

# New record of *Pterois cf. miles* (Actinopterygii: Scorpaeniformes: Scorpaenidae) from the eastern middle Adriatic Sea (Croatian waters): Northward expansion

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## Abstract

A single specimen of *Pterois cf. miles* has been recorded in the eastern middle Adriatic Sea. It was observed near the island of Vis at a depth of 15 m. The location of the record is further north than previous Adriatic records and it constitutes the northernmost record of this species in the Mediterranean Sea to date. The record is based solely on photographs and video footage provided by a professional underwater photographer.

## Keywords

invasion, Lessepsian migrant, lionfish, Mediterranean Sea, *Pterois miles*

## Introduction

The devil firefish, *Pterois miles* (Bennett, 1828), commonly known as lionfish, is a fish species belonging to the family Scorpaenidae, native to the Indo-Pacific Ocean where it is distributed from the Red Sea to Sumatra. It is also present in the Mediterranean Sea which it most likely entered from the Red Sea through the Suez Canal (Bariche et al. 2017). The first record of this species in the Mediterranean dates back to 1991 when a single specimen was recorded from the Levantine coast (Golani and Sonin 1992). Subsequent records appeared after more than two decades when two specimens were collected in 2012 in Lebanon (Bariche et al. 2013). The first signs of an increase in the initially slow-paced expansion were documented in Cyprus when numerous specimens were

recorded in the 2013–2015 period (Kletou et al. 2016). Substantial expansion both in abundance and space followed and *P. miles* spread to many coastal areas including Turkey and Greece in the north and Tunisia and Italy in the west (Turan and Öztürk 2015; Dailianis et al. 2016; Azzurro et al. 2017; Dimitriadis et al. 2020). Until 2019, the northernmost record of this species was indicated by Dimitriadis et al. (2020) near the Greek island of Corfu in the Ionian Sea. Subsequently, sightings of the lionfish were recorded in the Adriatic Sea near Lecce (Italy) and beach Dhermi (Albania) in July 2019 and in Torre Canne near Brindisi in August 2020 (Di Martino and Stancanelli 2021). Dynamics of the expansion in the eastern Mediterranean and invasive potential of *P. miles* led Karachle et al. (2017) to foresee its potential arrival in Albanian waters a few years prior to its first record in the area.



**Figure 1.** A specimen of *Pterois* cf. *miles* photographed at Rt Stupišće near Komiža (Vis Island, eastern middle Adriatic). Photo: D. Zurub.

The concerns associated with the occurrence of this species in the Mediterranean are mostly motivated by the western Atlantic scenario whereby a non-native lionfish (*Pterois miles*/*Pterois volitans* complex) severely impacted the biodiversity and ecological processes in invaded areas. For example, high predation rates of this generalist piscivore species negatively impact local fish communities by reducing their abundance and recruitment at invaded locations (Ballew et al. 2016; Goodbody-Gringley et al. 2019).

In this paper, we report the first observation of this species in the middle eastern Adriatic Sea, in Croatian waters.

## Material and methods

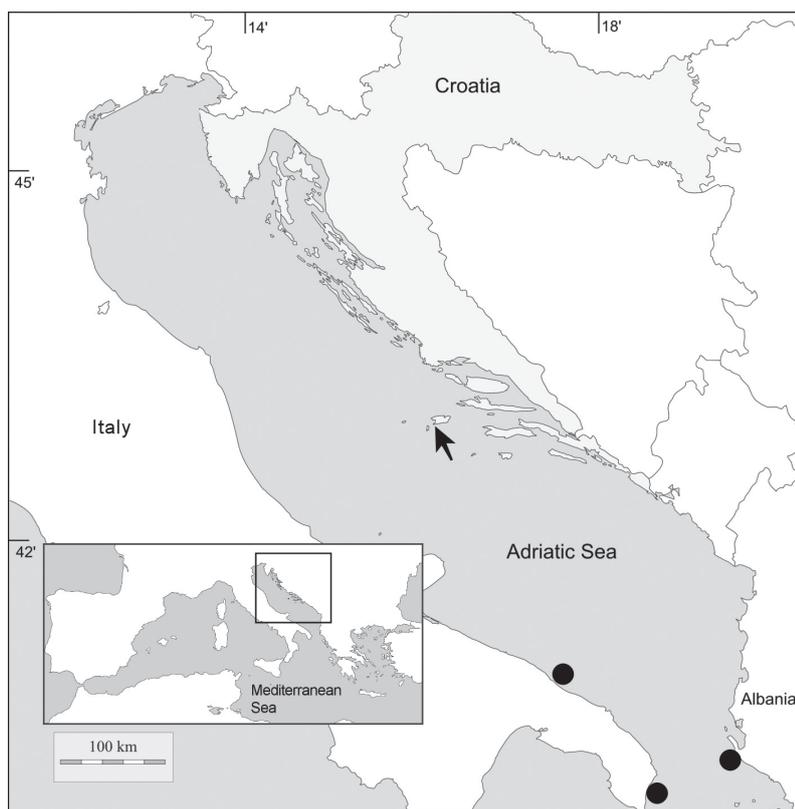
A specimen of lionfish was observed and photographed (Fig. 1) by a professional underwater photographer during scuba diving on 13 August 2021 at a depth of 15 m, near Komiža at cape Stupišće (island Vis, Croatian waters, middle Adriatic; 43°0'18.25"N, 016°4'1.27"E) (Fig. 2). Diving was organized by the local diving center "Manta". Sea temperature at the site was measured at 24°C with Mares Genius diving computer.

## Results and discussion

The length of the specimen was approx. 13–15 cm in total length. It was observed on the bottom consisting of large boulders overgrown with various algae including invasive

*Caulerpa cylindracea* (Chlorophyta). The individual was slowly moving on the algal mat which allowed the photographer to take high-quality photos. Divers observed the fish at the same position on three consecutive days. Due to the nature of the record (photos and video), it was not possible to accurately count meristic characters which distinguish *P. miles* and *P. volitans*, so the species identification was tentatively assigned to *Pterois* cf. *miles*. Tentative identification was based on particular morphological traits of the specimen visible in provided photos such as distinctive coloration i.e., alternating brown and white vertical stripes throughout the body; large feather-like pectoral fins; conspicuously large dorsal fin spines and fleshy tentacles above the eyes and mouth; soft rays of dorsal, anal and caudal fins with dark spots (Golani and Sonin 1992; Bariche et al. 2013). If we consider the route of species spreading in the eastern Mediterranean, confidence in the species assignment is further strengthened as many of the records along the route were genetically confirmed as *P. miles* records (Bariche et al. 2017; Stern et al. 2018; Vavasis et al. 2020).

The area where the specimen was found is located on a protruding cape on a northwestern part of Vis island oriented toward the open sea and influenced by open sea currents (Fig. 2). The location itself is about 143 Nm farther than the closest previous Adriatic record reported from Italy (Torre Canne) by Di Martino and Stancanelli (2021). The present record also represents the northernmost record of this Lessepsian migrant both in the Adriatic Sea and the entire Mediterranean to date.



**Figure 2.** Map showing location of the present record (arrow) and previous Adriatic records (black circles; from Di Martino and Stancanelli 2021) of *Pterois miles*.

Predictions of the expansion of *P. miles* in the Mediterranean from various studies offer different future scenarios for the Adriatic Sea (D’Amen and Azzurro 2020; Dimitriadis et al. 2020; Poursanidis et al. 2020). Such differences mostly stem from diverse methodologies and parameters considered in driving the prediction models, but also due to differing time frames considered in predictions. Only the northernmost part of the Adriatic is consistently excluded as a distributional area in these predictions, while predictions for the middle and southern Adriatic vary. For example, the study by Dimitriadis et al. (2020) indicated a scenario with an increased risk of expansion towards the middle Adriatic until 2050. These authors considered the role of low winter temperatures as a limiting factor for the expansion and establishment of the species. On the other hand, for example, Poursanidis et al. (2020) considered the Adriatic to be an unfavorable area for the lionfish invasion based on habitat suitability modeling.

Kimball et al. (2004) experimentally determined that at a mean temperature of 16.1°C lionfish stop feeding while a mean 10°C was determined to be a chronic lethal temperature. At present, low winter temperatures in the middle Adriatic (Russo et al. 2012), which fall below the one at which lionfish cease to feed, can pose an obstacle for its successful invasion. However, it is suggested that lionfish can survive prolonged fasting which, in synergy with the possibility of climatic niche expansion and sea warming trends, can challenge this hypothesis (Parravicini et al. 2015; Côté and Smith 2018; Grbec et al. 2018). In

any case, the present record clearly shows that the species reached the middle Adriatic, but its establishment and impact will need to be evaluated with future investigations.

As indicated by Azzurro et al. (2017) the majority of records of this species in the Mediterranean were made based on underwater footage provided by divers as is the case with the present record. Recently, Phillips and Kotschal (2021) took advantage of this fact and, using diving centers’ expertise, managed to detect additional lionfish sightings throughout the Mediterranean coast indicating the high potential of such methodology in the tracking of its expansion. Also, citizen science campaigns have been initiated throughout the Mediterranean to keep track of lionfish expansion (Azzurro et al. 2017; Giovos et al. 2019).

Due to the high negative impact of *P. miles* on native fish communities in invaded areas, campaigns aimed at population control of the species have been initiated in the eastern Mediterranean, particularly in Cyprus where such actions resulted in a significant decrease in lionfish numbers in areas targeted (Kleitou et al. 2021). Actions aimed at population control rather than eradication are more realistic in cases of marine invasions as instances of successful eradication are rare (Giakoumi et al. 2019). As early detection and rapid response in the first stages of invasion are considered crucial for successful mitigation and even eradication (see Campbell et al. 2018), we emphasize the need for immediate action in Croatia which should be coordinated among scientific institutions and relevant governmental bodies. For example, actions aimed at population control should be foreseen and

an appropriate legal and logistic basis for such actions should be established as soon as possible. Several citizen science campaigns have already been undertaken in Croatia in the last decade to heighten the general public's awareness about marine biological invasions (for example, in the course of LEKFishResCRO project founded by the Croatian Science Foundation) and to motivate citizens to indulge in monitoring efforts through reporting observations of unusual species. Also, the perils of the lionfish invasion, both in terms of its ecosystem impact

and potential health hazard due to its venomousness, have already been conveyed to the general public through various news channels and social networks even before this record and similar efforts should be continued.

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