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First sighting of *Zebrasoma flavescens* (Teleostei: Acanthuridae) and *Balistoides conspicillum* (Teleostei: Balistidae) in the Mediterranean Sea: Two likely aquarium releases

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Abstract

We hereby provide the first documented occurrence of the yellow tang *Zebrasoma flavescens* and the clown triggerfish *Balistoides conspicillum* in the Mediterranean Sea. These tropical fishes were photographed in October 2008 off Sitges (Costa Daurada, Spain: 41°13'27.09" N; 1°47'22.35" E) and in July 2012 in front of Palamós (Costa Brava, Spain: 41°50'56.19" N; 3°8'26.29" E), respectively. Their possible release from private aquaria is discussed.

Keywords: Aquarium release, Balistidae, Acanthuridae, Mediterranean, Catalan Sea, first record.

Introduction

The trade in ornamental species is emerging as an important source of introduction of exotic organisms in aquatic systems (Semmens *et al.*, 2004; Maceda-Veiga *et al.*, 2013). In the Mediterranean Sea, some 18 species are assumed to be introduced by aquarium release or are escapees. These include nine tropical fishes, representing around 2% of the total number of exotic species recorded so far in the basin as a whole (Zenetos *et al.*, 2012). We hereby document the first Mediterranean occurrence of two popular aquarium fish species: the yellow tang *Zebrasoma flavescens* (Bennett, 1828) and the clown triggerfish *Balistoides conspicillum* (Bloch & Schneider, 1801).

The yellow tang is a small tropical reef fish belonging to the family of Acanthuridae. It is a northern hemisphere Pacific species distributed from Hawaii (where it is abundant) to the Ryukyu Islands, including the Marshall Islands, Wake, Minami Tori Shima (Marcus Island), Mariana Islands, and Ogasawara Islands (Randall, 2001). Adults inhabit coral-rich areas, both in protected lagoon waters and along seaward reefs, down to 50 m depth (Lieske & Myers, 1994). They may occur singly or in groups of up to a few hundred individuals and they feed mainly on algae during the day (Atkins, 1981). Due to the aquarium trade, the total catch of *Z. flavescens* has recently approached half a million individuals per year (Williams *et al.*, 2009).

The clown triggerfish is a tropical fish belonging to the family of Balistidae, and is widespread in the tropical Indo-West Pacific. The species is naturally distributed

from East Africa through Indonesia to Samoa, and from southern Japan to New Caledonia (Matsuura, 2001). Adults usually occur in outer reef areas adjacent to steep drop-offs down to depths of 75 m. They feed on sea urchins, crabs and other crustaceans, molluscs, and tunicates and are popular aquarium fish with a minor importance to fisheries (Matsuura, 2001).

Methods

Both specimens were photographed and filmed with underwater cameras. Due to the unavailability of specimens for taxonomical analysis, diagnostic features used for the identification of both *Z. flavescens* and *B. conspicillum* were extracted from photographs and videos and consisted of conspicuous traits of the colour pattern and body shape. *Zebrasoma flavescens* was identified following Randall (2001; 2002) and other field guides (i.e. Allen *et al.*, 2003; Lieske & Myers, 1994; Randall, 2010). Length of the individual was estimated underwater. For *B. conspicillum*, species identification followed Matsuura (2001), Smith & Heemstra (1995) and Allen *et al.* (2003). The specimen was measured but unfortunately it was not preserved.

Results

In October 2008, a yellow tang *Z. flavescens* was observed at a depth of 6 metres in front of the town of Sitges (Costa Daurada, NE Spain, 41°13'27.09" N; 1°47'22.35" E). The sighting was made by one of the authors (BW) dur-

ing underwater visual surveys. The specimen was encountered on a rocky bottom covered by coralline algae (*Lithophyllum incrustans*) and benthic invertebrates (mainly *Aiptasia mutabilis*, *Anemonia sulcata*, *Crouania francescoi* together with the alien sponge *Paraleucilla magna*).

The individual spotted off Sitges (Fig. 1; Supplementary file 1) had the following features: deep body with a moderately protruding snout and continuous undivided dorsal and anal fins; the colour was bright yellow with a visible white scalpel (caudal spine) and a pale horizontal stripe along the middle of the bodyline. It was estimated to measure 15 cm TL.

In July 2012, a clown triggerfish, *B. conspicillum*, was encountered at a depth of 3 metres, in Cala Margarida, in front of Palamós (Costa Brava, NE Spain, 41°50'56.19" N; 3°8'26.29" E) by a recreational scuba diver. The fish was hiding in a rocky crevice characterized by benthic species typical of such habitats, including *Ellisolandia elongata*, *Halopteris scoparia*, *Dictyota dichotoma* and

Codium vermilara. The same individual was observed in the same crevice for three consecutive days and at the end it was captured alive, using a hand net.

The individual spotted in front of Palamós (Fig. 2; Supplementary file 2) had the following features: body deep, compressed, black to yellowish in ground colour with large round white blotches on the ventral half of body and small blotches on the back, and with a white band across the snout in front of the eye; the lips and the area around the mouth were orange-yellow; the mouth was terminal. The fish measured 15.0 cm TL.

Discussion

The present findings from the Catalan Sea are the first documented occurrences of *Z. flavescens* and *B. conspicillum* in the Mediterranean. In the last few years, other exotic fish species have been documented from the Cata-



Fig. 1: *Zebrasoma flavescens* (Bennett, 1828) photographed off the coast of Sitges (Catalan Sea, Spain) on October 2008 at a depth of 6 metres. Photo: Boris Weitzmann.



Fig. 2: *Balistoides conspicillum* (Bloch & Schneider, 1801) photographed off Palamós (Catalan Sea, Spain) on July 2012 at a depth of 3 meters. Photo: Eva Roqueta i Vilà.

lan Sea. In November 2012, one specimen of *Abudefduf saxatilis* was spotted along the coasts of Palamós by a recreational diver (Azzurro *et al.*, 2013). In December 2007, also at Palamós (Morro de Vedell creek: Cala Margarida), a single specimen of the Lessepsian *Fistularia commersonii* Ruppell, 1838, was reported by Sánchez-Tocino *et al.* (2007).

The unique colour patterns of both *Z. flavescens* and *B. conspicillum* (Allen *et al.*, 2003; Smith & Heemstra, 1995) provide acceptable confidence that the observed specimens were correctly identified, even in the absence of specific meristic and morphometric data.

As far as *Z. flavescens* is concerned, some acanthurids such as *Acanthurus coeruleus* (Schofield *et al.*, 2009), present a yellow body during the juvenile stage (Guiasu & Winterbottom, 1998) but no other surgeonfish is similarly coloured to the yellow tang during the adult stage (Randall, 2002). Also, the very closely related *Zebrasoma scopas* (Cuvier, 1928) has a darker coloration than *Z. flavescens* (Randall, 2001). Another morphological character that matches the description of *Z. flavescens* is the shape of the fins and the moderately protruding snout (e.g. Allen *et al.*, 2003; Lieske & Myers, 1994; Randall, 2010). Certainly, a closer morphological examination of the Sitges individual would have provided further details on the taxonomical identification. Moreover, in the absence of molecular analyses, cases of hybridization among these species cannot be excluded, which is often reported in the ornamental fish trade (Steinke *et al.*, 2009).

The particular pattern of large white spots on the clown triggerfish has no equivalent among the other triggerfishes and can be considered as a stable taxonomic character (Matsuura, 2001). The band across the snout in front of the eye and the orange colour of the lips are also typical of this species (Smith & Heemstra, 1995; Matsuura, 2001; Allen *et al.*, 2003).

According to Wabnitz *et al.* (2003), *Z. flavescens* is one of the ten most traded species of ornamental fishes worldwide, and the number of specimens imported between 1997 and 2002 has been estimated to exceed 38,000 in the European Union. Following the criteria given by Michael (1999), the yellow tang is highly suitable for aquaria, being generally durable and hardy, with most individuals acclimatizing to a home aquarium. It is noteworthy that this species has been introduced to the Gulf of Mexico, where it occurs together with another four exotic congeners e.g. *Zebrasoma desjardini* (Bennett 1836); *Z. veliferum* (Bloch, 1795); *Z. xanthurum* (Blyth, 1852) and *Z. scopas* (Cuvier, 1829) (Semmens *et al.*, 2004; Schofield *et al.*, 2009). *Balistoides conspicillum* is also a commonly traded ornamental fish and one of the most highly prized aquarium species because of its attractive pigmentation (Reksodihardjo-Lilley & Lilley, 2007).

Considering that both *Z. flavescens* and *B. conspicillum* are not reported to occur in the Red Sea (Golani & Bogorodsky, 2010), Lessepsian migration cannot be invoked as a suitable pathway of introduction for these species. Because of their importance as ornamental aquarium species, it is likely that these tropical fishes had been released from private aquaria.

Aquarium releases have had dramatic consequences on aquatic systems (Padilla & Williams, 2004); the lionfish (the *Pterois volitans* - *P. miles* complex) invasion along the Western Atlantic coasts is one of the most recent and spectacular examples (Whitfield *et al.*, 2002). Early identification of new invaders, together with an understanding of the vectors and pathways of introduction, are critical steps for proper management (Kolar & Lodge, 2001). When a new exotic species becomes established, its control may be very difficult, or even impossible, especially in the marine environment (Barbour *et al.*, 2011).

Most marine fishes available for sale in pet shops are exotic and some could have the potential to establish permanent populations in the Mediterranean Sea (e.g. Zammit & Schembri, 2011). This reinforces the need for more careful implementation of education programmes, regulation and monitoring of trade (Semmens *et al.*, 2004; Gertzen *et al.*, 2008). Education should be accompanied by printed information for every species sold at aquariums. In addition, a system should be established where any unwanted aquarium fish could be returned to the store, preventing potential releases into the wild. Furthermore, citizen science programmes could improve our ability to track exotic species in the wild and at the same time serve to raise public awareness (e.g. Azzurro *et al.*, 2011). Since aquarium species represent a potential and realized threat to marine communities and considering the general lack of regulation of this trade (Padilla & Williams, 2004), these proactive actions should be seriously considered by organizations committed to the protection of biodiversity and by policy-making bodies.

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