Mediterranean Marine Science

Vol 23, No 1 (2022)

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doi: 10.12681/mms.28769

Short Communication

Mediterranean Marine Science
Indexed in WoS (Web of Science, ISI Thomson) and SCOPUS
The journal is available on line at http://www.medit-mar-sc.net
www.hcmr.gr
DOI: http://doi.org/10.12681/mms.28769

A transparent invasion: a first Mediterranean record and an established population of the glassfish *Ambassis dussumieri* Cuvier 1828

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Contributing Editor: Paraskevi K. KARACHLE

Received: 30 November 2021; Accepted: 26 January 2022; Published online: 14 March 2022

Abstract

In this study, we document the first record of the glassfish *Ambassis dussumieri* in the Mediterranean Sea. Confirmation for taxonomic identity has been conducted using morphological and molecular approaches and was based on a sub-sample of six individuals that were collected from a large school that resides within an artificial protected bay of a local power plant in Tel Aviv, Israel. This unique occurrence of an undisturbed school of invasive species is hereby discussed.

Keywords: *Ambassidae;* Levant Basin; Lessepsian invasion; invasive species.

Introduction

The glassfish family Ambassidae, also known as the Asiatic glassfishes or perchlets, are Indo-Pacific shallow water zooplanktivorous fishes that inhabit both the marine, brackish or freshwater environment (Anderson & Heemstra, 2003). This family comprised of seven valid genera and over 100 species (Fricke *et al*., 2021), glassfish taxonomy has been partially revised, using traditional (Martin & Heemstra, 1988; Anderson & Heemstra, 2003; Geetakumari & Basudha, 2012) or molecular approaches (Verma *et al*., 2019).

The most speciose genus within this family is the glassy perchlets *Ambassis*, which comprised 21 valid species from which eight are restricted to freshwater and the remaining can be found in both freshwater, brackish or marine environment (Froese & Pauly, 2021). Although common and abundant throughout the Indo-Pacific, few studies have been conducted on the biology of glassfishes and were mainly focused on the freshwater or estuarine representatives of this genus (Martin, 1989; Coates, 1990; Llewellyn; 2011; Minh Dinh *et al.,* 2020). In addition, there are no documented cases of glassfish as an introduced alien species, whether deliberately or unintentionally.

In this paper, we provide the first such record, by documenting a large school of the tropical *Ambassis dussumieri* Cuvier 1828, inside an artificial bay of a power station at the Israeli Mediterranean coast. Following a morphological and genetic description of the species, we debate its invasion route and the possible ecological impact of this species, facing its remarkably large population size.

Materials and Methods

On the 13th of October 2021, a single individual of *A. dussumieri* was caught by a coastal angler using a simple rod and baited dough inside the artificial bay of 'Reading' power plant in Tel Aviv, Israel (GPS 32.108194° N, 34.775778° E; Fig. 1, 2). Exactly a month later, the second author KG used a hand net to collect five more individuals and documented the surrounding area and the residing school using an underwater camera (Fig. 3).

After capture, the six individuals were documented individually, muscle tissues were preserved in absolute ethanol for genetic analysis, and the whole fish were frozen for further analysis. After close examination under a light stereo microscope, whole fish were preserved in 70% ethanol and stored at the Steinhardt Museum of Natural History at Tel Aviv University under the catalogue vouchers SMNHTAU P.16628 and P.16636.

Fig. 1: Sampling site of *Ambassis dussumieri* inside the vicinity of the artificial bay of 'Reading' power plant in Tel Aviv, Israel.

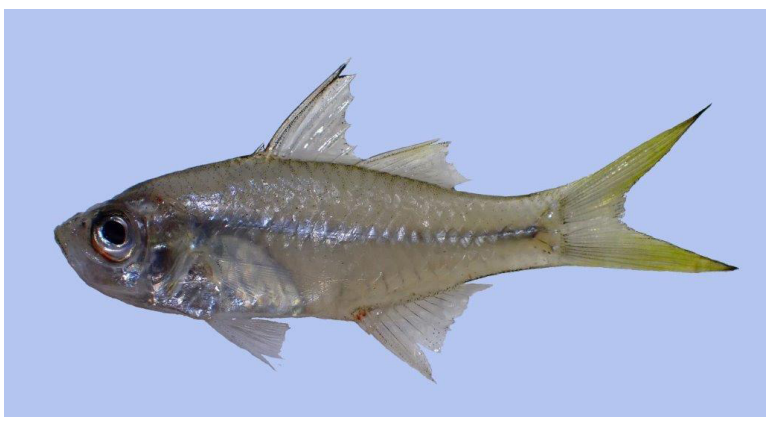

Fig. 2: *Ambassis dussumieri*, collected in Tel Aviv, Israel, 13.10.2021. Museum voucher SMNHTAU P. 16628, BOLD voucher BIM1011-21, Standard length 33.72 mm.

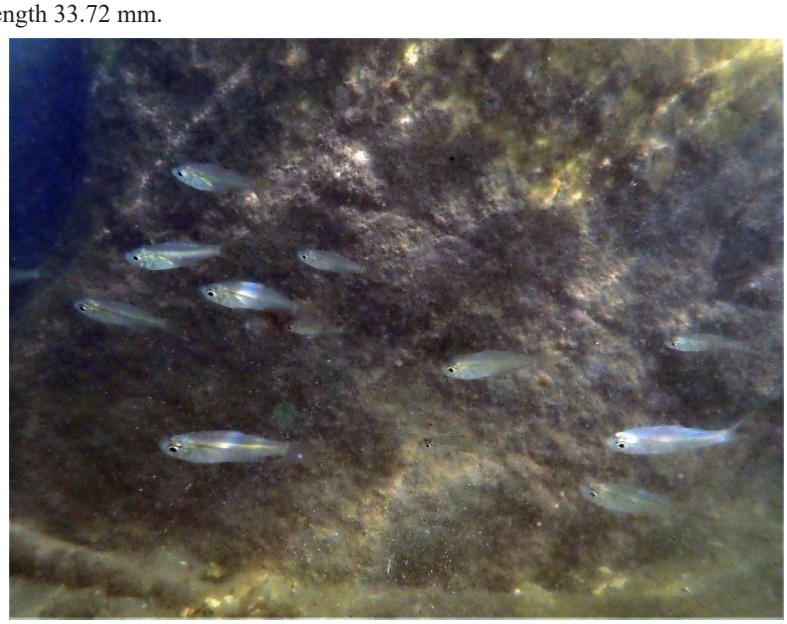

Fig. 3: Underwater image of a small section of the invasive school of *A. dussumieri* within the enclosed artificial bay in Tel Aviv, Israel. 11.11.21; GPS 32.108194° N, 34.775778° E.

Morphological examinations

Fish individuals were inspected in fresh condition under light stereo microscope. Measurements were taken using a digital caliper with 0.01 mm accuracy.

Final taxonomy was determined following the revision of Anderson & Heemstra (2003).

Molecular methodology

Total genomic DNA was extracted using a micro tissue genomic DNA isolation kit following the manufacturer's protocol (AMBRD Laboratories, Turkey). Next, ca. 50 ng of template DNA were used to amplify 635-693 bp fragments of the cytochrome *c* oxidase subunit I mitochondrial gene (*COI*), following standard working protocols (Ward *et al.,* 2005). Sequences, photographs, and trace files were uploaded to the Barcode of Life Database system (BOLD) at www.v4.boldsystems.org under the BIM project (Biota of the Israeli Mediterranean) with BOLD Samples IDs: BIM1011-21 – BIM1016-21. Last, sequences were used to verify the morphological description using the search engines of both the National Center for Biotechnology Information (NCBI) and BOLD.

Results

***AMBASSIS DUSSUMIERI* CUVIER 1828** (Fig. 2)

Ambassis dussumieri Cuvier, in Cuvier & Valenciennes, 1828: 181 (type locality: SW India).
Ambassis denticulata Klunzinger, 1870: 719 (type locality: Red Sea).
Ambassis gymnocephalus (non Lacépède, 1802): Bleeker, 1874: 99
Ambassis urotaenia (non Bleeker, 1852): Pellegrin, 1933: 88.
Chanda gymnocephalus Dor, 1984: 94.

Material examined

Six specimens, collected inside the artificial bay of 'Reading' power plant, northern Tel Aviv, Israel, Eastern Mediterranean Sea (GPS 32.108194° N, 34.775778° E), depth 2m (Fig 1) – SMNHTAU P. 16628, 1 specimen: 33.72 mm in standard length (SL), collected by Raz Bachar, 13 October 2021; SMNHTAU P.16636, 5 specimens: 29.3-38.2 mm SL, collected in the same site by K. Gayer, 13 November 2021.

Diagnosis

A species of *Ambassis* with the following characters: two supraorbital spines; pre-orbital rostral spine below anterior nostril; discontinuous lateral line; two rows of scales on the cheek; body depth 2.82-3.17 in SL; lower gill rakers 19-21.

Description

Summary of morphometric and meristic measurements is given in Table 1.

Body depth 2.82-3.17 times in SL; dorsal-fin rays VII/I, 8-9; anal-fin rays III, 9-10; pectoral-fin rays 13-14; lateral line interrupted below base of soft dorsal rays; vertical scale rows 26-27; horizontal scale with nine rows; cheek with two scale rows; pre-dorsal scales 13-14; gill rakers 7-10+19-21.

Counts of head serrae followed Fig 1 in Anderson & Heemstra (2003): two supraorbital spines; pre-orbital ridge smooth; pre-orbital edge with 2-3; retrorse rostral spine; pre-opercle ridge with 5-8 serrae; lower edge of pre-opercle with 8-16 serrae.

Live coloration: translucent dorsally with a horizontal silver band along mid-body; dark membrane around second and third dorsal-fin spines; black lineation along base of dorsal and anal fins; caudal fin yellow with dark edges.

Table 1. Selected morphological and meristic measurements for six individuals of *Ambassis dussumieri*, SMNHTAU P. 16326, P. 16636.

Size and proportions	
Total length (TL)	39.4-48.8
Standard length (SL)	29.3-38.16
Body depth (BD)	9.5-12.2
BD to SL	2.82-3.17
Predorsal length	15.02-16.6
Prepelvic length	11.7-13.03
Preanal length	16.71-22.86
Total weight (g)	0.51-0.97
Meristic characters	
Dorsal fin	VII/I, 8-10
Pectoral fin	13-14
Ventral fin	I, 5
Anal fin	III, 9-10
Scale counts	
Scales on lateral line	26-27
Pre-dorsal scales	13-14
Scales on horizontal line	9 rows
Scales on cheek	2 rows
Gill raker counts	
No. of gill rakers on upper limb	8-10
No. of gill rakers on lower limb	19-21
Counts of serrae on head	
Supraorbital ridge	2
Pre-orbital ridge	2-3
Pre-orbital edge	4-5
Pre-opercule ridge	5-8
Lower edge of pre-opercule	8-16

Genetic analysis

Three *COI* haplotypes were observed within the six examined individuals, with shallow interspecific divergence of a maximum value of 0.64%. Comparisons of the sequences generated in this study with online databases (NCBI and BOLD) have shown matchings of 99.67-100% with individuals of *A. dussumieri* collected from the Indian Ocean in South Africa (i.e., accession JF492813 in NCBI) and India (i.e., KF770831 in NCBI). In addition, possible taxonomic misidentifications have been observed in both NCBI and BOLD, with matching results of our specimens with previously published sequences of *A. gymnocephalus* (i.e., accession TZMSA437-04 in BOLD) and *A. commersoni* (accession KC774633 in NCBI).

Distribution

Indo-West Pacific from South Africa, north to the Red Sea, and eastward around India and Australasia to the Philippines and China in estuarine and coastal waters. This study reports a new record of *A. dussumieri* as an alien species in the Mediterranean Sea.

Remarks

Only very few records of alien fish species in the Mediterranean Sea have reported the presence of an established reproducing population in their first published documentation. Such incidents have been seen for example by Golani (2002), in the case of *Plotosus lineatus* and by Ben-Tuvia (1983), in the case of *Oxyurichthys petersii* (reported as *O. papuensis*). In this study, we report an undetected isolated school of hundreds of individuals within the enclosed artificial bay of the power station (Fig. 3). To the best of our knowledge, there are no other alien species to be seen first in such abundance.

Discussion

In the native environment, marine glassfish are coastal schooling fish, with a preference for sheltered estuaries and harbors (Martin & Heemstra, 1988; Anderson & Heemstra, 2003). The large school of *A. dussumieri* that was documented in this study has resided inside an artificial bay of a power plant that may cater for the ecological needs of the species. Moreover, the fact that this large school has been observed only in this enclosed bay may indicate that a sheltered area is fundamental for the successful establishment and reproduction of this species. Moreover, although salinity level within the bay is marine (Abramzon, 2021), its proximity to the estuary of the Yarkon River (approx. 500 m in aerial distance) may further suits its ecological requirements.

Other abundant alien fish species that can be seen in enclosed harbors in the Israeli coast with relatively similar trophic preferences and schooling behavior are the spotback herring *Herklotsichthys punctatus* (Rüppell, 1837) and the Red Sea hardyhead silverside *Atherinomorus forskalii* (Rüppell, 1838).

The glassfish *A. dussumieri* is not being traded in the ornamental aquarium industry, nor it is likely to hitchhike through ballast water since there are no large marine vessels in the area of observation. Although its exact abundance in the Red Sea is unknown, *A. dussumieri* is listed in the checklist of Red Sea fishes, along with its congeneric *Ambassis urotaenia* Bleeker 1852 (Golani & Fricke, 2018). *A. urotaenia* can be distinguished from *A. dussumieri* by having a continuous lateral line and an absence of rostral spine below anterior nostrils (Anderson & Heemstra, 2003). Considering the proximity of the Suez Canal to the Israeli coastline, a Lessepsian invasion of *A. dussumieri* through the canal is the most likely scenario for its introduction route.

Since no other incidents of invasive glassfish are known elsewhere, the possible impacts of this species in the invaded area are not apparent, as similar to *H. punctatus* and *A. forskalii*. As previously shown by Goren *et al.* (2016), we presume that further enlargement and spread of its population may deliver future alteration of local trophodynamics, by simultaneously increasing the predation pressure on local zooplanktonic communities and allowing new food provision for opportunistic pelagic predators. Further examinations to evaluate our hypothesis will need to include gut analysis of *A. dussumieri* to understand its trophic preferences in the Mediterranean Sea, and the occasion examination of local predators such as scombrids or carangids to assess their use of this new prey opportunity.

Acknowledgements

Authors would like to thank Raz Bachar for providing the first specimen of this report, and to R. Fricke, BS. Galil and M. Goren for their valuable advices.

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