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SHORT COMMUNICATION

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The westernmost record of *Terapon jarbua* (Forsskål, 1775) in the Mediterranean Sea: a new non-indigenous fish for Libya

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Abstract: The occurrence of the Indo-Pacific fish *Terapon jarbua* (Forsskål, 1775) is documented for the first time from Libya. This record represents the third and westernmost observation of the species in the Mediterranean Sea. Introduction pathway for this fish in Libyan waters and in the Mediterranean Sea in general is discussed.
***Keywords*:** *Terapon jarbua*; Lessepsian immigrant; Terapontidae; Red Sea; biological invasions

Sažetak: NAJZAPADNIJI NALAZ VRSTE *TERAPON JARBUA* (FORSSKÅL, 1775) U SREDOZEMNOM MORU: NOVA NEZAVIČAJNA VRSTA RIBE U LIBIJI. Nalaz indo-pacifičke vrste *Terapon jarbua* (Forsskål, 1775.) po prvi put je dokumentiran na području Libije. Ovaj nalaz predstavlja treće i najzapadnije opažanje ove vrste u Sredozemnom moru. U radu se raspravlja o razlozima pojavljivanja ove ribe u libijskim vodama i Sredozemnom moru općenito.
Ključne riječi: *Terapon jarbua*; Lesepsijski migrant; Terapontidae; Crveno more; biološke invazije

INTRODUCTION

Terapontidae family comprises 61 species in 15 genera of coastal marine, brackish and freshwater fishes, whose distribution comprises the Indo-West Pacific (Fricke *et al*., 2021; Froese and Pauly, 2021). In the Mediterranean Sea, a total of four non-indigenous species belonging to this family have been recorded, namely: *Pelates quadrilineatus* (Bloch, 1790), *Terapon jarbua* (Forsskål, 1775), *Terapon puta* Cuvier, 1829 and *Terapon theraps* Cuvier, 1829 (Louire and Ben-Tuvia, 1970; Ben-Tuvia, 1976; Lipej *et al*., 2008; Golani and Appelbaum-Golani, 2010).

Terapon jarbua, commonly known as the Jarbua Terapon, is a coastal medium-sized marine fish able to tolerate and inhabit brackish and freshwater, usually on sandy bottoms. Juveniles of this species are common in the intertidal area and in tidal pools (Froese and Pauly, 2021). Its distribution extends from the Red Sea and East Africa to Samoa (Japan) and Arafura Sea (Australia). In its native range, this species represents a commercially important resource for fishery; furthermore, it has also been recognized as an ornamental fish (Gupta and Banerjee, 2012; Nandikeswari *et al*., 2014).

This species was recorded for the first time in the Mediterranean Sea in 2009 at Haifa (Israel) (Golani and Appelbaum-Golani, 2010). In more recent times, on 12 November 2020, a specimen was recorded in the Mediterranean Egyptian coast, west Alexandria (Al Mabruk *et al*., 2021a). To the best of our knowledge, no other records of this species were reported from the Mediterranean Sea. In the present paper, thanks to the contribution of a citizen scientist, we report for the first time the presence of *T. jarbua* from Libya, discussing its pathway of introduction and importance of citizen science in early detection of non-indigenous fishes.

MATERIAL AND METHODS

On 15 March 2020, a recreational fisher speared an unknown fish swimming alone on sandy bottom at 20 m depth, near Al-Hamama coast, eastern Libya (Fig. 1, 32°54'35.7"N, 21°36'51.9"E). The recreational fisher's companion sent the photo to one of the author (AA)

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Fig. 1. Mediterranean records of *Terapon jarbua*; red dot represents current record (Libya), black dots represent previous published records.

via WhatsApp, in order to identify the specimen (Fig. 2). The fish was identified as *T. jarbua* following the description provided by Psomadakis *et al*. (2020).

RESULTS AND DISCUSSION

The body was relatively elongated and laterally compressed with four irregular longitudinal black stripes on a silvery-white background body color. The upper three irregular stripes were curved upward. The lower stripe was almost straight and extends from the tail to the beginning of the head. The dorsal fin showed black spots, and black stripes were present also on the caudal fin. Unfortunately, the fish was consumed by the fisherman and no further analysis were possible.

According to Zenetos and Galanidi (2020), on average four species per year currently enter the Mediterranean Sea through the Suez Canal, indicating that this pathway plays a key role for biological invasions in the Mediterranean Sea. More than 73 marine alien species have been recorded in Libyan waters, nine of which are currently exploited for human consumption (Shakman *et al*., 2019). Currently, a total of 42 alien fish species are reported from Libyan waters (manuscript in preparation). However, it is likely that many alien species still remain undetected in the area due to the lack of targeted field studies.

Fig. 2. The specimen of *Terapon jarbua* caught in Libyan waters.

In recent years, citizen science and social media have contributed greatly to the monitoring and early detection of non-indigenous species in the Mediterranean Sea (Al Mabruk *et al*., 2018; Al Mabruk and Rizgalla, 2019; Azzurro and Tiralongo, 2020; Osca *et al*., 2020; Tiralongo *et al*., 2019, 2020; Al Mabruk *et al*., 2021b; Tiralongo *et al*., 2021). The strategic geographical location of Libya at about the center of the southern Mediterranean Sea and bordering with Egypt, makes this region a key area for the monitoring of tropical organisms arriving from both the Red Sea (Lessepsian immigrants) and Atlantic Ocean (Shakman *et al*., 2017; Al Mabruk *et al*., 2020, 2021c). On the basis of this, more studies targeting alien species should be performed in this area.

Although *T. jarbua* is known to be an ornamental fish, exported from India to other countries (Gupta and Banerjee, 2014), considering the proximity between Libya and the Suez Canal (Egypt), the first record here reported of the species in Libyan waters is in all likelihood the results of a Lessepsian immigration. The same can be stated for the other Mediterranean records of the species (Golani and Appelbaum-Golani, 2010; Al Mabruk *et al*., 2021a). Furthermore, considering the recent record of *T. jarbua* in Egyptian waters, the record from Libya here reported could be the result of a specimen coming from an established and undetected population in Egyptian waters. *Terapon jarbua* could compete with native species for habitat occupation and food resources. In all cases, further studies are necessary in order to monitor and study the presence of this species in Mediterranean waters and to better understand the impact that could have on the new ecosystem.

CONCLUSIONS

The Mediterranean Sea is one of the most important biodiversity hotspots in the world, hosting about 17000 species, of which 700 are fishes (Coll *et al*., 2010; Psomadakis *et al*., 2012). However, its native biodiversity is threatened by the presence of non-indigenous species (NIS), with more than 1000 alien taxa currently recorded in the basin (Zenetos *et al*., 2017). Hence there is a need to monitor species' movements over time. In this context, as in the case here reported, the contribution of citizen science can cover a key role for the monitoring and early detection of alien species in the Mediterranean Sea, especially in little studied strategic areas such as Libya and Egypt (Tiralongo *et al*., 2019, 2020; Al Mabruk *et al*., 2021b).

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