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Rapid Communication

From the Strait of Sicily to the Sicilian Ionian Sea: the expansion of *Hemiramphus far* (Forsskål, 1775) in Italian watersFrancesco Tiralongo^{1,2,*}, Daniele Tibullo^{2,3}, Clara Monaco⁴, Iuri Peri⁴, Adriana Vella⁵, Noel Vella⁵, Giuseppina Messina¹ and Bianca Maria Lombardo¹¹Department of Biological, Geological and Environmental Sciences, University of Catania, Catania, Italy²Ente Fauna Marina Mediterranea, Scientific Organization for Research and Conservation of Marine Biodiversity, Avola, Italy³Section of Biochemistry, Department of Biomedical and Biotechnological Sciences, University of Catania, Catania, Italy⁴Department of Agriculture, Food and Environment (Di3A), University of Catania, Catania, Italy⁵Conservation Biology Research Group, Department of Biology, University of Malta, Msida, Malta

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Citation: Tiralongo F, Tibullo D, Monaco C, Peri I, Vella A, Vella N, Messina G, Lombardo BM (2022) From the Strait of Sicily to the Sicilian Ionian Sea: the expansion of *Hemiramphus far* (Forsskål, 1775) in Italian waters. *BioInvasions Records* 11 (in press)

Received: 22 June 2021**Accepted:** 3 September 2021**Published:** 15 March 2022**Handling editor:** Michel Bariche**Thematic editor:** Amy Fowler**Copyright:** © Tiralongo et al.

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Abstract

On 21st May 2021, a single specimen of *Hemiramphus far* was caught by an angler along the southeastern coast of Sicily (Ionian Sea). This species has only been recorded once before in Italian waters, in 2013 in Lampedusa (Strait of Sicily). The presence of *H. far* in the Sicilian Ionian Sea, eight years after its first observation in Lampedusa, could indicate the spread of this species in Italian waters. We report the first record of the species in the Italian Ionian Sea and discuss its presence in Italian waters. Furthermore, we offer some considerations on its further expansion and the possibility of using this new resource for human consumption.

Key words: Lessepsian immigrant, Mediterranean Sea, citizen science, fisheries**Introduction**

Hemiramphidae Gill, 1859 are medium-sized fishes widely distributed in the Atlantic, Indian and Pacific Oceans. This family, whose members are commonly known as “halfbeaks”, is comprised of 61 valid species in 16 genera (Eschmeyer et al. 2021; Froese and Pauly 2021). The main morphological trait of these fishes, in most species, is a lower jaw that is much longer than the upper one. Dorsal and anal fins are quite short and are located posterior to the body. Pectoral and pelvic fins are short, while the caudal fin is quite developed and shows a markedly larger lower lobe in most species. The body is elongated and laterally compressed. These fishes are omnivorous and feed on algae, zooplankton and fishes (Talwar 1962). The flesh of Hemiramphidae is considered excellent food, and larger species are utilized as a food resource in many parts of the world (Salas et al. 2011).

Two non-indigenous fish of the Hemiramphidae family have been reported in the Mediterranean Sea so far: *Hemiramphus far* (Forsskål, 1775) and *Hyporhamphus affinis* (Günther, 1866), both considered Lessepsian

immigrants (Golani et al. 2002). A third species, namely *Hyporhamphus picarti* (Valenciennes, 1847), is native to the basin. *Hemiramphus far* was among the first Lessepsian immigrant fish recorded in the Mediterranean Sea. It was recorded for the first time in 1927 in Palestine, where it was initially misidentified as *Hemiramphus marginatus* (Forsskål, 1775) (Steinitz 1927). Subsequently, the species has spread westward into the basin (Charfi-Cheikhrouha 2004; Ben Souissi et al. 2005; Shakman and Kinzelbach 2007; Akça and Bilecenoglu 2010; Rafrafi-Nouira et al. 2012; Kara et al. 2012 and references therein), establishing populations and reaching the Italian coasts (Lampedusa, Strait of Sicily) in 2013 (Falautano et al. 2014). To date the species has been recorded in Syria, Turkey, Lebanon, Cyprus, Egypt, Libya, Greece, Albania, in the eastern Adriatic Sea, Tunisia, Algeria and the Strait of Sicily (Italy) (Kara et al. 2012 and reference therein; Falautano et al. 2014; Bariche and Fricke 2020). The native range of this Indo-Pacific species extends from the Red Sea and East Africa to Samoa, north to Ryukyu islands, south to northern Australia and New Caledonia (Froese and Pauly 2021). *Hemiramphus far* is an epipelagic and coastal species that exhibits schooling behaviour. Maturation size is reported to be around 18 cm standard length (SL), with a spawning period in spring-summer. Eggs are attached to floating or benthic vegetation. The maximum reported total length (TL) is 45 cm (Collette and Parin 1986; Collette and Su 1986).

To the best of our knowledge, our report from 2021 is the first record of *H. far* for the Sicilian Ionian Sea. The specimen was caught by a local fisherman, highlighting the importance of local knowledge in identifying non-native species.

Materials and methods

On 21st May 2021, a specimen of *H. far* was caught at Noto (southeastern Sicily; Ionian Sea; 36.84604N; 15.11141E) by an angler fishing from the shore, at a depth of about 2–3 m (Figure 1). The bait used was live fly larvae. The fish was caught in the proximity of the surface together with other fish species: *Oblada melanura* (Linnaeus, 1758) and *Trachinotus ovatus* (Linnaeus, 1758). The fisherman immediately realized that he was faced with a “strange-looking species” (Figure 2) and contacted experts in the field. The specimen was identified and examined by experts of the AlienFish project, a national citizen science project, promoted by Ente Fauna Marina Mediterranea, for monitoring and studying non-indigenous and rare fish species in Italian waters (Tiralongo et al. 2019, 2020a). All main morphometric and meristic measurements were performed with an ichthyometer to the nearest 0.1 cm. Gut contents were analyzed using a stereomicroscope (Nikon SMZ745T), and the maturation stage of the gonads was macroscopically investigated. The specimen was then stored frozen with code #EFMM-210521.

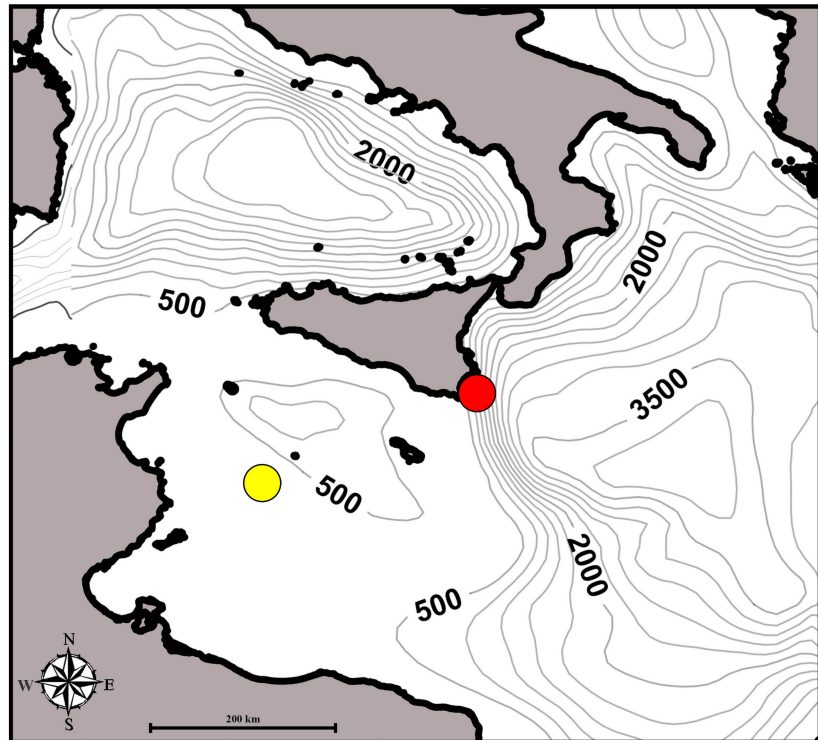


Figure 1. Italian records of *Hemiramphus far*. The yellow circle indicates the location of the only previously published record of the species from Lampedusa (2013). The red circle indicates the location of the current record (21st May 2021) from the Ionian Sea (Sicily).



Figure 2. The specimen of *H. far* caught on 21st May 2021 at Noto (southeastern Sicily, Ionian Sea). (A) The specimen freshly caught. (B) The specimen in laboratory. Photographs by Salvatore Canzonieri (A) and Francesco Tiralongo (B).

Results

The specimen exhibited all of the characteristics reported for *H. far* (Collette and Su 1986), including an elongated and stout body that is laterally compressed. The lower jaw was elongated while the upper jaw was short and lacked scales in the upper part; the eyes were quite developed.

The caudal fin was deeply forked, with the upper lobe less developed than lower one. The background body color was bluish dorsally, with silver color laterally and white ventrally. There were three dark spots on sides. The upper lobe of the caudal fin was yellow, while the lower lobe was bluish. The tip of the lower jaw was pink. Between the anal opening and the pelvic fins, there was a short series of quite stout scales.

The specimen had a total length (TL) of 354 mm, a standard length (SL) of 303 mm, a head length (HL) of 117 mm, a pre-anal length (PAL) of 255 mm and an eye diameter (ED) of 11 mm. The weight was of 126 g. The meristic formula was: D = 13; A = 12; P = 12; V = 6.

Gut content analysis showed the presence of filamentous green algae of the genus *Chaetomorpha* Kützing, 1845 and a fragment of a leaf of *Cymodocea* K.D. König, 1805. The gonads were in first stages of development, and thus it was not possible to determine the sex macroscopically.

Discussion

Although 70 specimens of this species were first recorded in Italian waters in 2013 at Lampedusa, no subsequent records have been reported in Italian waters until 2021 (Falautano et al. 2014). The size of the specimen and analysis of gonads indicated that the fish caught in 2021 was a maturing adult. Meristic data were similar to those recorded in specimens from Lampedusa by Falautano et al. (2014). Interestingly, the species has not been recorded from Malta. Therefore, despite the considerable number of individuals recorded at Lampedusa, the species has thus far failed to colonize Italian areas northwards, including the Sicilian Ionian Sea and other areas of the Strait of Sicily such as Malta. Due to its particular morphological features, *H. far* is a species that hardly goes unnoticed, even by less experienced fishermen, and thus the species presumably reached the Sicilian Ionian Sea only recently. However, another possibility could be that due to low abundance, it has gone undetected until now. To date only four Lessepsian immigrants are established along Italian waters, namely *Fistularia commersonii* (Rüppell, 1838), *Lagocephalus sceleratus* (Gmelin, 1789), *Siganus luridus* (Rüppell, 1829) and *Stephanolepis diaspros* (Fraser-Brunner, 1940) (Servello et al. 2019; Tiralongo et al. 2019, 2020a), suggesting that most Lessepsian immigrants struggle to adapt to Italian waters. We hypothesize that the water temperatures are probably too cold in the winter to allow successful overwintering. However, considering the biological features of *H. far* and of Hemiramphidae in general, such as fast growth rates and opportunistic feeding, this species could be a good candidate for future establishment in Italian waters and westward throughout the Mediterranean Sea (Stewart and Hughes 2007; Rocha de Oliveira and Chellappa 2014; Mehanna et al. 2019). The record reported here could indicate the recent arrival of the species in the Sicilian Ionian Sea and underlines the need and importance of monitoring potentially invasive species in conjunction with citizen scientists (Azzurro and Tiralongo 2020;

Tiralongo et al. 2019, 2020a, b; Al Mabruk et al. 2021). Several studies, including those mentioned above, have demonstrated that citizen science is an effective and low cost tool for monitoring marine biodiversity in the Mediterranean Sea.

Considering the schooling behaviour of *H. far*, the negative impact on the new ecosystem could be particularly relevant. However, considering the edibility of this species, fisheries and commercialization of this fish could be a valid alternative to reduce its abundance, and it could be an additional economic resource for the local fishery (Shakman and Kinzelbach 2007; Mehanna et al. 2019).

In Italian waters the number of established non-indigenous fish species is still low, especially if compared with the eastern part of the Mediterranean Sea. However, the increasing mean annual temperature of the basin could favor the establishment and arrival of new non-indigenous fish species in the central and western part of the Mediterranean Sea (Francour et al. 1994; Raitzos et al. 2010). Invasive species already established in the eastern part of the basin, such as *L. sceleratus*, *P. miles* and *H. far*, could be the new invaders of Italian waters (Shakman and Kinzelbach 2007; Giovos et al. 2019). Hence the urgent need of concrete actions in order to manage biological invasions.

Acknowledgements

We are grateful to Corrado Caruso and Salvatore Canzonieri for their collaboration to the AlienFish project and for providing us the specimen of *Hemiramphus far* and data relative to its caught, and to the two anonymous reviewers for their helpful comments. This work has been performed in the framework of the Interreg V-A Italia-Malta 2014-2020 programme, “Sea Marvel – Save, Enhance, Admire Marine Versatile Life” project of the Universities of Catania and Malta in collaboration with Ente Fauna Marina Mediterranea. Its publication has been funded by the Funds for Research Projects of the University of Catania (2016/2018), WP4 “Sustainability of local food systems and fisheries”.

Authors’ contribution

FT: conceptualization, data collection, first draft preparation and review; DT: data collection and review of the manuscript; CM, IP, AV, NV, GM, BML: review of the manuscript.

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