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## The first record of the lessepsian migrant *Pteragogus trispilus* Randall 2013 (Osteichthyes: Labridae) off the Libyan coast, east Mediterranean Sea



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### ABSTRACT

The Red and Mediterranean seas are connected by the Suez Canal. Since its opening, the Canal has been regarded as a hotbed for invading alien species. During the lessepsian migration, species find their way into the Mediterranean waters and the opposite rarely happens. A single specimen of the Lessepsian migrant labrid fish was obtained at a depth of 20 m during a fishing field trip in Al-Bardi region near the Libyan-Egyptian border. The fish sample was transported to the laboratory (Marine Resources Department, Faculty of Natural Resources and Environmental Sciences, Tobruk University, Tobruk, Libya) and subjected to morphometric and meristic measurements to facilitate its identification. The scientific identification has verified that the caught fish is *Pteragogus trispilus* belonging to family Labridae. This is the first record of *Pteragogus trispilus* in the east Mediterranean Sea off the Libyan coast.

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### Introduction

The number of new Red Sea fish (Lessepsian migrants) invading the Mediterranean has increased, making it a hotspot for marine bio-invasions (Golani & Sonin, 1992; Katsanevakis, Zenetos, Belchior, & Cardoso, 2013; Coll et al., 2010). On the other hand, the estimated records of new species along the shores of North Africa are especially important for complete inventories and biodiversity assessments (Azzurro, Milazzo, & Maynou, 2012; Galil, 2009). This knowledge is much more important when the recorded organisms are non-indigenous, as biological invasions are a major changing driver in the Mediterranean. After the opening of the Suez Canal in 1869, the Mediterranean became connected to tropical and subtropical regions, and the so-called Lessepsian migrant phenomenon became one of the key factors contributing to the change in the biodiversity of the Mediterranean basin (Galil et al., 2015). On the other hand, the penetration and invasion increased after the construction of the Aswan High Dam in 1970. This phenomenon eventually became the primary cause of the

increasing faunal divergence of the Mediterranean Sea (Golani et al., 2002; Quignard and Tomasini, 2000).

The first record of *Pteragogus* species in the Mediterranean was documented for the first time by Golani & Sonin, 1992, and it has since been discovered in Turkey, Cyprus, Lebanon, and Tunisia. The Lessepsian species richness has a strong east–west gradient (Coll et al., 2010), with the largest number of records off the coast of Lebanon in the east and reaching Turkey in the Northeastern Mediterranean (Golani, 1998, 2010).

Libya's seashore stretches for 2000 km and is defined by a broad continental shelf that includes a diverse range of habitats and topography (Shakman & Kinzelbach, 2007; Shakman, 2008). Zenetos et al. (2010) reported 613 established and 208 casual alien species in the Mediterranean Sea alone. Libya's position in the Mediterranean Sea's central and "warm" areas is compelling because it can host thermophilic species arriving from the east (Indo-Pacific origin) or spreading from the west (Tropical Atlantic origin).

In the present study the appearance of *Pteragogus trispilus* is confirmed for the first time off the coast of Libya, and the species' status is discussed. Furthermore, the spread of *P. trispilus* and its success in establishing itself in the Mediterranean Sea are investigated. Such study could be a useful indicator for predicting possible changes in the marine ecosystems (Yapici et al., 2015).

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**Materials and methods**

*Study area*

This research was conducted at Al-Bardi site off Libya's coast, Mediterranean Sea. This is a port in Eastern Libya, about 120 km east of Tobruk and close to the Libyan-Egyptian border. Al-Bardi site is characterized by the presence of several valleys that flow into Al-Bardi Bay (Fig. 1), as well as a tremendous diversity of endemic and exotic marine life.

*Fish sampling*

A small fish was caught by trammel nets at a depth of 20 m on 2 February 2021, during a fishing field trip in Al-Bardi in the area known as Minqar Qasir (31° 45'10"N, 25° 05' 30" E) (Fig. 1). The

caught fish was taken to the lab for further examination. The fish sample was photographed (Fig. 2A, B) and then morphological measurements were recorded (Table 1). Nineteen morphometric measurements and eight meristic counts were considered for Labrid fishes. Taxonomic position was performed based on Froese and Pauly (2021) as follows: Phylum: Chordata, Subphylum: Vertebrata, Superclass: Gnathostomata, Superclass: Pisces, Class: Actinopterygii, Order: Perciformes, Suborder: Labroidei, Family: Labridae, Genus: *Pteragogus*, Species: *trispilus*.

**Result**

For the first time, the investigated labrid fish *Pteragogus trispilus* Randall (2013), has been described as a new record from the Libyan Coast in the Mediterranean Sea. *Pteragogus trispilus* (Fig. 2) has a total length of 11.3 cm and a standard length of 8.8 cm, with a total

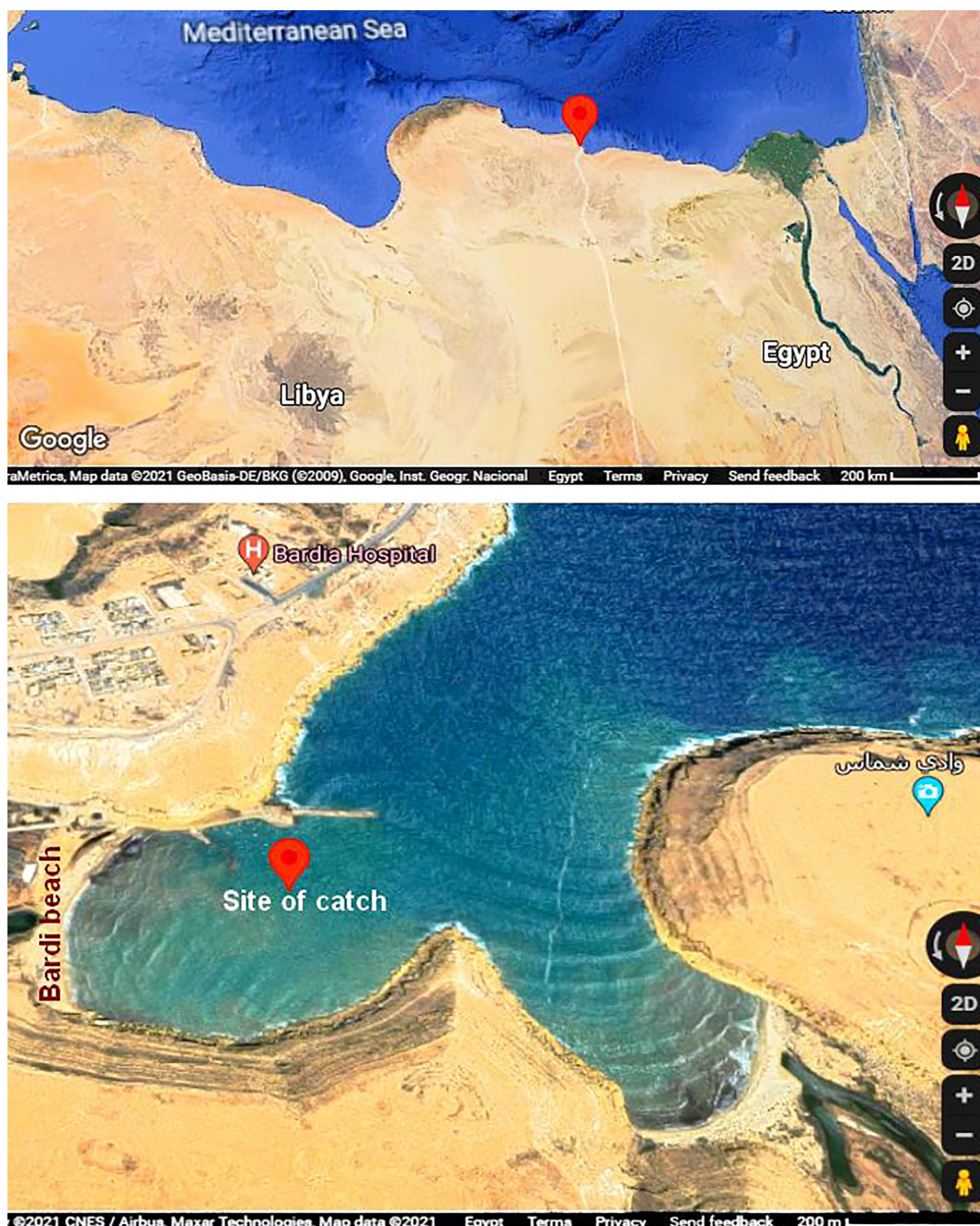


Fig. 1. *Pteragogus trispilus* collection site at Al-Bardi region, Libya.



**Fig. 2.** *Pteragogus trispilus* collected during this study with distinct morphological features (A). The black spot on each of the first three anterior membranes of the dorsal fin is shown by arrows (B).

weight of 96 g. The head has a straight dorsal profile, and the body is 3.4 cm deep. The pelvic fin filaments stretch past the anal fin. The eyes are small, measuring 0.6 cm in diameter. The caudal fin is 2.6 cm long and the caudal peduncle is 1.4 cm long. Each of the dorsal fin's first three membranes have a black spot on it (Fig. 2). The number of dorsal and anal fins on both soft and hard rays is the same (9 fins). The dorsal fin has 11 spines, three on the anal fin, and one on the pelvic fin. The cycloid scales cover the entire body.

**Discussion**

Overfishing, pollution, habitat degradation, food availability, climate changes, and the introduction of non-native species are all issues that have an impact on biodiversity in general and fisheries in particular. Lessepsian migrants are particularly important in the Mediterranean Sea, where the opening of the Suez Canal has resulted in an influx of Red Sea species.

The Eastern Mediterranean is home to a large number of known non-indigenous species (Bernardi, Golani, & Azzurro, 2010; Farrag, AbouelFadl, Alabssawy, Toutou, & El-Haweet, 2018). Until 2019, the number of marine alien species in the Libyan waters was 73 species (Shakman et al., 2019). The first record of species of the genus *Pteragogus* (*Pteragogus pelycus*) in the Mediterranean Sea was from Haifa Bay (Golani & Sonin, 1992). *Pteragogus trispilus* is a small non-commercial fish that lives on the bottoms of coastal zones where brown algae, seaweed, and coral patches are abundant (Randall, 2013). In the current study, the diagnostic and descriptive characters were consistent with Randall (2013), such

as the rounded caudal fin, oblique elliptical black spot on opercula, the presence of black spots behind the eye and on the nape. The lateral line has black dots, dashes, and white dots. Until recently, *Pteragogus trispilus* has only been recorded in two Mediterranean coastal areas, Tunisia (Hamed et al., 2018) and Turkey (Ergüden et al., 2019). The current study has revealed that *P. trispilus* was

**Table 1**  
Morphometric and meristic measurements of *Pteragogus trispilus* collected during the current study.

Morphometric measurements (cm)		Meristic counts	
Total length (TL)	11.3	Dorsal fin spines	XII
Standard length (SL)	8.8	Dorsal fin soft rays	8
Dorsal fin length	4.3	Anal fin spines	III
Pectoral fin length	2.2	Anal fin soft rays	8
Pelvic fin length	2.6	Caudal fin soft rays	15
Anal fin length	2.9	Pectoral fin soft rays	13
Pre pelvic length	1.9	Pelvic fin spines	1
Pre anal length	1.5	Pelvic fin soft rays	5
Pre-dorsal length	1.8		
Pre-pectoral length	1.7		
Pre-orbital length	0.4		
Post-orbital length	0.9		
Total Weight (g)	96		
Body depth	3.4		
Jaw length	0.3		
Head length	2.3		
Eye diameter	0.6		
Caudal peduncle	1.4		
Caudal fin length	2.6		

found in Al-Bardi region, Libya, at a depth of 20 m, reported for the first time on the Libyan Coast near the Libyan-Egyptian border westward. The spread of *P. trispilus* and its success of inhabiting the Mediterranean Sea, may be a valuable predictor of potential changes in the marine ecosystems (Yapici et al., 2015). According to Golani (1990), 414 fish species were reported in the Eastern Mediterranean, but their numbers fluctuated and have significantly increased dramatically as a result of the alien species introduction through various means, such as the Suez Canal, Gibraltar, and shipping activities (Mavruk & Avsar, 2008). On the other hand, a few Mediterranean species have migrated to the Red Sea (Belmaker, Parravicini, & Kulbicki, 2013; Nawrot, Chattopadhyay, Zuschin, & MacIsaac, 2015; Streftaris, Zenetos, & Papathanassiou, 2005; Zenetos, 2017).

Accordingly, the migration that stems from the Suez Canal is usually northward. Thereby, the reasons of the direction of Lessepsian migration (Ben-Tuvia, 1973) was attributed to the following: Firstly, the Red Sea has a greater diversity of fish species than the Mediterranean Sea. Secondly, the Indo-Pacific species are more adaptable to the changing ecological conditions than Atlanto-Mediterranean species. Furthermore, Red Sea species are normally able to adapt to subtropical conditions (Por, 1973). Thirdly, the prevailing currents and winds aid in the transport of species' eggs and larvae from the Red Sea to the Mediterranean. Moreover, the Suez Canal's prevailing northward current is caused by hydrological variations between the two seas (Tortonese, 1964). Despite this, the current does not flow in the same direction all year; in August and September it switches directions and flows southward.

The fluctuations in the current course are thought to occur because the Mediterranean's summer temperatures are higher than those of the Red Sea. The nesting behavior and hatching process of loggerhead turtles have been recorded to be influenced by changes in ecological factors such as water temperature along the same coast (Libya) (Mahdy et al., 2020). In this concept, it could be argued that as a result of global warming, the Mediterranean's temperature values have risen, promoting the establishment of Lessepsian organisms (Salihoğlu & Öztürk, 2021). Salinity, on the other hand, plays a role in fish spread. The addition of freshwater from the Nile to the Mediterranean may act as a natural barrier to the Lessepsian migrants (Avşar, 1999). The salinity of the Eastern Mediterranean and the Suez Bay are somewhat alike (Mavruk & Avsar, 2008), which might encourage the entry of the invasive species.

The Mediterranean Sea's biodiversity, like that of the Red Sea, is rapidly changing due to a variety of human-caused alterations and climate change (Bianchi & Morri, 2000). Unfortunately, species and habitat conservation programs are also in short supply (Elmasry, Abdel Razek, El-Sayed, Omar, & Hamed, 2015).

The eco-biological studies investigating the Libyan Coast are still scarce and little attention has been paid to fish stock assessments and population. There is no doubt that the opening of Suez Canal has resulted in several biological and ecological changes in the Red Sea and Mediterranean Sea including the Libyan Coast. Consequently, further research is needed to learn more about these changes and impacts of non-indigenous species on the Libyan Coast. On the other hand, potential cooperation between researchers and fishermen should be facilitated to identify recent non-native species invasions in Mediterranean coastal waters as early as possible.

#### CRedit authorship contribution statement

**Amani Fitori:** Sampling, **Aldoushy Mahdy:** Help in identification, **Rashad E.M. Said:** Writing, mapping, revision, and **Ali Al-Faturi:** Measurements. The authors certify that they have par-

ticipated sufficiently in the work to take public responsibility for the content, including participation in the concept, design, analysis, writing, or revision of the manuscript based on scientific ethics.

#### Ethical Clearance

On behalf of the Scientific Research Ethics Committee of the Faculty of Science, Al-Azhar University, Assiut, I hereby give ethical approval in respect of the project entitled "The first record of the lessepsian migrant *Pteragogus trispilus* Randall 2013 (Osteichthyes: Labridae) off the Libyan coast, East Mediterranean Sea. To view the ethical clearance full certificate please click on the link of the supplementary data.

#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ejar.2021.09.009>.

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