

RESEARCH ARTICLE

The first record of the lowfin chub *Kyphosus vaigiensis* (Quoy & Gaimard, 1825) from Malta

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Abstract

This paper presents the morphometric, meristic and genetic analyses of the first specimen of the lowfin chub, *Kyphosus vaigiensis*, from the coastal Maltese waters. A single specimen was caught in January, 2015 from Malta, but since then a number of other occasional visual records of this species have been noted in close-by areas, indicating an established population in these waters.

Keywords: *Kyphosus vaigiensis*, alien species, Malta, Mediterranean Sea, DNA barcoding

Introduction

The fish species of the genus *Kyphosus* (Perciformes: Kyphosidae) are not native to the Mediterranean, nonetheless the oldest Mediterranean records date back to 1847, 1884 and 1904 (Doderlein 1884; Ariola 1904; Manino *et al.* 2015), indicating that members of this genus had expanded their home-range long before the current alien fish invasion.

In the past two decades, the Mediterranean records of this genus have been on the increase (Merella *et al.* 1998; Hemida *et al.* 2004; Francour and Mouine, 2008; Orsi-Relini *et al.* 2010; Ligas *et al.* 2011; Kiparissis *et al.* 2012; Lelong, 2012; Azzurro *et al.* 2013; Mannino *et al.* 2015). However, the high similarity between the species of the genus led to taxonomic confusion (Knudsen and Clements, 2013, 2016; Mannino *et al.* 2015). Recent taxonomic revisions identified a number of invalid and synonymous taxa, with different revisions accepting different valid species' names (Knudsen and Clements, 2013, 2016; Sakai and Nakabo 2014). According to Knudsen and Clements (2013, 2016), *K. incisor* (Cuvier 1831) is a junior synonym of *K. vaigiensis* (Quoy and Gaimard 1825), representing a species with a home-range extending from the Atlantic to the Indo-Pacific. However, Sakai and Nakabo (2014) considered the latter two taxa as two

different species with *K. incisor* being an Atlantic species and *K. vaigiensis* being an Indo-Pacific species. Recent molecular studies by both Mannino *et al.* (2015) and Knudsen and Clements (2016) have shown that DNA sequences from the Indo-Pacific *K. vaigiensis* matched those of the Atlantic *K. incisor*, placing all the specimens within the same monospecific clade, thus concluding that *K. incisor* is synonymous to *K. vaigiensis*.

Materials and Methods

On 12 January 2015, a specimen of *K. vaigiensis* (Figure 1) was caught close to Delimara, Malta (GPS: 35°50'6.936N, 14°33'45.486E) at a depth of 2 m (Figure 2). Upon capture, the specimen was photographed by the angler (Figure 1). Soon after, it was made available for scientific analyses and kept as part of the ichthyological collection of the Conservation Biology Research Group laboratory at the University of Malta. The species identification was undertaken through morphological and meristic investigations, using a dissecting microscope, following Sakai and Nakabo (1995; 2014), Knudsen and Clements (2013) and Mannino *et al.* (2015). All measurements were taken to the nearest 0.1 mm using electronic calipers and mass to the nearest 0.1 g.



Figure 1. The individual *Kyphosus vaigiensis* caught from Malta in January, 2015 (image by angler, J. Ellul).

Given that the genus *Kyphosus* is composed of a number of similar species (Knudsen and Clements, 2013; 2016; Mannino *et al.* 2015), thus genetic analyses were used to confirm species identification. Total genomic DNA was extracted using proteinase K and AccuPrep Genomic DNA Extraction Kit (Bioneer Inc.). PCR amplifications was carried out for: Cytochrome c oxidase I gene (COI), Cytochrome b (Cytb) and 12S to 16S ribosomal RNA genes (12S-16S) using the primers sets as described in Vella *et al.* (2016a) and 16S ribosomal RNA gene (16S) using 16Sar and 16Sbr primers (Palumbi *et al.* 1996). PCR amplifications were carried out following the amplification protocols described in Vella *et al.* (2016a). The PCR products were purified and sequenced via ABI3730xl sequencer using both forward and reverse primers. The sequences were analysed at both the nucleotide and amino acid level via Geneious (<http://www.geneious.com>, Kearse *et al.* 2012). The sequences obtained were

deposited in GenBank accession numbers KX278312-5 for COI, Cytb, 12S-16S and 16S genes respectively. These sequences were compared to other sequences available in genomic databases using BLASTn.

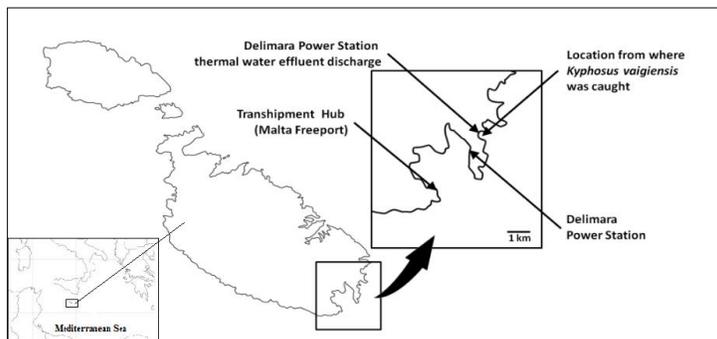


Figure 2. Map of the Maltese Islands showing the locations from where *Kyphosus vaigiensis* was caught.

Results

The specimen's morphology, meristics (Table 1) and colour (Figure 1) matched with the descriptions for the species *K. vaigiensis* given by Sakai and Nakabo (1995, 2014), Knudsen and Clements (2013), and Mannino *et al.* (2015). Its body was rather elongate, oval shaped, bronze to brown in colour, with a number of light coloured patches and longitudinal golden yellow stripes that extended from the operculum to the caudal fin. The upper edge of the dorsal fin, the edge of the slightly emarginated caudal fin, the pelvic fins and the anal fin were dark in colour. The specimen had a total length of 157 mm and as this specimen was eviscerated by the angler prior to investigation, it weighed 49.1 g (Table 1). Meristic data collected showed that this individual has XI+13 dorsal fin rays, III+12 anal fin rays and I+5 pelvic fin rays (Table 1).

The sequence lengths obtained from this specimen were 655 bp, 803 bp, 1020 bp and 590 bp for COI, Cytb, 12S-16S and 16S genes respectively, and each was run via BLASTn to identify sequence matches. The COI gene from the current specimen gave a 100% match with *K. vaigiensis* KF714952 from the Philippines (Juguilon *et al.* unpublished) and JF493713 from South Africa (Steinke *et al.* unpublished), while it had one base difference, that is a 99.8% match, to the Italian specimen studied by Mannino *et al.* 2015 (gb:KR013046). As for the 16S rRNA gene, the latter Italian specimen (Mannino *et al.* 2015; gb:KR013047) completely matched the local specimen. The local specimen also had a 100% match with gb:KC136531 from South Africa (West Indian Ocean), gb:KC136543 from North-West Australia, and gb:KC136544 from Ascension Island (Knudsen and Clements 2016), when using the 12S-16S sequence. The latter sequence also exhibited a 99.8% match to another Italian specimen collected by Ligas *et al.* (2011), that was identified as *K. saltatrix*, but genetic analyses by Knudsen and

Clements (2016) and the revised taxonomy by Knudsen and Clements (2013) indicated that this Italian specimen was also *K. vaigiensis*.

Table 1. Measurements and meristics of the first *Kyphosus vaigiensis* specimen caught in Maltese water.

Parameter	Measurements	% SL
Mass (eviscerated)	49.1 g	
Total length	157.0 mm	
Fork length	144.0 mm	
Standard length	129.0 mm	
Maximum body depth	50.8 mm	39.4%
Length of dorsal fin base	65.0 mm	50.4%
Pectoral fin base	6.0 mm	4.7%
Anal fin base	31.6 mm	24.5%
Pre-pelvic length	43.4 mm	33.6%
Pre-anal length	66.4 mm	51.5%
Pre-pectoral length	31.0 mm	24.0%
Head length	33.0 mm	25.6%
Pre-orbital length	8.4 mm	6.5%
Eye diameter	9.9 mm	7.7%
Inter-orbital distance	12.9 mm	10.0%
Depth of caudal peduncle	12.8 mm	9.9%
		Counts
Dorsal fin spines		11
Dorsal fin soft rays		13
Pelvic fin spines		1
Pelvic fin soft rays		5
Anal fin spines		3
Anal fin soft rays		12
Pectoral fin soft rays		18
Scales on lateral line		60

Discussion

This study presents the scientific data associated with the first record of *K. vaigiensis* in Maltese waters. This record is another addition to the growing list of species that are finding their way from the Atlantic or the Indo-Pacific Ocean into the Mediterranean Sea (Galil 2008; Golani *et al.* 2014, Vella *et al.* 2015a,b; 2016a,b). The recent Mediterranean records for the genus *Kyphosus* (Merella *et al.* 1998; Hemida *et al.* 2004; Francour and Mouine 2008; Orsi-Relini *et al.* 2010; Ligas *et al.* 2011; Kiparissis *et al.* 2012; Lelong 2012; Azzurro *et al.* 2013; Mannino *et al.* 2015) are indicative that this tropical genus may be facilitated in its migratory paths through either shipping activity (Galil 2008; Golani *et al.* 2014) or floating debris, given that in their natural habitat juvenile *Kyphosus* sp. are usually pelagic and are found associated with floating objects (Smith and Heemstra 1986; Carpenter 2002). Additionally, favourable environmental conditions including climatic changes namely warming sea temperatures (Galil 2008; Occhipinti-Ambrogi and Galil 2010; Turan *et al.* 2016), could further encourage the movement of this tropical genus into the Mediterranean Sea. These conditions have allowed the distribution of *K. vaigiensis* to spread and now also establish itself in Maltese waters.

This first record of *K. vaigiensis* in Malta was recorded in an area that is characterized by heavy marine traffic as it occurs in the vicinity of a harbour which constitutes a major transshipment hub and off-shore bunkering sites in the central Mediterranean (Figure 2). Additionally, the semi-enclosed embayment from where the specimen was caught, locally known as Ħofra ż-Żgħira, is an area that receives thermal effluent discharges from the nearby Delimara power station. This thermal effluent within a semi-enclosed area causes the sea temperature at Ħofra ż-Żgħira to raise by up to 8°C when compared to surrounding ambient temperatures (Enemalta 2011). Recently *Abudefduf hoefleri*, a tropical Eastern Atlantic species, was also recorded in the same embayment (Vella *et al.* 2016a). The warmer environmental conditions at this site facilitate the survival of tropical species, such as *A. hoefleri* (Vella *et al.* 2016a) and *K. vaigiensis* by providing the ideal sea temperatures. At the same time, this environment may act as a stepping stone for the species to further expand. In fact, recently other specimens of *K. vaigiensis* have been observed by divers in close-by areas indicating the presence of an established population in these waters.

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