An additional record of the non-indigenous species (NIS) *Seriola fasciata* from the southern coast of Sicily (Central Mediterranean Sea)

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An additional record of the non-indigenous species (NIS) *Seriola fasciata* from the southern coast of Sicily (Central Mediterranean Sea) is here described in this note. The catch record is the first in the area and confirms the key role of the area for NIS spreading. In addition, an updated map of its spatial distribution is provided as well as a discussion on the possible misidentification and competition with the native greater amberjack *Seriola dumerili*.

Key words: Herculean species, non-indigenous species, biodiversity, spatial distribution, Strait of Sicily

INTRODUCTION

The biodiversity of the Mediterranean Sea has changed considerably over the past two decades, mainly due to the increasing occurrence of non-indigenous species (NIS) introduced both naturally (i.e. via Suez Canal and the Strait of Gibraltar) and due to anthropic activities, such as marine shipping (ballast waters, fouling) and aquaculture (GALIL et al., 2017). NIS are classified as lessepsian species, if migrate from the Red Sea to the eastern Mediterranean Sea across the Suez Canal, or herculean, if a species naturally via Strait of Gibraltar (GOULETQUER et al., 2014; LOCKWOOD et al., 2013). Fishes are an important component of NIS and among them the majority are lessepsian species (DEIDUN et al., 2015).

The most successful lessepsian fish species are *Fistularia commersonii* (Rüppell, 1838) (AZZURRO et al., 2013; VITALE et al., 2016); *Lagocephalus sceleratus* (Linnaeus, 1758) (AZZURRO et al., 2014; KARA et al., 2015); *Pterois miles* (J. W. Bennett, 1828) (VAVASIS et al., 2020); *Siganus luridus* (Rüppell, 1828) (AZZURRO & ANDALORO, 2004); *Stephanolepis diaspros* (Fraser-Brunner, 1940) (DEIDUN et al., 2015) and *Upeneus pori* (Ben-Tuvia & Golani, 1989) (DEIDUN et al., 2018; GERACI et al., 2018). Although herculean species represent the minority of NIS their settlement effects on Mediterranean marine communities are not to be neglected, especially if they compete with other species particularly important to the local economies. The Lesser Amberjack *Seriola fasciata* (Bloch, 1973) is a herculean species, widespread across the Atlantic Ocean that may compete with the native greater amber-
jack *Seriola dumerili* (Risso, 1810). In the Mediterranean Sea, it was recorded for the first time in Balearic Island (Massuti & Stefanescu, 1993) and then has spread rapidly eastward up to Israel, Lebanon, Syrian and waters (Sonin et al., 2009; Crocetta et al., 2015; Jawad et al., 2015). The rapid natural expansion of the species via Strait of Gibraltar would be supported by an increase in water flux through the strait and hydroclimate modifications, such as temperature increase, which would favour the settlement of species of subtropical and tropical affinity (Andaloro & Rinaldi, 1998; Quignard & Tomasin, 2000).

The present note concerns the first record of *S. fasciata* in the southern coast of Sicily and provides an update of its spatial distribution.

**MATERIAL AND METHODS**

In November 2016, off the southern coast of Sicily (Terrible Bank: approximate coordinates 37.15000° N, 12.88333° E), one specimen of *S. fasciata* was caught using trammel net at about 50 m depth. It was identified according to the morphological description and meristic given by Fischer et al. (1981) and Golani et al. (2002). In addition, the meristic and morphometric characteristics of the specimen were compared with other Mediterranean records (Andaloro et al., 2005; Jawad et al., 2015; Stamouli et al., 2017; Dogdu et al., 2019). In particular, only for Andaloro et al. (2005) the morphometric features of nine specimens were provided as mean values. All measurements were performed through ImageJ software (Rueden et al., 2017) to the nearest 0.5 cm while sex was determined macroscopically. Then, maturity stage was determined through Medits (International bottom trawl in the Mediterranean) scale (Anon., 2017). Map of the *S. fasciata* first records in the Mediterranean was made by means Quantum GIS software in order to update its spatial distribution.

**RESULTS AND DISCUSSION**

Specimen was an immature male, measured 20.5 cm TL and weighted 128.8 g. The end of upper jaw relatively narrow, the typical irregular dark body bars and meristic count were in agreement with Fischer et al. (1981) and Golani et al. (2002) (Fig. 1). In addition, as shown in Table 1 by comparing the morphometric and meristic features it was emerged that all values were similar with the other Mediterranean studies which strengthen the correct identification of the species and therefore the presence of *S. fasciata* in Strait of Sicily. The occurrence of *S. fasciata* in the Sicilian waters is not totally unexpected indeed the Strait of Sicily may represents an ecological corridor for NIS from the Atlantic Ocean and the Indo-Pacific Ocean as well (Scannella et al., 2017; Servello et al. 2019, Geraici et al., 2019; Falsone et al., 2020). Around Sicily waters, the catch of juveniles of *S. fasciata* with trammel net represents an anomaly considering that it was caught mainly caught by purse seine fishing the common dolphinfish (*Coryphaena hippurus*) with fish aggregating devices (FADs) (Andaloro et al., 2005; Tiralongo et al., 2018) (Fig. 2).

Concerning spatial distribution, in the Strait of Sicily *S. fasciata* was never reported in the southern coast of Sicily. Previously it has been reported both in Lampedusa (Andaloro et al., 2005) and Malta islands (Deidun et al., 2011) while the closest finding to the present record was in Egadi Islands (Lipej et al., 2017) (Fig. 2). Despite Golani et al. (2002) stated that most of the Atlantic fish are irregular species and unable to create stable populations in their new habitats, *S. fasciata* represents a successful colonizer becoming a commercial species in central Mediterranean Sea (Andaloro et al., 2005). It is worth to highlight as to date in the Mediterranean, only

**Fig. 1.** Specimen of *Seriola fasciata* caught off the southern coast of Sicily.
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a record above the 40th parallel, i.e. Gulf of Lion, was reported by QUIGNARD & TOMASINI, (2000) based on unpublished record (QUIGNARD, 1996, no published) (Fig. 2). This spatial pattern may be due to the subtropical and tropical affinity of the species that hampers its spreading toward the highest latitudes where the marine waters result generally colder.

Regarding morphological aspects, it should be noted that due to the similarity between the adults of S. dumerili and S. fasciata, fishers may confuse the two conspecific carangidae. As matter of fact, the only macroscopic difference of the above mentioned species is the supramaxilla, wide in S. dumerili narrow in S. fasciata (ISPRA, 2012). So, the presence and abundance of S. fasciata in the Mediterranean Sea might be underestimated (TIRALONGO et al., 2018). Indeed, most of the records concern juveniles, which are more easily identifiable than adults. The possible adult misidentification with S. dumerili lead to define the S. fasciata as cryptogenic questioning if the specie is really a NIS (CROCETTA et al., 2015). Indeed, the term cryptogenic refers to circumtropical species or species with a disjoint distribution, and whose native range is still unknown or its presence may be the result of past introductions not recorded in the literature (CARLTON, 1996). In the light of the above, further investigation will be needed to monitor this species expansion in the southern coast of the Mediterranean sea and better understand its possible competition with the greater amberjack S. dumerili.

Fig. 2. Updated map showing location of Seriola fasciata first records in the Mediterranean basin reported according to the catch date. 1: 1989 (Massuti & Stefanescu, 1993); 2, 3, 4, 5, 6: 1994-1995,1997-1998, 2002 (Andaloro et al., 2005); 7: 2003 (Shakman et al., 2017); 8: 2004 (Corsini et al., 2006); 9: 2005 (Crocetta & Bariche, 2015); 10: 2008 (Sonin et al., 2009); 11, 12: 2008-2009 (Deidun et al., 2011); 13: 2012 (Özvarol & Gökoğlu, 2014); 14: 2013 (Jawad et al., 2015); 15: 2014 (Castriota & Spinelli, 2016); 16: 2016 (Castriota & Falautano, 2017); 17 (black star): present study; 18: 2017 (Akel and Rizkalla, 2017);19: 2018 (Doğdu et al. 2019); 20: 2018 ( Yapici & Filiz, 2020); ?: doubtful record (Quignard, 1996, no published data)
Table 1. Seriola fasciata morphometric and meristic characters of the present study (Strait of Sicily) compared with other Mediterranean Sea records

| Morphometric and meristic characters | ANDALORO et al., 2005 | JAWAD et al., 2015 | STAMOULI et al., 2017 | DOĞDU et al., 2019 | YAPICI & FILIZ, 2020 | Present study |
|-------------------------------------|-----------------------|-------------------|-----------------------|-------------------|---------------------|--------------|
| Weight (g)                          | NA                    | NA                | 49                    | 106.2             | 587.5               | 128.8        |
| Total length (cm)                   | 27.4                  | 16.9              | 16                    | 18.3              | 34.9                | 20.5         |
| % Total Length                      |                       |                   |                       |                   |                     |              |
| Fork length                         | 86.8%                 | 87.6%             | 87.5%                 | 87.4%             | 86.24%              | 88.9%        |
| Standard length                     | 82.8%                 | 83.4%             | 77.5%                 | 76.5%             | 75.64%              | 84.5%        |
| Pre 1st dorsal fin length           | 26.4%                 | 33.1%             | 33.1%                 | 34.3%             | 27.42%              | 29.0%        |
| 1st dorsal fin length               | 7.7%                  | 8.3%              | 10.6%                 | 11.5%             | 8.49%               | 10.7%        |
| 2nd dorsal fin length               | 37.4%                 | 36.7%             | 36.2%                 | 37.7%             | 34.84%              | 37.8%        |
| Pre second dorsal fin length        | NA                    | 42.0%             | 41.3%                 | 40.7%             | 27.42%              | 40.8%        |
| Height of 2nd dorsal fin lobe       | 13.5%                 | NA                | 10.0%                 | 9.7%              | NA                  | 10.7%        |
| Pre pectoral length                 | NA                    | NA                | 26.3%                 | 24.3%             | NA                  | 24.0%        |
| Pectoral length                     | 12.8%                 | NA                | 10.6%                 | 14.4%             | NA                  | 15.5%        |
| Pre ventral fin length              | NA                    | NA                | 26.9%                 | 30.7%             | NA                  | 28.5%        |
| Ventral fin length                  | 19.5%                 | NA                | 13.8%                 | 19.2%             | NA                  | 19.7%        |
| Pre anal fin length                 | 44.8%                 | NA                | 53.8%                 | 52.4%             | 43.98%              | 55.6%        |
| Anal fin length                     | 21.4%                 | 24.3%             | 21.9%                 | 23.9%             | 19.42%              | 23.8%        |
| Body depth                          | 29.8%                 | 34.3%             | 25.6%                 | 30.9%             | 25.27%              | 32.8%        |
| Body width                          | NA                    | NA                | 10.6%                 | 24.3%             | NA                  | NA           |
| Caudal-peduncle length              | 8.7%                  | NA                | 13.8%                 | 12.1%             | NA                  | 10.6%        |
| Caudal peduncle depth               | NA                    | NA                | 5.0%                  | 3.7%              | 3.72%               | 5.6%         |
| Height of anal fin lobe             | NA                    | NA                | 8.8%                  | 7.3%              | NA                  | 8.5%         |
| Head length                         | 24.3%                 | 24.3%             | 23.8%                 | 24.2%             | 23.38%              | 25.5%        |
| % Head Length                       |                       |                   |                       |                   |                     |              |
| Pre Orbital length                  | 37.0%                 | 24.4%             | 31.6%                 | 31.0%             | 29.28%              | 28.2%        |
| Post Orbital length                 | 45.0%                 | 48.8%             | 60.5%                 | 60.5%             | 47.5%               |              |
| Eye diameter                        | 22.4%                 | 26.2%             | 23.7%                 | 23.4%             | 24.26%              | 27.2%        |
| Inter Orbital length                | NA                    | NA                | 22.1%                 | 21.8%             | 27.94%              | NA           |
| 1st dorsal fin rays                 | VIII                  | VIII              | VIII                  | VII               | VIII                | VIII         |
| 2nd dorsal fin rays                 | I, 29                 | I+28-33           | I + 24                | I+29              | I+31                | I+29         |
| Pectoral fin rays                   | I, 19                 | I-19              | I + 24                | I+19              | I+19                | I + 19       |
| Pelvic fin rays                     | I, 5                  | I-5               | I + 5                 | I+5               | I+5                 | I+5          |
| Anal fin rays                       | II,I+19               | II,I+17-20        | II, I+19              | II,I+19           | II+1, 19            | II, I+19     |
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Dodatni nalaz rasprostranjenosti *Seriola fasciata* (Carangidae) u Sredozemnom moru

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**SAŽETAK**

U ovoj je bilješci opisan dodatni nalaz o vrsti *Seriola fasciata* s južne obale Sicilije (Sredozemno more). Ovaj nalaz je prvi na tom području i potvrđuje ključnu ulogu područja za širenje stranih vrsta (NIS).

Osim toga, prikazana je ažurirana karta prostorne raspodjele vrste *Seriola fasciata*, kao i rasprava o mogućoj pogrešnoj identifikaciji i kompeticiji s vrstom *Seriola dumerili.*

**Ključne riječi:** Herkulske vrste, *Seriola fasciata*, biološka raznolikost, prostorna rasprostranjenost, Sicilijski tjesnac