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# Filling the gap – on the occurrence of an *Abudefduf* Forsskål, 1775 individual from Nisyros Island, Dodecanese, Greece

**(Teleostei, Pomacentridae)**

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The first record of the *Abudefduf* cf. *saxatilis/vaigiensis/troschelii* from Nisyros Island, Dodecanesse is given. On 20th September 2022, a single *Abudefduf* sp. was observed during diving and videographed in situ at the north shores of Nisyros Island, at a depth of 1–3 m. The individual was observed over rocky bottom with patches of *Posidonia oceanica* (Linnaeus) Delile, 1813. The total length of the fish was estimated at 10 cm.

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## Introduction

It is well documented that introductions of marine organisms by human activities have altered the biodiversity of the Mediterranean Sea. Such activities comprise: (i) aquaculture (Kampouris et al. 2020, Saad et al. 2022), (ii) aquarium trade (Bariche et al. 2021), (iii) marine transportation (Ulman et al. 2019), (iv) transfer of live animals for the seafood industry (Kampouris et al. 2021) and (v) the Suez Canal construction leading to the well documented Lessepsian migration. Up to now, 666 allochthonous marine species are considered as established in Mediterranean Sea, and, from 2017 to 2019, twenty new non-indigenous fishes were recorded in the region (Zenetos & Galanidi 2020).

Since 2012, the presence of seven alien pomacentrid fish species has been confirmed in the Mediterranean Sea, the majority of which belong to the genus *Abudefduf* (Bitar 2021, Dragičević et al. 2021, and references within). Furthermore, an unidentified individual, probably belonging at the genus *Stegastes* Jenyns, 1840 was reported from Lebanon (Bariche et al. 2021). The damselfish *Chromis chromis* (Linnaeus, 1758) is the only native Mediterranean species of the family (Louisy 2022).

Fishes of the Pomacentridae family are amongst the most common fish species in reefs, occurring in all tropical and subtropical seas, mainly in the Indo-Pacific region (Froese & Pauly 2023), e. g., members of the genus *Abudefduf* occur in all tropical coral and rocky reefs (Cooper et al. 2009). They are omnivorous species feeding predominantly on algae, small-sized benthic invertebrates, and zooplankton (Aguilar-Medrano & Barber 2016). There is an ongoing debate on how many species, subspecies, and varieties are in the genus, as, for instance, the morphologically distinct species *Abudefduf vaigiensis* (Quoy & Gaimard, 1825) and *Abudefduf sexfasciatus* (Lacepède, 1801) were found to be nested in the mitochondrial

**Fig. 1.** Snapshot of the *Abudefduf* sp. and the relevant habitat from Nisyros Island, Dodecanese, SE Aegean Sea, Greece, obtained from the original video file.

gene tree despite their genetic distinction based on nuclear loci (Bertrand et al. 2017). Moreover, their external morphological features may exhibit significant plasticity, and yet they do not necessarily reflect genetic diversity, e. g., *Abudefduf saxatilis* (Linnaeus, 1758) (Piñeros et al. 2015).

The current study reports the first record of the *Abudefduf* cf. *saxatilis/vaigiensis/troschelii* species complex form Nisyros Island, Dodecanese (Greece). This record fills an important gap in the distribution of the genus *Abudefduf* in the east Mediterranean Sea. Furthermore, this is only the fourth record for the Hellenic waters. The previous records are from SW Aegean Sea, from off the Saronikos Gulf (Giovos et al. 2018, Zenetos & Miliou 2020) and from Kythira Island (Pirkenseer 2020). Also, a single individual from the NE Turkish Aegean coast was recorded (Bilecenoğlu 2016). Nevertheless, a very recent study, covering the whole Mediterranean Sea, does not report any records of the genus *Abudefduf* from the region of Dodecanese (Ragkousis et al. 2023).

## Material and methods

On 20th September 2022, a single *Abudefduf* sp. was observed during scientific diving (Sponge Project) and videographed in situ by the second author (AS). The specimen was identified by the first author (TEK), based on the general external morphology as described by Bitar (2021), i. e., the presence of five continuous blue-black vertical bars on the body in combination with the presence of two dots on the caudal peduncle. The main body colouration was light blue to light green dorsally while the ventral side was silvery, fading to white. However, the colour of the dorsal side between the 1st and the 4th vertical bar was bright yellow fading to white.

## Results

The individual was observed at the north shores of Nisyros Island, at a depth of 1-3 m (approx. 36°37'15.30"N 27°10'02.6"E). It was observed over rocky bottom with patches of *Posidonia oceanica* (Linnaeus) Delile, 1813 (Fig. 1). The total length of the fish was estimated to be about 10 cm, a common length for many *Abudefduf* species (Froese & Pauly 2023).

## Discussion

Morphological characters of *A. saxatilis*, *A. troschelii* and *A. vaigiensis* can show a degree of overlap which impairs their proper identification on the species level when based solely on photographic material (Bitar 2021, Dragičević et al. 2021). Thus, the authors provide an unambiguous identification to species level based solely on underwater observation. However, according to Bariche et al. (2021) "it remains more crucial to report these unusual findings, as opposed to not doing so". Furthermore, despite quite a few first regional or national records of exotic species are published, many additional occurrences are likely to remain unpublished. These records are useful to study invasion rates and distribution changes of exotic species (Katsanevakis et al. 2020, Ragkousis et al. 2023). In addition, publishing these records is beneficial for exotic species inventories, contributing to the implementation of respective policies, at least on EU level (Zenetos & Galanidi 2020). Introduction vectors for a given occurrence are difficult to establish and may vary depending on the species. Nonetheless, the most probable should be the Lessepsian migration, the shipping via ballast water and an intentional aquarium release. There are numerous well documented records of non-indigenous species introductions via ballast water (Wang et al. 2022); even though international (and national laws) agreements exist on the management and treatment of ballast water (e. g., Verna & Harris 2016). For instance, in China that is heavily impacted by marine traffic; several planktonic organisms and pathogenic bacteria were reported (Wu et al. 2017). Furthermore, in Canada several taxonomic groups, fish species included, were introduced via shipping and ballast water (Scriven et al. 2015). The Mediterranean region suffers from introductions of non-indigenous species as well, and shipping is among the most common pathway (Katsanevakis et al. 2013). There are many documented studies and further analysis does not fall within the scope of the present study. Recently, many studies, regarding the Mediterranean waters had highlighted the increased phenomenon of non-indigenous fish species introductions, via aquarium

releases, in many cases. Suchlike examples include, but not limited to, the species *Zebrasoma flavescens* (Bennett, 1828) and *Balistoides conspicillum* (Bloch & Schneider, 1801) from the Spanish coast (Weitzmann et al. 2015), *Chrysiptera hemicyanea* (Weber, 1913) from Malta (Deidun et al. 2018), and *Holacanthus bermudensis* Goode, 1876, *Balistes punctatus* Gmelin, 1789, and *Rhinecanthus assasi* (Forsskål, 1775) from Lebanon (Bariche et al. 2021).

It has been suggested that the external morphology of non-indigenous fishes is an important factor for invasion success in the Mediterranean. Alien fish species with morphological features not being represented in the autochthonous community or species with different biological traits, as compared to congeneric native species, may have higher introduction rates, along with higher establishment rates (Azzurro et al. 2014, Karachle et al. 2022). In simple terms, their specific morphology and biological traits may contribute to their better performance of niches in novel environments. An example is the different performance of the Mediterranean red mullets (*Mullus* sp.) and the Red Sea goatfish species. Currently, at least in Cypriot waters, the Red Sea goatfish *Parupeneus forsskali* (Fourmanoir & Guézé, 1976) is the most abundant species, competing for habitat with the native counterpart red mullets (Evagelopoulos et al. 2020).

Pomacentrids of genus *Abudefduf* exhibit biological traits known from several other successful neozooens in Mediterranean waters, e. g., a comparatively high territoriality and life-history plasticity. For instance, the Eastern Pacific *A. troschelii* is, like most *Abudefduf* species, very territorial, especially when reproducing (Guillen-Parra et al. 2020). The Hawaiian *A. abdominalis* (Quoy & Gaimard, 1825) has extended reproduction periods and it is able to flexibly adapt its reproduction strategy and frequency according to changing biotic (food availability) and abiotic (lunar periodicity) factors (Tyler & Stanton 1995). Finally, the Caribbean Sea *A. saxatilis* is an opportunistic species with several reproduction periods within 12 months and fast growth rates (Villegas-Hernández et al. 2022). Thus, they may outcompete native Mediterranean pomacentrids, i. e., *C. chromis* for space and resources. Nevertheless, it remains to be demonstrated that *C. chromis* is less territorial and less flexibly adaptive than *Abudefduf* species.

Finally, this study highlights the importance of molecular species identification of neozoic *Abudefduf* specimens of Mediterranean Sea, because of their yet imperfect species identification and since damselfishes are known to hybridize in nature (Bariche et al. 2021).

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