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New additions to the fish fauna of Sea of Marmara: *Dentex maroccanus* Valenciennes, 1830 (Sparidae) and *Gobius couchi* Miller & El-Tawil, 1974 (Gobiidae)

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Abstract
Dentex maroccanus Valenciennes, 1830 and *Gobius couchi* Miller & El-Tawil, 1974 were captured from the Marmara Archipelago in May 2022. Both species are new additions to the Sea of Marmara fish fauna. According to the available data, we assume *D. maroccanus* to be recently introduced to the region, while *G. couchi* may have been overlooked in previous studies due to its cryptogenic lifestyle.

Keywords: *Dentex maroccanus*, *Gobius couchi*, Sea of Marmara, New record.

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Introduction

The Sea of Marmara is a peculiar semi-enclosed ecosystem acting as a biogeographical corridor between the Mediterranean Sea and the Black Sea through Çanakkale and Istanbul straits, respectively. The basin is characterized by a permanent two-layer stratification and two-layer current systems; the upper layer consists of low saline Black Sea water, while saline Mediterranean waters take place in the lower layer (Chiggiato et al. 2012). Due to this hydrobiological uniqueness, the Sea of Marmara serves as a barrier and an acclimatization zone for several marine taxa from the two adjacent seas (Öztürk 2002).

Fish diversity of the Sea of Marmara has prominently altered during the last decade by adding several unrecorded taxa. A minor proportion of these records belong to previously overlooked native species such as *Chromogobius zebratus* (Kolombatovic, 1891) (Engin et al. 2016). There is also a growing entrance of thermophilic taxa i.e. *Trachinotus ovatus* (Linnaeus, 1758) (Bilecenoğlu and Öztürk 2019) and alien fish of the Red Sea and Indo-Pacific origin i.e. *Siganus rivulatus* (Forsskål & Niebuhr, 1775) (Karakulak et al. 2020). Recent inclusions indicate that this basin is under severe co-occurring threat of Mediterranization and tropicalization phenomena. The mean surface water temperature of the Sea of Marmara has experienced a significant increase from 15.1°C from 1970-1979 to 16.8°C from 2011-2021 (TSMS 2021), which seems to continue enhancing the introduction of more species with warm-water affinities. During an expedition, we carried out scuba dives and bottom trawling at several sites in the Marmara Archipelago, where we sampled two fish species previously unrecorded from the Sea of Marmara, namely *Dentex maroccanus* Valenciennes, 1830 and *Gobius couchi* Miller & El-Tawil, 1974. Owing to the unmistakable morphology of the former species, we are assuming its occurrence in the region to be a recent event, while the latter cryptobenthic species might be overlooked in previous studies.

Material and Methods

A scientific research cruise on board the research vessel K. Piri Reis was organized in May 2022 within the scope of the MarIAS project (Addressing Invasive Alien Species Threats at Key Marine Biodiversity Areas

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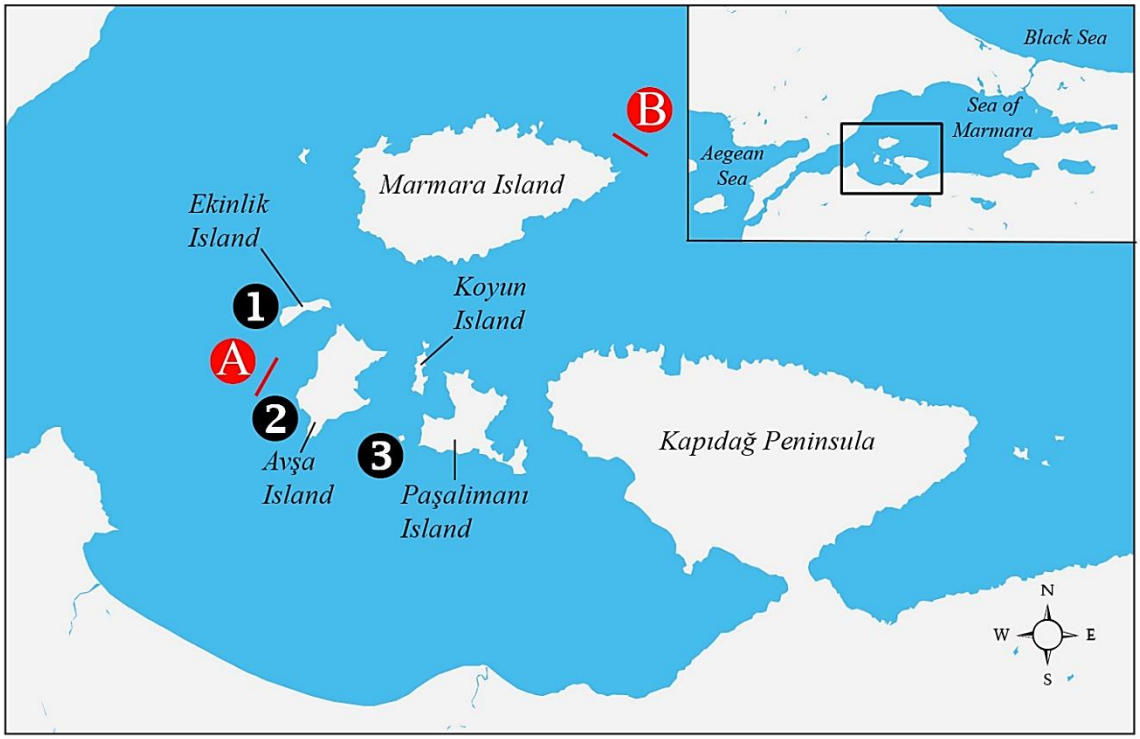

Figure 1. Sampling localities of *Dentex maroccanus* at the Marmara Archipelago. Red letters (associated with red lines, corresponding to start/end of hauls) indicate bottom trawling grounds (A: trawl #1; B: trawl #2). *Gobius couchi* was sampled from Ekinlik (1) and Avşa (2) Islands, while an underwater photograph was taken from Yeradası (3).

Project) to assess the composition and distribution of certain alien species. Samplings were made both by scuba dives and bottom trawling hauls. On 16 May 2022, two individuals of *D. maroccanus* were collected from two different trawl catches (west of Avşa Island, trawl #1 start 40°30.833 N - 27°26.582 E, trawl#1 end 40°29.573 N - 27°26.158 E, depth 59 – 60 m; east of Marmara Island, trawl #2 start 40°39.817 N - 27°44.037 E, trawl #2 end 40°39.540 N - 27°45.655, depth 67-69 m; Figure 1). The fish were photographed upon their collection and fixed in 4% formalin. Identification of the species was followed by Bauchot and Hureau (1986).

During 16 – 20 May 2022, the authors had chance to capture a total of two *G. couchi* individuals over soft and gravel bottoms at depths ranging from 8 to 12 m at Avşa Island (40°29.566 N - 27°28.684 E) and Ekinlik Island (40°32.330 N - 27°27.927 E). An underwater photograph of *G. couchi* was also taken from Yeradası (40°28.021 N - 27°33.784 E) (Figure 1). Ekinlik Island specimen was fixed in 4% formalin, while Avşa Island specimen was spared for the genetic confirmation of the species. For genetic analysis, DNA was extracted from muscle tissue of the *G. couchi* specimen, by using Genomic DNA Isolation Kit (AMBRD) according to the user's manual. Mitochondrial cytochrome oxidase subunit I (COI) sequences were partially amplified using the primers LCO1490 and HC02198 (Folmer et al. 1994). The PCR mixture and amplification protocol was the same as used by Folmer et al. (1994). Sequencing was carried out by the Macrogen Europe (Amsterdam, Netherlands) with the use LCO1490 primer. The sequence was manually checked, by ChromasPro v.1.5. The 5' terminal with high background and 3' primer sequence were trimmed. The sequence is deposited in the GenBank under the accession number ON643474. Identification of the species was followed by Kovačić (2020), terminology of lateral-line system follows Sanzo (1911) and Miller (1986), morphometric measurements and meristic counts were made in accordance with Kovačić (2001).

Figure 2. (A) *Dentex maroccanus* (14.7 cm TL, 11.6 cm SL), sampled from west of Avşa Island, and (B) gillrakers of the same individual (Photographs: M.Bilecenoğlu).

Results and Discussion

Dentex maroccanus Valenciennes, 1830

(Fig. 2)

Description: Body oblong and deep, without stripes or bars. Upper profile of head gently curved towards eye. Caniniform teeth in both jaws, outer strongest. Dorsal spines increase in length from first to fifth, then subequal backward. Meristic counts and morphometric proportions of two individuals (8.0-11.6 cm SL) are as follows: D XII+10, A III+8, P 14, lateral line scales 47-48 to caudal base. Gill rakers 7-8 upper, 11 lower. H 32.5-34.5, SN/D 37.5-38.8, SN/A 63.8-69.0, SN/V 40.0-40.5, CP 14.7-14.5, CPd 10.6-10.3, Db 50.0-49.1, Ab 21.3-19.8, all as percentage of SL. SN 33.6-32.5, E 32.7-32.5, PO 40.7-40.9, all as a percentage of HL. Body silvery light red with pinkish fins. Dorsal, anal and caudal fins with reddish border. A distinct small dark blotch at upper pectoral axil. Morphological measurements and meristic counts perfectly in agreement with Bauchot and Hureau (1986).

Dentex maroccanus is present in the eastern Atlantic from the Bay of Biscay to Nigeria, also commonly found in the southern and eastern Mediterranean Sea (including the Ionian and Aegean Seas), but not in the Sea of Marmara or the Black Sea (Bauchot and Hureau 1986; Russell et al. 2014). The species may be found as deep as 250 m in the Mediterranean Sea (Bauchot and Hureau 1986). However, it mostly prefers shallow grounds (50 to 70 m) having bottom salinity around 39.1‰, avoiding the deeper waters (>80 m) (Maravelias et al. 2007).

To date, three members of the genus *Dentex* were recorded from the Sea of Marmara; the relatively rare *D. dentex* (see Bauchot and Hureau 1986), *D. gibbosus* (repeatedly listed as a part of Marmara ichthyofauna by Bilecenoglu et al. (2002, 2014) and Fricke et al. (2007) based on a single record by Fischer (1973), which is erroneous information and should be removed from further local inventories), and *D. macrophthalmus* (known by a single record from Bandırma Bay by Torcu-Koç (2004), but relevant paper was unintentionally missed in the faunal checklist by Bilecenoglu et al. (2014). Considering the quite distinctive features of *D. maroccanus* (9-12 lower gill rakers, small dark blotch at the upper pectoral axil, equally developed upper and lower canines), we simply eliminate the possibility that it was previously overlooked and/or misidentified by its closely allied congenerics (i.e. *D. macrophthalmus*, characterized by 17-20 lower gill rakes, no dark spot on the pectoral upper

Figure 2. (A) *Gobius couchi* individual (live coloration; 4.0 cm SL) sampled from Ekinlik Island, Marmara Archipelago, and (B) Underwater photograph of a *G. couchi* from Yeradası, Marmara Archipelago (Photographs: M.Bilecenoğlu).

axil, lower canines clearly less well developed than uppers). Since *D. maroccanus* is common along the northern Aegean Sea coastline (Gul et al. 2014), it obviously penetrated the Marmara Archipelago through the Çanakkale Strait.

Gobius couchi Miller & El-Tawil, 1974
(Fig. 3)

Description: Body moderately elongate and somewhat compressed at caudal peduncle. Head fairly large, with oblique snout (shorter than eye diameter) and large eyes with narrow interorbital space. Anterior nostril short and tubular with small triangular process from rim, posterior nostril rounded. Posterior angle of oblique mouth reaches below anterior 1/3 of eye. Body proportions are given in Table 1, which are generally in agreement with previous studies. Formula of fins as follows: first dorsal fin VI, second dorsal fin I+13, anal fin I+12, pectoral fin 16, pelvic fin I/5+I/5, caudal fin 15 (branched rays). Body covered with ctenoid scales; predorsal area and breast also scaled but noscales on cheek. 40 scales in lateral series, 12 in transverse series (from below anterior of second dorsal fin to anal fin).

The body is fawn to grey with coarse reticulation on the upper parts, with a series of small dark blotches along the lateral line. Belly creamy white with gold flecks. There is a distinct dark spot on the mouth corner, followed by two dark dashes. A typical white stripe is present from the below eye to the mouth corner. Pectoral fin with a dark mark in upper fin origin. Dorsal fins transparent with five irregular reddish-brown stripes; pectoral and caudal fins mottled with pale and brownish dots.

The pattern of the lateral-line system is within the defined range for the north-eastern Atlantic (Miller and El-Tawil 1974) and the Mediterranean Sea (Kovačić 2001) populations, characterized as follows: head with

Table 1. Body proportions of *Gobius couchi*, with a comparison to previous studies. The ranges given by Kovačić (2001) and Liu et al. (2009) correspond to combined sexes (Abbreviations: TL, total length; SL, standard length; A, anal fin; C, caudal fin; D1, D2, first and second dorsal fins; P, pectoral fin; V, pelvic fin; Ab, anal fin base; Ad and Aw, body depth and width at anal fin origin; Cl, caudal fin length; CHd, cheek depth; CP and CPd, caudal peduncle length and depth; D1b and D2b, first and second dorsal fin base; E, eye diameter; H and Hw, head length and width; I, interorbital width; Pl pectoral fin length; PO, postorbital length; SL, standard length; SN, snout length; SN/A and SN/AN, distance from snout to vertical of anal fin origin and anus; SN/D1 and SN/D2, distance from snout to origin of first and second dorsal fins; SN/V, distance from snout to vertical of pelvic fin origin; V/AN, distance from pelvic fin origin to anus; Vd, body depth at pelvic fin origin; Vl, pelvic fin length).

		Kovačić 2001	Liu et al. 2009	Present study
%SL	H	26.2-30.9	26.0-27.3	28.8
	Hw	19.4-22.9	13.9-16.1	22.5
	SN/D1	31.6-38.2	33.4-36.3	31.3
	SN/D2	50.5-56.8	52.4-54.4	52.4
	SN/AN	52.6-58.0	52.8-54.7	56.3
	SN/A	54.2-61.3	55.1-58.5	59.3
	SN/V	28.8-31.7	28.1-30.2	30.0
	CP	16.0-19.9	19.8-23.4	18.3
	D1b	15.5-20.3	11.3-13.2	15.5
	D2b	30.0-35.9	30.5-34.2	31.0
	Ab	20.7-27.5	21.5-26.0	25.9
	Cl	20.4-25.9	21.0-24.1	20.7
	Pl	20.4-25.9	21.9-23.1	22.4
	Vl	18.6-22.7	18.7-19.8	21.4
	Vd	17.8-22.7	18.4-21.4	19.0
	Ad	15.1-20.3	16.5-18.9	17.5
	Aw	11.6-15.8	12.2-14.8	14.5
	CPd	8.8-11.3	10.4-11.9	8.8
	V/AN	21.7-27.0	24.9-26.6	28.6
%CP	CPd	47.7-66.2	44.7-58.5	58.3
%H	SN	23.9-32.1	22.0-28.5	22.9
	E	23.9-29.0	26.5-31.0	26.1
	PO	41.9-52.2	46.3-50.9	45.7
	CHd	17.4-24.4	14.7-18.5	18.6
	Hw	67.4-80.6	52.0-60.2	78.3
%E	I	17.9-32.4	22.2-26.4	30.0
%V/AN	Vl	74.8-101.0	72.8-77.4	74.7

anterior and posterior oculoscapular, and preopercular canals, with pores *σ, λ, κ, ω, α, β, ϱ, ϱ*1, *ϱ*2, and *γ, δ, ε,* respectively; anterior oculoscapular canal with pore *α* at the rear of orbit; oculoscapular row x^1 of sensory papillae ending forward behind pore *β*; suborbital papillae rows of lateral-line system without longitudinal row *a*; six transverse suborbital rows of sensory papillae; longitudinal suborbital row *d* divided below suborbital row *3*; oculoscapular anterior longitudinal row x^1 ending anteriorly behind pore *β*.

The NCBI blast analysis revealed that the sequence generated in the present study (GenBank accession number ON643474) is 100% identical to *G. couchi* from Corfu Island / Greece (MT670205), 100% with Krk

Island / Croatia (MT670202), 99.69% with Fethiye / Turkey (KY176488) and 99.08% with Catalonia / Spain (MW459354), supporting our morphological identification.

Originally described from the English Channel and the Celtic Sea (Miller and El-Tawil 1974), *G. couchi* displays a spotted distribution in the Mediterranean Sea, which is currently absent along the northern African coast (Patzner 2021). The species is known from Turkey by two distant records in the Aegean Sea, one from the entrance of Çanakkale Strait (Özen et al. 2009) and the other from the vicinity of Aliağa (Engin et al. 2018). Our recent record simply fills the known distribution gap of the species, since *G. couchi* was sampled from the northern Black Sea back at the end of 1990's (erroneously identified as a juvenile *G. niger*), which now has a well-established population at the Sevastopol shores (Karpova and Boltachev 2018). It is highly probable that *G. couchi* has a much wider distribution range in Turkey, especially considering two additional data from Ayvalık Islands in the northern Aegean Sea (GenBank accession no ON643473) and Fethiye Bay in the northwestern Levant (GenBank accession no KY176488) (M. Baki Yokeş, unpublished data). The occurrence of the species in the Turkish Black Sea and northern Levant coast is yet to be documented, which requires a targeted effort on understanding the Gobiidae diversity.

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