias *et al.*, 2012; Orfanidis *et al.*, 2021; present note). The reports of this species were documented in the months of April, June and September in the Caribbean Sea (Ortea & Espinosa, 2000; Redfern, 2002; 2013); and in February, July and November in the areas of Macaronesia and the Mediterranean Sea (Malaquias *et al.*, 2012; Orfanidis *et al.*, 2021; present note). Considering all of the above, *T. mazda* could represent, in the Mediterranean basin, a species with an unknown biology and ecology suitable for further study by both specialists and enthusiasts to better understand the distribution and colonisation dynamics of marine heterobranchs and sacoglossans.

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NOV SREDOZEMSKI ZAPIS O POJAVLJANJU POLŽA ZAŠKRGARJA VRSTE *THURIDILLA MAZDA* (MOLLUSCA, GASTROPODA) S PREGLEDOM NJENE RAZŠIRJENOSTI, BIOLOGIJE IN EKOLOGIJE

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POVZETEK

Pričujoči prispevek poroča o drugem sredozemskem zapisu o pojavljanju zaškrgarja vrste Thuridilla mazda *Ortea & Espinosa, 2000. O tej vrsti, izvorno opisani v Karibskem morju (zahodni Atlantik), so v zadnjih dvajsetih letih poročali v dveh predelih Makaronezije (Azori in Kanarsko otočje) in v skrajnem zahodnem delu Sredozemskega bazena. Drugi zapis o pojavljanju te vrste iz centralno-vzhodne obale Sicilije (Jonsko morje) predstavlja še en pomemben korak k poznavanju vrste. Poleg tega ta zapis opisuje razpoložljive podatke o razširjenosti, biologiji in ekologije obravnavane vrste.*

Ključne besede: Jonsko morje, morski Heterobranchia, Sacoglossa, Santa Maria La Scala, morski zaškrgarji

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