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First record of *Felimare picta* (Philippi, 1836) (Mollusca, Gastropoda, Chromodorididae) from Tobruk, Libyan coast

by

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Abstract

Biodiversity in the Mediterranean Sea has not yet been fully explored. There has been very little research on molluscs along the Libyan coast. An individual of the chromodoridid nudibranch *Felimare picta* (Philippi, 1836) was encountered during scuba diving at the Lido resort near the Tobruk bay basin. The sample was carefully transported to the lab in seawater, photographed, and identified. The current study revealed that *Felimare picta* was recorded for the first time on the Libyan coast. Despite *Felimare picta* being rather common in many Mediterranean regions, records of it on the southern Mediterranean coasts are extremely rare or absent. It may be concluded that this study represents not only the southernmost record of *Felimare picta* in the Mediterranean but also the first record of the species in Libya.

Key words: Mediterranean Sea, *Felimare picta*, Libyan coast, first record

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1. Introduction

The biodiversity of the Libyan coast remains largely unexplored compared to many other Mediterranean regions. This study expands on-going scientific collaborations, including discovering new aquatic records and monitoring diverse environments and ecosystems (Mahdy et al. 2020, Fitori et al. 2021, Fitori et al. 2022, Mahdy et al. 2022). The majority of marine exotics in the Mediterranean and adjacent waters are thought to be tropical or subtropical marine species (Rilov & Galil 2009; Zenetos et al. 2012; Fitori et al. 2021). Molluscs are the second-largest animal phylum on the planet, which comprise approximately 7% of all animals (Benkendorff 2010). Furthermore, over 100,000 species of molluscs have been identified, of which almost 75% are gastropods (Brown & Lydeard 2010). In this regard, Malacologists have long been curious on the exact level of mollusc diversity in the Mediterranean Sea (Sabelli & Taviani 2014). Chromodorididae Bergh, 1891, were supposed to be one of the largest families of gastropod nudibranchs (Turner & Wilson 2008). Biologists have long been fascinated in chromodorids *Felimare picta* (Philippi, 1836) due to their variable coloration and diverse geographic distribution that covers the western and eastern Atlantic Ocean, Mediterranean Sea as well as the eastern Atlantic archipelagos of Cape Verde, Canaries, Madeira, Azores, and Gulf of Mexico (Ortea et al. 1996, Almada et al. 2016). Likewise, this species is distinguished by a wide range of colour lineages that have been compared to those of other subspecies, inhabits rocky substrate and predominantly feeds on sponges (Furfaro & Mariottini 2016). Due to a convergence of biological invasions, climate change, and manmade impacts, such as fishing, contamination, and habitat degradation, the Mediterranean Sea is one of the world's most environmentally threatened areas (Micheli et al. 2013; Halpern et al. 2019; Yapici et al. 2020; Derbali & Jarboui 2021). Libya's coastline is a regional biotope with a richness of biological diversity, making it one of the most attractive regions in the Mediterranean Sea. Regrettably, there haven't been many scientific studies of Libya's coastal biotopes, thus further research is needed (El-Drawany 2013, Mahdy et al. 2020, Fitori et al. 2021, Fitori et al. 2022). Literature-based information about Libyan molluscs is scant. Until the first half of 2020, 344 species of molluscs inhabited the Libyan coast, with Gastropod being the most prevalent taxon, followed by Bivalvia, Cephalopoda, Polyplacophora, and Scaphopoda (Bek-Benghazi et al. 2020). Even so, there is no available data regarding the distribution of the gastropod nudibranchs along the Libyan coast. Therefore, this study is being carried out to improve the dataset of gastropods from the Libyan waters. Additionally, this study highlights the biodiversity and ecological importance of the Libyan coast utilising informative, scientific, and social communication.

2. Materials and methods

2.1. Study area and sample identification

Tobruk bay basin is in the southeast of Tobruk city. This bay measures roughly 5 km in length and ranges in width from 2 km at the entrance to 0.6 km (Fig. 1). The bay's depth ranges from 5 to 16 m. There is some economic activity on both sides of the bay, including a Turkish port (fishing boats) and a commercial port (merchant ships, fishing, and rescue boats). The Lido resort is situated at 32° 4'41.41"N, 24° 1'8.02"E approximately 1 km north of the entrance to the Tobruk basin. A number of scientific publications and websites on taxonomic and morphological characteristics were consulted to aid in classification and characterization (Ortigosa et al. 2017, Yapici et al. 2020).

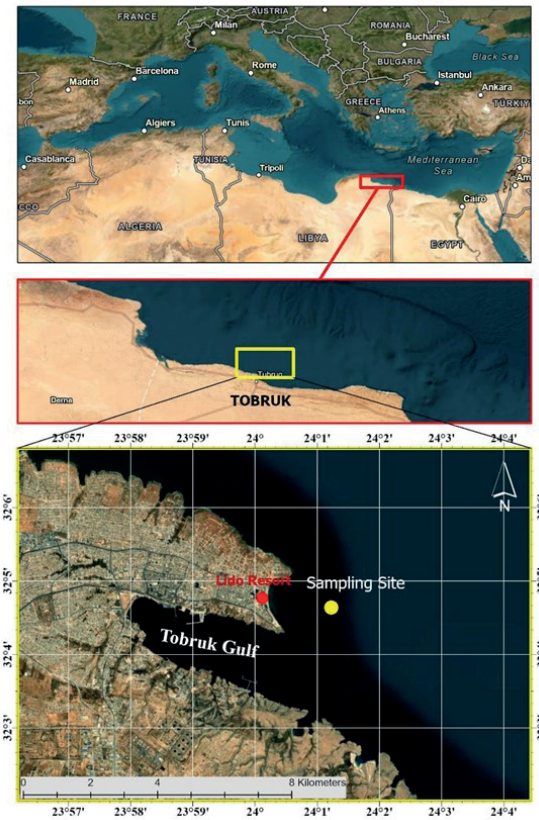

Figure 1

Sampling site of *Felimare picta*, off Tobruk, Libyan coast

3. Results and discussion

During our survey, the nudibranch *Felimare picta* was first recorded crawling on sand-rocky ground at a depth of about 15 m, 1.6 km from the coast of the Lido resort in the Mediterranean Sea off the Libyan coast. The *F. picta* specimen is characterized by a soft body that is 1.9 g in weight, 8 cm long, and 3.2 cm thick. Since such a soft animal contracts after being trapped, its exact measurements can be larger than those listed. Also, it has a blue backdrop coloration with a golden-yellow dorsal region. Due to the lengthy transportation of the sample to the lab, the colour hue slightly altered (Fig. 2).

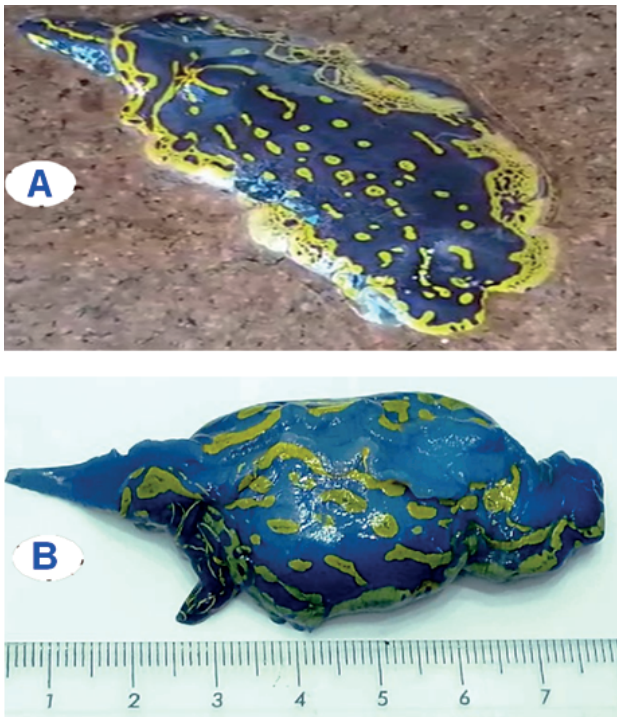

Figure 2

Sampling site of *Felimare picta*, off Tobruk, Libyan coast

Nudibranchs are coloured opisthobranches that commonly dwell in seagrass beds, coral reefs, mangroves, rocky, muddy, and sandy habitats (Carpenter et al. 1997). The popularity of scuba diving and waterproof cameras has grown and evolved over the past few decades, which has surprisingly enhanced nudibranch exploration (Mienis et al. 2016). Additionally, the largest family of dorid nudibranchs is Chromodorididae Berg, 1891, which has over 300 species and is primarily found in tropical and subtropical waters (Turner & Wilson 2008; Johnson & Gosliner 2012). Genetically, all Hypselodoris species from the Atlantic Ocean have been assigned to the genus Felimare (Johnson & Gosliner 2012). Conversely, species located along the Atlantic Ocean's east and west coastlines are referred to as amphi-Atlantic species (Malaquias & Reid 2009; Claremont et al. 2011).

Felimare picta appears to have an amphi-Atlantic distribution in the northern hemisphere, with records in the Gulf of Mexico, the Azores, the Canary Islands, the Atlantic coasts of the southern Iberian Peninsula (Furfaro et al. 2016, Almada et al. 2016), and the entire Mediterranean Sea, with a greater richness of records in the western basin (Furfaro & Mariottini 2016). This distribution pattern is crucial because it demonstrates that gastropod larvae can populate new areas (Carmona et al. 2011). Furthermore, Chromodorididae nudibranchs exhibit a variety of colour patterns, therefore morphological coloration has mostly been employed to distinguish them (Padula et al. 2016). The colourful patterns of nudibranchs, including chromodorids, provide strong evidence for aposematism in this group of molluscs (Edmunds 1991, Haber et al. 2010). Based on colour variation, Ortea Rato et al. (1996) reclassified this species into subspecies including *Felimare picta picta, Felimare webbi,* and *Felimare azorica*. In order to confirm that the *F. picta* that is now being observed is the first record from the southernmost section of the Mediterranean, we have researched earlier records and checklists from multiple Atlantic-Mediterranean locales. *F. picta* has been recorded in a variety of locations around the western and eastern Atlantic coasts, including Florida, the Gulf of Mexico, Angola to Cape Verde, the Canary Islands, Madeira, the Azores, the Balearic Islands, the Iberian Peninsula, and the Mediterranean (Cervera et al. 2004, Ortea et al. 1996, Almada et al. 2016, GBIF 2022). This distribution implies that *Felimare picta* is dispersed over a vast area in the Mediterranean Sea, although there are no records or observations from Libyan waters (Fig 3). As a result, recent studies in the Mediterranean Sea have placed emphasis on the diversity of molluscs, both native and exotic. For example, *Baeolidia moebii* Bergh, 1888, an Indo-Pacific nudibranch, was observed for the first time in the Mediterranean Sea via Lessepsian migration (Kytinou et al. 2022) and the distribution of the nudibranch *Melibe viridis* Kelaart, 1858 was determined in Turkish waters (Özvarol 2013). Furthermore, Bariche et al. (2020) reported the occurrence of *Goniobranchus obsoletus* Rüppell & Leuckart, 1830 in the Antalya Gulf, *Anteaeolidiella lurana* Marcus & Marcus, 1967 in Greek waters, and *Thecacera pennigera* Montagu, 1813 in Slovenia. While *F. picta* was observed along Turkish Aegean coasts using scuba diving (Yapici et al. 2020), it was also included in the checklist of the

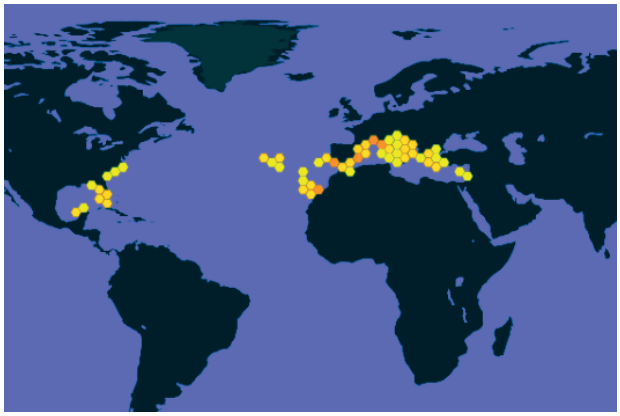

Figure 3

Species map showing the distribution of *Felimare picta* within the Mediterranean sea, Source: (GBIF 2022), https://doi.org/10.15468/39omei

Nudibranchs from Tuscany (Furfaro & Mariottini 2016). *F. picta* was not detected in any of the multisource data that Bek-Benghazi et al. (2020) collected about marine molluscs in Libyan waters between 2005 and 2017. When considering environmental issues, climate change is attracting attention on a worldwide scale in terms of species distribution, endemism, biological invasion, population dynamics, migration, biodiversity, etc. For instance, sea surface temperatures frequently encourage thermophilic species to disperse and expand their ranges in poleward orientations (Yapici et al. 2020). The Mediterranean Sea is a fascinating hotspot because of its location; it receives Atlantic water through the Straits of Gibraltar and is home to a large number of species with subtropical affinities (Bianchi 2007). At the Egyptian coast, multiple species have been reported to migrate from the Red Sea, where the Red Sea and Mediterranean Sea converge via the Suez Canal (Corsini et al. 2005, Bentur et al. 2008, Zakaria 2015, Fitori et al. 2021). In combination, these bio-ecological processes imply "tropicalization," which was previously perceptible in the southeast corner of the Mediterranean Sea (Bianchi et al. 2018).

Lastly, it is crucial to intensively monitor the distribution of Chromodorididae species throughout the Mediterranean. It is crucial to periodically monitor the environmental variables and climatic shifts in nearby waters as well as intensify scientific effort along the coasts of north Africa in order to increase the distribution and richness of species in the future, as well as upgrading our knowledge of regional biodiversity as a major goal and even reporting exotic species.

4. Conclusion

Geographically speaking, the Mediterranean Sea is currently going through climate change, which is known to promote biological invasion and the loss of biodiversity. In the current study, the Chromodoridid nudibranch *Felimare picta* was discovered and addressed for the first time along the Libyan coast.

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