Short communication

First record of *Cephalopholis formosa* (Shaw, 1812) (Perciformes: Serranidae) in the Persian Gulf

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Introduction

The genus *Cephalopholis* (Bloch and Schneider 1801) (Perciformes: Serranidae) contains 22 species, of which most are mysterious groupers inhabiting within or near coral reefs (Heemstra and Randall, 1993). However, only four species of this genus, *C. argus*, *C. hemistiktos*, *C. miniata* and *C. sex-maculata*, have been reported to occur in the Persian Gulf (Valinassab and Sedghi Marouf, 2013). One of the widespread species of this genus is *C. formosa*, recorded in many places in the Indo-West Pacific region (Heemstra and Randall, 1993), but not in the Persian Gulf. In this study, we report the existence of *C. formosa* in Iranian waters of the Persian Gulf for the first time, as evidenced through both phenotypic and genetic examination.

Materials and methods

During an October 2013 study on marine biodiversity in Iranian waters of the Persian Gulf, an unidentified fish species was observed coincidentally and photographed.

Two fish specimens were captured using a spear-gun in a rocky habitat at a 5 m depth southwest (26°49'16.7"N, 56°19'30"E) of Larak Island. Morphometric measurements were taken using a dial caliper with an accuracy of 0.1 mm, and meristic data were recorded based on Randall and Taylor (1988) and Heemstra and Randall (1993). Pyloric appendages were also investigated as specific morphological characteristics. To ensure phenotypic identification of the specimens, a partial sequence of the mitochondrial COI gene was PCR amplified on caudal fin tissue DNA by Col-Fish-F: TTCTCAACTAACCAYAAAGAYATYGG and Col-Fish-R: TAGACTTCTGGGTGGCCRAARAAYCA primers (Hemming, 2012). The polymerase chain reaction product was sequenced (Source BioScience, Nottingham, UK) and aligned with congener species COI sequences deposited in the NCBI GenBank. To ascertain correct identification of the species, a phylogenetic tree of the COI sequences with the maximum likelihood tree was constructed with the bootstrap analysis of 1000.

Results

Although no study to date has yet reported the sighting of *Cephalopholis formosa* in the Persian Gulf (see Heemstra and Randall, 1993; Assadi and Dehghani, 1997; Rezai and Savari, 2004; Grandcourt, 2012; Valinassab and Sedghi Marouf, 2013), the results of this study provide the first definitive evidence of the existence of this species in the Persian Gulf. Some morphometric characteristics of the two captured *C. formosa* specimens (174 and 182 mm SL) are presented in Table 1: the dorsal fin is continuous, with nine spines and 17 soft rays; the anal fin has three spines and nine soft rays; the pectoral fin has 16 soft rays; and the pelvic fin contains one spine and five soft rays.

The genetic distance of the sequenced specimens from the NCBI reported specimens was 0.2–1% and 6.8–11.1% for within and between species, respectively. The genetic difference between COI sequences of *C. formosa* and *C. boenak* was 11% (Fig. 1). Both morphological and genetic evidence confirmed the captured specimens to be *C. formosa* (Fig. 1, Table 1).

Discussion

One of the main Serranidae morphological characteristics for accurate species identification is the arrangement and number of pyloric appendages (Roy and Gopalakrishnan, 2011).

Table 1
Morphometric characteristics of two *Cephalopholis formosa* specimens captured 17 October 2013 in the Persian Gulf

Specimen 2 mm (% SL)	Specimen 1 mm (% SL)	Morphometric characters
220.3	227.7	Total Length (TL)
174.2	182.4	Standard Length (SL)
69.4 (39.83)	74.2 (40.67)	Head Length (HL)
61.4 (35.24)	63.6 (34.86)	Body width
109.1 (62.62)	104.3 (57.18)	Length of dorsal base
11.1 (6.37)	11.3 (6.19)	Eye diameter
50.1 (35.48)	43.7 (23.95)	Pectoral fin length

Fig. 1. Maximum likelihood tree of *Cephalopholis* COI sequences. All branches had bootstrap support above 50%. Green: identified and sequenced sample from the Persian Gulf. The out-group is *Mycteroperca microlepis*

Nine pyloric appendages with a single twisted arrangement were observed in our specimens. Roy and Gopalakrishnan (2011) report 7–10 appendages with the same arrangement as a key to identifying *C. formosa*.

The high degree of genetic differences between this specimen and other morphologically-similar species (*C. boenak*) as well as the tree topology (Fig. 1) show that the observed species is *C. formosa* and not *C. boenak*. The values are similar to genetic differences reported between and among other species within the Serranidae family (Craig and Hastings, 2007).

In conclusion, *C. formosa* has been successfully sighted, identified and reported to exist in the vicinity of the Persian Gulf islands in light of both genetic and morphological

evidence. The COI sequences and pyloric appendages both prove the species occurrence in Iranian waters of the Persian Gulf. The results of this study are helpful for further investigation of the biology of this species as well as the overall taxonomic and phylogeographic status of the Serranid fishes.

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