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Rapid Communication

A bevy of surgeons: first record of *Acanthurus chirurgus* (Bloch, 1787) from the central Mediterranean, with notes on other Acanthuridae recorded in the region

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Abstract

The doctorfish *Acanthurus chirurgus* (Bloch, 1787) is reported for the first time from the central Mediterranean, based on a specimen caught in Maltese waters during August 2016. Since the only previous Mediterranean record of this species was based on a single individual observed in the Tyrrhenian Sea, the present record likely represents an independent introduction that may have occurred through the aquarium trade or via shipping. Two other surgeonfish species, *Acanthurus coeruleus* Bloch and Schneider, 1801 and *Acanthurus monroviae* Steindachner, 1876, were previously recorded from the central Mediterranean. While *A. coeruleus* may have established a population in the Levantine Sea, like *A. chirurgus* it has only been reported once from Malta (and from the central Mediterranean in general); both *A. coeruleus* and *A. chirurgus* are, therefore, considered to be casual species in Maltese waters. In contrast, *A. monroviae* was reported from several Mediterranean countries including Tunisia and Malta in the central Mediterranean. Here we present several authenticated reports of this species from Maltese waters, which strongly suggest that it has managed to establish a population in this region, although the possibility of multiple introductions cannot be excluded.

Key words: aquarium trade, Malta, non-indigenous species, surgeonfish

Introduction

The family Acanthuridae, comprising surgeonfishes, tangs and unicornfishes, has a circumtropical distribution with most species associating with coral reefs (Froese and Pauly 2016). No acanthurid species are indigenous to the Mediterranean Sea, but six species have been recorded as newcomers (alien or range-expanding species) in this sea. The Monrovia surgeonfish, *Acanthurus monroviae* Steindachner, 1876, was first recorded in 1981 from Spain (Crespo et al. 1987), and has since been reported from several other Mediterranean countries (see Batjakas et al. 2015 and references therein). The other five species are much more recent additions to the Mediterranean ichthyofauna: *Zebrasoma flavescens* (Bennett, 1828) was reported from the Balearic Sea, near Sitges (Spain), in 2008 (Weitzmann et al. 2015); *Acanthurus coeruleus* Bloch and Schneider, 1801, was first sighted in 2011 in Cyprus (Langeneck et al. 2012); *Acanthurus chirurgus* (Bloch, 1787), was recorded from off Elba Island, Tyrrhenian Sea in 2012 (Langeneck et al. 2015); *Zebrasoma xanthurum* (Blyth, 1852) was sighted in Sardinia in 2015 (Guidetti et al. 2016); while *Paracanthurus hepatus* (Linnaeus, 1766) was observed off Bat Yam, Israel in 2015 (Marcelli et al. 2016). Apart from *A. monroviae*, only *A. coeruleus* has managed to establish itself in the Mediterranean (Golani et al. 2015; Langeneck et al. 2015); the other four species are only known from single observations.

Acanthurus monroviae and *A. coeruleus* are also the only two acanthurids that have been reported from the central Mediterranean region to date: *A. monroviae* was

Figure 1. Photograph of the *Acanthurus chirurgus* specimen caught from the Grand Harbour, Malta, in August 2016. Photograph by Reno Tonna.

first reported from Tunisia in 2010 (Ben Souissi et al. 2011), while *A. coeruleus* was sighted in Maltese waters in 2013 (Evans et al. 2015a). Here we report the presence of yet another surgeonfish, the doctorfish *Acanthurus chirurgus*, in the Maltese Islands, which represents the first central Mediterranean record for this species. We discuss possible modes of introduction for this species and also provide an update on the status of the Acanthuridae recorded from the region.

Results and discussion

On 31 August 2016, a single young (11.8 cm in TL) specimen of *A. chirurgus* (Figure 1) was caught by means of recreational fishing from the Grand Harbour (35º53.75′N; 14º31.25′E), Malta, where it occurred on a rocky bottom at a depth of 3–5 m. No other individuals of this species were observed in the area. The specimen was deposited in the collection of the Department of Biology at the University of Malta and preserved frozen, allowing detailed morphological and meristic analyses (Table 1). The fresh fish had a greenish-grey body with a whitish patch between the pectoral and pelvic fins, a light coloured region on the caudal peduncle, eight narrow dark grey vertical bars on the flank that almost reached the ventral edge, and a bright blue margin around the peduncular spine. During preservation, the background colour of the body darkened to brownish-grey, making some features such as the peduncular spine margin colour and vertical bars less apparent. The coloration pattern of the fresh specimen, together with the morphometric measurements and meristic counts, enabled positive identification as *A. chirurgus* (Randall 2002; Froese and Pauly 2016). The specimen, however, differed from reported counts for the anal fin spines and soft rays since it possessed 5 spines and 21 soft rays separated by a notch, rather than 3 spines and 22–23 soft rays as reported in the literature (Randall 2002; Froese and Pauly 2016).

Since the only previous Mediterranean record of *A. chirurgus* was based on a single specimen and no established populations of this species are known for this region, the present finding is likely due to a separate, independent, introduction. Given that the doctorfish is a non-migratory reef-associated species, we exclude autonomous long-range dispersal of juvenile or adult individuals, whose native range is restricted to the western and central Atlantic; records from West Africa are probably based on misidentifications (Rocha et al. 2012). On the other hand, the relatively long pelagic larval phase of *A. chirurgus* (up to 71 days) allows for high connectivity between the western and central Atlantic populations of this species (Rocha et al. 2002), so it is possible that larvae may also disperse to the eastern Atlantic and enter the Mediterranean. Such a mode of entry is considered unlikely due to the presence of oceanographic barriers to dispersal such as the Canary current and

Table 1. Morphometric measurements, meristic counts and body mass of the specimen of *Acanthurus chirurgus* caught from the Grand Harbour, Malta, in August 2016.

Morphometric measurements	Absolute value (mm)	% of Standard Length
Total Length	118.0	124.2
Standard Length	95.0	100.0
Body depth	47.5	50.0
Body width	15.0	15.8
Head length	24.5	25.8
Snout length	9.5	10.0
Jaw length	6.0	6.3
Eye diameter	7.5	7.9
Dorsal fin base length	60.0	63.2
Dorsal fin length	13.5	14.2
Anal fin base length	40.0	42.1
Anal fin length	12.0	12.6
Pectoral fin base length	8.5	8.9
Pectoral fin length	26.0	27.4
Pelvic fin base length	9.5	10.0
Pelvic fin length	21.0	22.1
Caudal fin length	23.0	24.2
Caudal peduncle height	9.5	10.0
Meristic counts		
Dorsal fin rays	IX + 25	
Anal fin rays	V + 21	
Pectoral fin rays	16	
Pelvic fin rays	I + 5	
Caudal fin rays	18	
Total mass (g)	36.65	

Almería-Oran Front (Patarnello et al. 2007; Vermeij 2012); however larval dispersal through the Strait of Gibraltar cannot be definitively excluded given that there are examples where these barriers appear to have been breached (Valdés et al. 2013).

While such a natural range expansion cannot be excluded, the species is more likely to have been introduced in Maltese waters through human agency. This could have occurred via a shipping-mediated dispersal since larvae may easily be transported via ballast tanks. Moreover, juvenile or adult fish can be translocated over relatively long distances in seawater-containing compartments such as sea chests, and may also actively follow slow moving vessels such as those towing oil platforms (Schembri et al. 2010; Pajuelo et al. 2016). Surgeonfish are also popular aquarium fish (Papavlasopoulou et al. 2014), so an accidental or intentional release of *A. chirurgus* imported for the aquarium trade is also possible. Indeed, the aquarium trade was considered to be the most likely introduction pathway for the specimen recorded from Elba Island (Langeneck et al. 2015). An aquarium release has also been considered as the most likely mode of introduction for most of the Acanthuridae reported from the Mediterranean: *A. coeruleus* (Langeneck et al. 2012), *P. hepatus* (Marcelli et al. 2016), *Z. flavescens* (Weitzmann et al. 2015), and *Z. xanthurum* (Guidetti et al. 2016). However, for *A. coeruleus*, a natural range expansion may be a better explanation (Golani et al. 2015, but see Marcelli et al. 2016). The presence of *A. monroviae* in the Mediterranean is also attributed to natural range expansion (Zenetos et al. 2012).

The present record of *A. chirurgus* represents its first sighting in the central Mediterranean, making it the third surgeonfish species (together with *A. coeruleus* and *A. monroviae*) recorded from the region. This also is only the second report of the doctorfish from the entire Mediteranean Sea. Given that the two records were both based on single individuals, *A. chirurgus* must still be considered as a casual species. In the case of *A. coeruleus*, the multiple sightings made in Cyprus (Langeneck et al. 2015) together with a record from Israel (Golani et al. 2015) suggest it has established populations in the Levantine Sea. However, only a single specimen was recorded from the central Mediterranean area (Evans et al. 2015a), so it is unlikely to have established a breeding population in this region.

Acanthurus monroviae is more regularly reported from the Mediterranean Sea, with records from Spain, Algeria, Tunisia, Malta, Greece and Israel (Batjakas

Table 2. Chronological list of records of *Acanthurus monroviae* made in Maltese waters; authenticated records are those supported by images or specimens.

Date	Location	No. of Individuals	Authenticated	Reference
28/09/2013	off St. Thomas Bay	1	Yes	Langeneck et al. (2015); Agius Darmanin et al. (2016)
13/10/2015	Grand Harbour	1	Yes	Agius Darmanin et al. (2016)
11/2015	not specified	1	Yes	Present work
11/12/2015	off Zurrieq	Several	?	Agius Darmanin et al. (2016)
12/2015	off Zurrieq	2	Yes	Present work
03/2016	not specified	1	Yes	Deidun et al. (2016)
27/03/2016	off Zurrieq	1	?	Agius Darmanin et al. (2016)
29/05/2016	off Zurrieq	1	Yes	Present work
06/2016	Grand Harbour	1	Yes	Present work
25/06/2016	off Zurrieq	1	Yes	Present work
26/06/2016	Merkanti Reef	1	No	Present work
07/2016	off Zurrieq	1	Yes	Present work

et al. 2015 and references therein). The first central Mediterranean record was that made in 2010 from Tunisia (Ben Souissi et al. 2011); a second specimen was sighted in Malta in 2013 (Langeneck et al. 2015). The latter was initially considered questionable by Evans et al. (2015b), but is actually substantiated by a photograph (J. Langeneck, pers. comm) which therefore authenticated the record (Evans and Schembri 2016). Two other authenticated records of the Monrovia surgeonfish have since been reported from Maltese waters by Agius Darmanin et al. (2016), although one of these has the exact same date of collection and geographic coordinates as that previously reported by Langeneck et al. (2015) with both publications acknowledging Mark Mercieca for the record, indicating that the two publications are referring to the same specimen. Another authenticated record was reported by Deidun et al. (2016). Agius Darmanin et al. (2016) also refer to yet another two sightings, made in December 2015 (several individuals) and March 2016 (single individual), but it is not clear if these are supported by photographs and hence cannot be authenticated. However, we are aware of several other authenticated reports of this species from Maltese waters that are supported by specimens or photographs (Table 2). Interestingly, about half of the sightings or specimens have been reported from the same general area off the coast of Zurrieq (SW Malta). Although some of these may represent repeated sightings of the same individual(s), the two specimens recorded in December 2015 were captured. Taken together, all these records clearly indicate that *A. monroviae* has successfully established a population in the central Mediterranean, although the possibility of multiple introductions cannot be entirely excluded.

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