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Yet another angelfish species for the Mediterranean – the first record of *Holacanthus africanus* Cadenat, 1951 from Maltese waters, central Mediterranean

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Abstract

The first documented record of the Guinea angelfish, *Holacanthus africanus*, for the Mediterranean is hereby reported, through the capture of two individuals within Maltese coastal waters. The fish were submitted as a contribution to the Spot the Alien Fish citizen science campaign. Considerations are made on the possible introduction pathway used by the species to reach these waters, including the aquarium trade or association with a towed oil platform.

Key words: new introduction, Guinea angelfish, alien, citizen science

Introduction

Angelfish (family Pomacanthidae) are typical inhabitants of tropical and subtropical waters. Recently, a number of angelfishes have been recorded in Mediterranean waters – two species belonging to the genus *Pomacanthus* Lacépède, 1802 (*Pomacanthus maculosus* and *P. imperator*) and one to the genus *Holacanthus* Lacépède, 1802 (*H. ciliaris*) (Golani et al. 2010; Bariche 2010; Salameh et al. 2012; Karachle et al. 2016; Evans et al. 2016). The genus *Holacanthus* is relatively small, with just seven recognised species, six of which are characteristic of Western Atlantic and Eastern Pacific coastal waters and only one species native to the Eastern Atlantic (Alva-Campbell et al. 2010). The only specimen to date documented in the Mediterranean is *H. ciliaris* (Linnaeus, 1758) — a species native of the Western Atlantic — and was found in coastal waters in proximity to an oil platform in Croatia (Dulčić and Dragičević 2013). The introduction of *H. ciliaris* to the Mediterranean has been linked by the authors to the towing of an oil platform, transferred from Mexico to Croatia for maintenance purposes. Other vectors of introductions were excluded, considering that the species is not important in the aquarium trade industry. Another two specimens belonging to the genus *Holacanthus*, i.e the West African or Guinea angelfish (*Holacanthus africanus* Cadenat, 1951), were recently caught in Maltese waters. This species occurs in the coastal waters from Cape Verde and Senegal in the north to the Democratic Republic of the Congo in the south (including the Gulf of Guinea islands) (Pyle et al. 2010). It is a benthivore species and is reported to be reef-associated, encountered at maximum depths of 40–50 m (Froese and Pauly 2017; Debelius 1997). In the Cape Verde islands, *H. africanus* occurs frequently in relatively dense shoals along with a small number of accompanying species (Monteiro et al. 2008). In this paper, the first record of *H. africanus* in the Mediterranean is described.

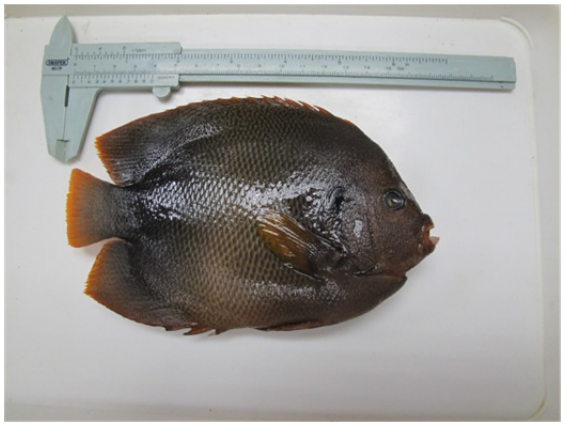

Figure 1. The first *Holacanthus africanus* individual recorded within Maltese waters, caught on the 5th April 2017 and having a total length of 15.9 cm. Photo: Alan Deidun.

Figure 2. Close-up of the head region of the first *H. africanus* individual reported in this study, caught on the 5th April 2017 and having a total length of 15.9 cm. Photo: Alan Deidun.

Figure 3. The second *Holacanthus africanus* individual recorded within Maltese waters, caught on the 25th May 2017 and having a total length of 13.0 cm. Photo: Alan Deidun.

Figure 4. Close-up of the head region of the second *H. africanus* individual reported in this study, caught on the 25th May 2017 and having a total length of 13.0 cm. Photo: Alan Deidun.

Material and methods

On the 5th of April 2017, we were alerted by a recreational fisherman, through the "Spot the Alien Fish" citizen science campaign administered in the Maltese Islands (http://www.aliensmalta.eu), about the capture of a potentially non-indigenous fish specimen. The specimen was caught within a baited pot deployed through a mooring line secured on land, acting as a trap for fish at the foot of a wharf at Senglea, in the Grand Harbour of Malta (35.890068ºN; 14.516296ºE). By the time of recovery of the specimen by our team, the fish had lost part of its livery (Figure 1). According to the fisherman, the same individual had consumed part of a juvenile white seabream [*Diplodus sargus* (Linnaeus, 1758)] individual (measuring about 12 cm in length) caught within the same pot. *Circa* six weeks later, on the 25th of May 2017, a second smaller individual, presumably belonging to the same species, was caught through spear-fishing, also at Senglea, less than 500 m away from the collection site of the first individual (35.884880ºN; 14.515246ºE), in close proximity to the Noble Paul Romano semi-submersible oil rig (Noble Corporation 2017) stationed within the Grand Harbour for maintenance work. The main morphometric and meristic characteristics of both specimens were recorded and are reported in Table 1. All measurements were taken with a dial caliper to the nearest mm. Both specimens are currently preserved in a frozen state within the premises of the University of Malta.

Results and discussion

Both specimens (Figures 1 and 3), measuring 15.9 cm TL and 13.0 cm TL, respectively, had the following diagnostic characters: an orbicular body with dorsal

Table 1. Morphometric measurements and meristic counts for the two individuals of *Holacanthus africanus* caught from Maltese waters.

Morphometric measurements	Values for the first individual (caught on the 05.04.17)	Values for the second individual (caught on the 25.05.17)
Total length (cm)	15.9	13.0
Standard length (% of TL)	86.2	82.3
Head length (cm)	3.7	3.2
Pre-dorsal length (% of TL)	18.2	21.5
Pre-anal length (% of TL)	56.0	47.7
Pre-pectoral length (% of TL)	25.8	21.5
Pre-pelvic length (% of TL)	26.4	20.0
Body depth (cm)	9.1	6.7
Eye diameter (% of HL)	21.6	21.9
Inter-orbital length (% of HL)	24.3	28.1
Inter-orbital width (% of HL)	37.8	37.5
Meristic counts		
Dorsal fin	XIV, 16	XIV, 16
Anal fin	III, 18	III, 18
Pectoral fin	14	13
Pelvic fin	I, 5	I, 6
Caudal fin	15	16
Lateral line scales	40	40
Above lateral line scales	7	7
Below lateral line scales	30	29
Gill rakers	17	17

and anal soft fins not extended into filaments; a triangular head bearing a strong backward spine at the angle of the toothed preopercle, with a non-elongated snout; hind margin of preorbital bone without spines (Figures 2 and 4). At the time of recovery, the specimens exhibited the following coloration: three large vertical bands, the two external ones being darker than the central one; one dark spot just above the pectoral fin base; mouth and pectoral fin yellowish; pelvic fin brown; anal and dorsal fins brown with posterior borders orange; caudal fin orange. All these features allowed to ascribe this specimen to *Holacanthus africanus* in its subadult stage. This species reaches the maximum total length of 45 cm and, like other angelfishes, undergoes colour transition with growth, from deep blue body with a vertical light band across the middle of the body and bright orange tail in juveniles, fading to uniform olive-yellow or brownish in adults which, furthermore, develop extended filaments on dorsal and anal soft fins (Debelius 1997; Bailly 2016).

The morphological measurements and meristic counts for *H. africanus* caught at Malta are included in Table 1.

The identification of angelfish may be sometimes problematic, due to the high variability of chromatic and morphological patterns between stages and sexes within the same species and also due to the similarities between species. Morphometric and meristic characteristics for the individuals from Malta correspond well, albeit with some minor variability, with the few reference values reported in the literature for this species (Bailly 2016).

The *H. africanus* records hereby presented constitute the first ones for the species within the Mediterranean basin to date. Given the importance of the species for the aquarium trade, the absence of previous records of the species from the Mediterranean, its non-migratory habit and the considerable disparity between the native range of the species and the locality where it was observed in the Mediterranean, an introduction mechanism mediated by an anthropogenic intervention is postulated. Introduction via aquarium trade can be considered the most likely hypothesis for our specimens. The trade of tropical aquarium organisms is playing an increasingly important role in the introduction of marine species to new regions, and Zenetos et al. (2016) have indicated 19 marine fish species whose introduction mechanism to the Mediterranean is suspected to be linked with this vector.

The occurrence of an oil rig in the Grand Harbour of Malta, where *H. africanus* was found, and an existing precedent of introduction for a congener – *Holacanthus ciliaris*, via the movements of an oil platform (Dulčić and Dragičević 2013), raise the possibility of a different introduction pathway for

the two *H. africanus* individuals to Maltese coastal waters. The aforementioned oil rig, which could act as a *de facto* FAD (Fish Aggregation Device), was towed in the Grand Harbour in 2012, presumably from the eastern Atlantic (the oil platform is registered in Liberia). This region is consistent with the native eastern Atlantic range of *H. africanus*. Galil (2006) had suggested that slower-moving and frequently-moored vessels, such as offshore oil and gas drilling platforms, could act as large artificial reefs which play an important role in the transmission of alien species. It is unclear, however, whether the two *H. africanus* individuals recorded within this study were able to survive associated to the moving oil rig for such a prolonged period (4–5 years since its arrival to Maltese waters), or they had simply exploited the sheltered oil rig environment, following their release or introduction through another pathway.

The Grand Harbour hosts a variety of different uses, ranging from a cruise passenger terminal, to cargo-handling facilities, shipyards and recreational vessel marinas. The co-occurrence of several potential vectors of introduction complicates the identification of introduction pathways for any non-indigenous species recorded there.

This study highlights the urgent need to define new methodologies useful for reconstructing introductory pathways for non-indigenous species. Within this context, efforts must be made to improve the traceability of aquatic species valuable within the aquarium trade. Operational monitoring efforts within known hotspots for non-indigenous species introductions, including ports, offshore rigs and platforms, should be extended in view of the increasing numbers of species being introduced through such pathways.

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