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First record of *Acanthurus chirurgus* (Perciformes: Acanthuridae) in the Mediterranean Sea, with some distributional notes on Mediterranean Acanthuridae

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Abstract

The occurrence of the doctorfish *Acanthurus chirurgus* is reported for the first time in the Mediterranean Sea, off Elba Island, Tyrrhenian Sea (42.726667° N, 10.434444° E). This record is tentatively related to aquarium release. The occurrence of Acanthuridae in the Mediterranean Sea is briefly reviewed, and some distributional notes on *Acanthurus coeruleus* and *Acanthurus monroviae* in the Mediterranean are provided.

Keywords: *Acanthurus chirurgus*, *Acanthurus coeruleus*, alien species, Mediterranean Sea.

Introduction

The Acanthuridae are a widespread teleost family of tropical to subtropical affinity, which currently comprises 84 species (Eschmeyer, 2014). These fish live mainly in coral reef habitats in the Atlantic and Indo-Pacific oceans. Most Acanthuridae feed on benthic algae, zooplankton and detritus (Kuitert & Debelius, 2001). Surgeonfishes are pelagic spawners and many species are popular as aquarium fishes (Papavaslopoulou *et al.*, 2014).

In the Mediterranean Sea only three species have been recorded to date, namely *Acanthurus monroviae* (Steindachner, 1876), *Acanthurus coeruleus* (Bloch & Schneider, 1801) and *Zebrafish* *flavescens* (Bennett, 1828). *A. monroviae* is the only Acanthuridae commonly occurring in the eastern Atlantic along the African coast from Morocco to Angola and in the Sao Tomè, Cape Verde and Canary Islands. However, some recent occurrences of this species outside its typical geographical range has been reported along the Brazilian and Portuguese coasts (Luiz-Junior *et al.*, 2004; Horta and Costa & Gonçalves, 2013) and in the Mediterranean area, where this species has been recorded in Spain (Crespo *et al.*, 1987), Israel (Golani & Sonin, 1996), Algeria (Hemida *et al.*, 2004) and Tunisia (Ben Souissi *et al.*, 2011). *A. coeruleus*, on the other hand, has been previously documented in the Mediterranean Sea in Cyprus, where two juvenile specimens were observed in shallow waters (Langeneck *et al.*,

2012), while *Z. flavescens* has been reported on the basis of one specimen found in the Balearic Sea, near Sitges (Spain) (Weitzmann *et al.*, 2015); these findings have been tentatively attributed to aquarium escapes.

In this work we report the first known occurrence of *Acanthurus chirurgus* (Bloch, 1787) in the Mediterranean Sea, and provide some new distributional data on *A. coeruleus* and *A. monroviae*.

Materials and Methods

Observations of *Acanthurus chirurgus* were made during SCUBA dives by some of the authors (M. Boyer, P.G. De Cecco and C. Luciani) with long experience in scientific studies of coastal fish assemblages using visual census techniques. In addition, new reports of *A. coeruleus* and *A. monroviae* were gathered from recreational divers and considered reliable by the authors after careful examination of good quality visual material such as photographs or video footage.

Results

The first sighting of *Acanthurus chirurgus* was made on 07 July 2012, while Scuba diving in the “Picchi di Pablo” dive site, near Porto Azzurro, Isola d’Elba (42.726667° N, 10.434444° E) (M. Boyer *pers. obs.*). The photographed fish (Fig. 1) was swimming in shallow water (5 m deep) in a coastal rocky environment characterized by photophilic algal communities. The fish has a gray-greenish colored



Fig. 1: The individual of *Acanthurus chirurgus* (~10 cm TL) observed at Elba Island on July 20, 2012 (Photo by M. Boyer).

body with a whitish ring on the caudal peduncle, and the characteristic 10 dark gray vertical bars on the posterior part of the flank reaching neither the dorsal nor the ventral edge. The unpaired fins show a thin but marked blue edge, and the dorsal and anal fins show several faint, oblique darker stripes. The peduncular spine shows a noticeable bright blue margin. This combination of characteristics allowed us to identify it univocally as *A. chirurgus* (Kuitert & Debelius, 2001). The fish was a young individual, about 10 cm TL, and appeared to be in good health.

The same specimen was repeatedly seen until 2 November 2012, in approximately the same area (P.G. De Cecco & C. Luciani *pers. obs.*). This fish was often spot-

ted swimming close to a small shoal of white sea breams (*Diplodus sargus sargus*) of similar size.

Our survey also allowed us to obtain two and three unpublished records of *A. monroviae* and *A. coeruleus*, respectively. Currently known reports of Acanthuridae in the Mediterranean Sea are summarized in Table 1 and Figure 2.

Discussion

Until recently, *Acanthurus monroviae* was the only surgeonfish species observed in the Mediterranean Sea; it is generally considered a casual species in Mediterranean environments, without reproductive Mediterranean populations (Golani *et al.*, 2013). The increasing number of reports from the northern African coast (Hemida *et al.*, 2004; Ben Souissi *et al.*, 2011), along with an unpublished report of a small adult fish (24 cm TL) speared near Malta (28 September 2013) (M. Mercieca *pers. comm.*) supports the hypothesis of the presence of a small reproductive population of *A. monroviae* in the southern Mediterranean Sea (Hemida *et al.*, 2004). In the north-western Mediterranean Sea this thermophilic species is more sporadic, and until now has been officially recorded only once (Crespo *et al.*, 1987), with the recent unpublished record of a small adult (~25 cm TL) observed near Marbella, Alboran Sea (19 March 2007) (J. Alfaro Barroso, *pers. comm.*). This is probably due both to colder waters and to the unfavourable current systems along the northern coast of the Alboran Sea (Cheney, 1978). The current range expansion northwards and eastwards in the Mediterranean Sea and in the northern Atlantic Ocean



Fig. 2: Records of Acanthuridae in the Mediterranean Sea. Legend: circle= *Acanthurus monroviae*; triangle= *Acanthurus coeruleus*; square= *Zebrasoma flavescens*; star= *Acanthurus chirurgus*. Gray marks represent published record, black marks are unpublished record.

Table I. Records of Acanthuridae from the Mediterranean Sea, with geographical coordinates, date, depth and size of the observed specimens. New records are marked with an asterisk.

Species	Locality	Geographical coordinates	Date	Depth	Size	Source
<i>Acanthurus monroviae</i>	Marbella	36.483333° N; 4.516667° W	03/1981	4 m	31 cm TL	Crespo <i>et al.</i> (1987)
	Haifa	32.850000° N; 34.983333° E	03/11/1994	30 m	32,9 cm SL	Golani & Sonin (1996)
	Algier	36.808056° N; 2.908889° E	05/12/2001	5-9 m	38 cm TL	Hemida <i>et al.</i> (2004)
	Algier	36.756147° N; 2.841300° E	15/08/2002	-	-	Hemida <i>et al.</i> (2004)
*	Marbella	36.496944° N; 4.872778° W	19/03/2007	20 m	~25 cm TL	J. Alfaro Barroso (<i>pers. comm.</i>)
	Tunis	37.058889° N; 10.090833° E	05/04/2010	10 m	37,9 cm TL	Ben Souissi <i>et al.</i> (2011)
*	Malta	35.854108° N; 14.594131° E	28/09/2013	10 m	24 cm TL	M. Mercieca (<i>pers. comm.</i>)
<i>Acanthurus coeruleus</i>	Xilofagou (Cyprus)	34.961389° N; 33.830000° E	01/12/2011	4-5 m	8 cm TL	Langeneck <i>et al.</i> (2012)
	Ayia Napa (Cyprus)	34.986389° N; 33.964722° E	03/12/2011	4-5 m	8 cm TL	Langeneck <i>et al.</i> (2012)
*	Mandria (Cyprus)	34.696742° N; 32.528706° E	03/12/2011	3 m	5 cm TL	K. Aristeidou (<i>pers. comm.</i>)
*	Pernera (Cyprus)	34.983525° N; 34.072967° E	12/09/2013	-	3,5 cm TL	H. C. Simak (<i>pers. comm.</i>)
*	Akrotiri (Cyprus)	34.568447° N; 33.004264° E	07/12/2013	3 m	5 cm TL	K. Aristeidou (<i>pers. comm.</i>)
*	Akrotiri (Cyprus)	34.596283° N; 32.931733° E	18/01/2014	2 m	7 cm TL	K. Aristeidou (<i>pers. comm.</i>)
<i>*Acanthurus chirurgus</i>	Porto Azzurro	42.726667° N; 10.434444° E	20/07/2012-02/11/2012	5-12 m	10 cm TL	M. Boyer, P.G. De Cecco, C. Luciani (<i>pers. obs.</i>)
<i>Zebrasoma flavescens</i>	Sitges	41.224192° N; 1.789542° E	10/2008	6 m	15 cm TL	Weitzmann <i>et al.</i> (2015)

(Horta e Costa & Gonçalves, 2013) is probably related to climatic changes resulting in the warming of surface waters, which makes Mediterranean environments more suitable for thermophilic species (Bianchi, 2007).

The introduction of *Acanthurus coeruleus*, *Zebrasoma flavescens* and *Acanthurus chirurgus* into the Mediterranean Sea, on the other hand, is very likely related to human transport, and more precisely to the aquarium fish trade, which seems a likely explanation for the presence of the first two species listed above (Langeneck *et al.*, 2012; Weitzmann *et al.*, 2015) and probably accounts for the newly-reported *A. chirurgus* as well. Although their quite large adult size and their particular feeding habits make the rearing in captivity of most Acanthuridae difficult, these fish are fairly common in the aquarium trade, and a diversity of species are found in aquarium shops (Papavaslopoulou *et al.*, 2014). However, the high connectivity observed between western and central Atlantic populations of both species (Rocha *et al.*, 2002) still allows formulation of a hypothesis of an independent arrival of individuals from the Atlantic in the Mediterra-

nean Sea, perhaps favoured by the increase in sea water temperature observed in recent decades (Bianchi, 2007). As *A. coeruleus* is highly thermophilic, the probability of establishment was regarded as very low at the time of the first report of its occurrence in the Mediterranean Sea (Langeneck *et al.*, 2012); however, further observations of juvenile specimens scattered along the entire southern coast of Cyprus between 2011 and 2014 (K. Aristeidou, H. C. Simak, *pers. comm.*) suggest that this species could actually have had some establishment success in the Levant Sea, although there is no record of adult individuals. On the other hand, since there are no further reports of *A. chirurgus* after November, 2012, we consider it a casual occurrence in the Mediterranean Sea.

Interestingly, Lessepsian species belonging to this family have not been reported in the Mediterranean Sea. This could be due to Red Sea Acanthuridae's close association with coral reefs, whose absence in the Mediterranean Sea prevents the majority of the hard bottom Red Sea fish from establishing populations in the Mediterranean (Goren *et al.*, 2011). Conversely, the wider eco-

logical spectrum of Atlantic surgeonfishes may enable them to establish themselves in Mediterranean environments (Rocha *et al.*, 2002). While Lessepsian migrants and thermophilic Atlantic species commonly have a high rate of establishment success, the same cannot be said of the few species whose presence in the Mediterranean Sea is due to human transport (Golani *et al.*, 2013). Among this small group of alien fishes, only *Tridentiger trigonocephalus* (Goren *et al.*, 2009), *Scatophagus argus* (Zammit & Schembri, 2011), and on the basis of present data *Acanthurus coeruleus*, have shown some evidence of local establishment, although unlike several Lessepsian migrants, none of these three species seems to have undergone significant range expansion. The presence and eventual spread of *A. coeruleus* along the coasts of Cyprus, however, should be closely monitored in order to verify the hypothesis of a more or less small reproductive stock and the possibility of a range expansion towards the eastern Mediterranean coasts. Regarding this last point, as has already been suggested in other studies (Delaney *et al.*, 2008; Azzurro *et al.*, 2013), occasional sightings by recreational divers, if appropriately gathered, can provide relevant information about the presence and distribution of easily recognizable alien species, and might represent a starting point for their monitoring.

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