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RESEARCH ARTICLE

Gobies on the Turkish coast of the Black Sea, and first record of the yellow-headed goby, *Gobius xanthocephalus* Heymer & Zander, 1992

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Abstract

Objective: Challenges in identifying species of the Gobiidae family and their high tolerance to salinity, which makes it difficult to determine their distribution boundaries, have prevented the achievement of a common checklist for these species in the Turkish waters of the Black Sea. In this study, we present a checklist of marine gobies, including the first record of the yellow-headed goby, *Gobius xanthocephalus* Heymer & Zander, 1992, in this region.

Materials and Methods: On July 29, 2019, one individual of *G. xanthocephalus* was observed and photographed at a depth of 12 m by SCUBA diving on the coast of Giresun Island (40°55'41.75"N - 38°26'14.15"E), the southeastern Black Sea Basin. The other individual was photographed on November 4, 2023, at a depth of 3 m in Kapuz Beach (41°28'15.64"N - 31°48'2.56"E), the southwestern Black Sea Basin.

Results: A list of species belonging to the Gobiidae family in the Turkish waters of the Black Sea was presented by reviewing the relevant literature, and the distribution of the yellow-headed goby was updated. Two new photo records of *G. xanthocephalus* from the Black Sea coasts of Türkiye are provided on Giresun Island and Zonguldak, between the depths of 3-12 m.

Conclusion: Although the number of gobiid species reported in the relevant literature ranges between 16 and 35, the presence of 16 species was confirmed after excluding freshwater and brackish water species with the addition of the yellow-headed goby to this revised list. To accurately determine the distribution of these species with high salinity tolerance, comprehensive studies of freshwater, transitional, and marine waters in the southern Black Sea are necessary.

Keywords: Gobiidae, yellow-headed goby, Black Sea gobies, first record

Introduction

The Black Sea, being nearly enclosed, experiences significant anthropogenic pressure on coastal biodiversity. The unique ecological characteristics, coupled with limited knowledge of marine biodiversity, make this region a high priority for research (Yildiz *et al.,* 2019). While scientific efforts have primarily focused on pelagic fish species due to their economic importance (FAO, 2023), demersal and coastal species have received comparatively less attention, leaving gaps in our understanding of marine biodiversity within the Black Sea.

Gobies are important components of coastal ecosystems, and play crucial roles in ecological interactions and food webs (Depczynski & Bellwood, 2003). They tend to follow coastlines, and the distribution boundaries of these species are mostly determined by salinity, temperature, and sea currents, which facilitate the spread of larvae (Kovačić & Patzner, 2012). Gobies evolved physiological responses to constantly fluctuating salinity and temperature, which are believed to represent adaptation strategies for living in salinity-varying environments (Mazzoldi *et al.,* 2012). They also exhibit several morphological adaptations, including the number and type of fins and the shape of the head and body, all of which are heavily influenced by their benthic lifestyle. The merging of the two pelvic fins into a single distinct pelvic disc is one of the most distinctive characteristics (Miller*,* 1986).

Among the gobiids found in the Black Sea, the yellow-headed goby, *Gobius xanthocephalus* Heymer & Zander, 1992 has long been misidentified due to its close morphological affinities to *Gobius auratus* Risso, 1810 and *Gobius fallax* Sarato, 1889. However, it can be distinguished by its unique coloration, size and shape of its' pelvic fin, and specific body proportions and meristic characteristics (Heymer & Zander, 1992). The Atlantic and Mediterranean Islands are home to yellow-headed goby populations. In the Mediterranean, the species is found continuously from the Strait of Gibraltar to the Cyprus (Yalgın & Türker, 2023). It has also been recorded in the north Aegean (Gökalp, 2011) and the Sea of Marmara (Tsagarakis *et al.,* 2021). In addition, isolated populations exist in the Black Sea, including Crimea (Boltachev *et al.,* 2009; Vasil'eva & Bodorodsky, 2004).

Because of the lower salinity levels in the northern and northwestern parts of the Black Sea compared to the southern region (Krivoguz *et al.,* 2002), it is expected that fewer gobiid species favoring freshwater and transitional habitats will be found in the southern Black Sea. However, Engin & Seyhan (2009) reported 35 gobiid species from the Black Sea basin, including a significant number of freshwater species not previously recorded along the Black Sea coast of Türkiye. Bilecenoğlu *et al.* (2014) provided a more refined checklist, noting that 16 of these species were specifically found in the Turkish waters of the Black Sea. This study aimed to present an updated and revised checklist of the Black Sea fish fauna of Türkiye, including the first record of the yellow-headed goby *G. xanthocephalus.*

Materials and Methods

On July 29, 2019, one individual of *G. xanthocephalus* was observed and photographed at a depth of 12 m during SCUBA diving on the coast of Giresun Island (40°55'41.75"N - 38°26'14.15"E), the eastern Black Sea Basin (Fig. 1). The other individual was photographed on November 4, 2023, at a depth of 3 m in Kapuz Beach (41°28'15.64"N - 31°48'2.56"E), western Black Sea Basin. The specimens were photographed by diver Tolga Taymaz, using a digital camera (CANON 500D with 18-55 lens) in an underwater housing.

Diagnoses correspond to the minimum combination of characters that distinguishes the species from confamiliars in the area (Kovačić *et al.,* 2022). The taxonomic nomenclature follows that of Fricke *et al.* (2024).

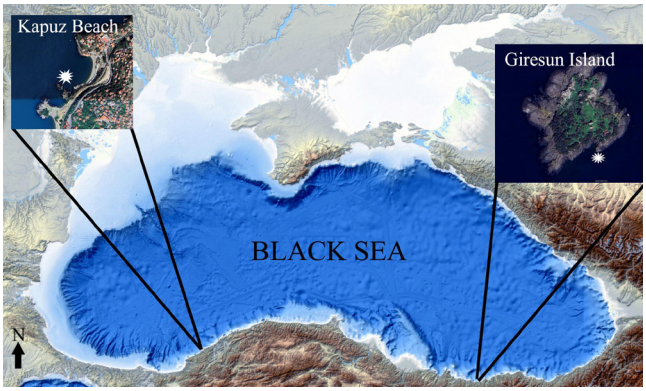

Figure 1. Map of the Black Sea showing locations where individuals of *Gobius xanthocephalus* were photographed.

Results and Discussion

The Gobiidae family has the highest number of species among marine fishes, with 1,417 species currently identified (Fricke *et al.,* 2024). These fish are integral to coastal ecosystems, contributing significantly to ecological dynamics (Beldade *et al.,* 2006) and are frequently used as models for studying various evolutionary and ecological patterns (Thacker, 2011). Despite their ecological importance and widespread use in research, gobies in the

marine waters of the Black Sea have been less thoroughly studied than their inland waters of the surrounding regions. This disparity highlights the need for more comprehensive research to better understand the role and diversity of gobies in the Black Sea marine environment.

Yankova *et al.* (2014) reported 35 gobiid species in the Black Sea, whereas Vasil'eva & Bogorodskii (2004) documented 29 species in the Azov–Black Sea Basin. However, a review of marine fish studies has revealed that several species documented in the Black Sea basin have not yet been observed in the Turkish waters of the Black Sea (Artuz, 1974; Bilecenoğlu *et al.,* 2014; Keskin, 2010; Mavruk & Ak Örek, 2017). Bilecenoğlu et *al.* (2014) identified 16 species in the Black Sea waters of Türkiye. In this study, after a thorough review of the relevant literature and exclusion of questionable records, 16 gobiid species were confirmed in the Turkish waters of the Black Sea. Because the northern and northwestern areas of the Black Sea have lower salinity than the southern part (Krivoguz *et al*., 2002), it is natural that gobiids favoring freshwater and transitional habitats are less represented in the southern Black Sea.

Among the gobies reported so far in Turkish waters of the Black Sea, the earlier geographic range of *G. bucchichi* in the Black Sea is likely based on misidentifications of *G. incognitus*, as noted by Kovačić & Kovtun (2022). Besides, the only record of *G. bucchichi* in the Black Sea is known to be attributed to Miller (1986). Therefore, it was not included in the present list due to its questionable occurrence in the area. Although *Babka gymnotrachelus*, *Knipowitschia caucasica*, *K. longecaudata*, *Neogobius fluviatilis*, *Ponticola eurycephalus*, *P. kessleri,* and *Proterorhinus marmoratus* have freshwater records in Türkiye, they were not included in the list because there are no records from the Turkish waters of the Black Sea (Table 1).

Underwater fish photography has expanded considerably over the past ten years (Kovačić *et al.,* 2021), serving as a valuable source of information on the geographic and ecological distribution of species (Kovačić & Svensen, 2019). *Gobius xanthocephalus* prefers hard substrates such as bedrock and coralligenous formations, as well as mixed bottoms such as sandy patches with pebbles, boulders, and seagrass (Kovačić *et al.,* 2022; Renoult *et al.,* 2022). Both specimens recorded in this study were photographed in biogenic habitats on bedrock at depths 3-12 m (Figs. 2-3).

Although the presence of *G. xanthocephalus* in the Mediterranean has been known since 1982 (Castillo & Brito, 1982), it was first observed in the Turkish waters in 2011. The first record of this species was presented as photographic evidence by Gökalp (2011) from the coasts of the North Aegean Sea. Later, the species was reported by Tsagarakis *et al.* (2021) from the Sea of Marmara. This study reports two new sightings that occurred on the southern coasts of the Black Sea.

It has been 20 years since the first record was obtained from the northern Black Sea (Vasil'eva & Bodorodsky,

Table 1. Previously published gobiid list in the Turkish waters of the Black Sea with the updated list.

Species	Artuz (1974)	Keskin (2010)	Bilecenoğlu *et al.* (2014)	Mavruk & Ak Örek (2017)	Present Study
Aphia minuta (Risso, 1810)	+	+	+	+	+
Babka gymnotrachelus (Kessler, 1857)	-	+	-	-	-
Gobius bucchichi Steindachner, 1870	-	+	+	-	-
Gobius cobitis Pallas, 1814	+	+	+	-	+
Gobius cruentatus Gmelin,1789	+	+	+	-	+
Gobius niger Linnaeus,1758	+	+	+	+	+
Gobius paganellus Linnaeus, 1758	+	+	+	+	+
Gobius xanthocephalus Heymer & Zander, 1992	-	-	-	-	+
Knipowitschia caucasica (Berg, 1916)	-	+	-	-	-
Knipowitschia longecaudata (Kessler, 1877)	-	+	-	-	-
Mesogobius batrachocephalus (Pallas, 1814)	+	+	+	-	+
Neogobius fluviatilis (Pallas, 1814)	-	+	-	-	-
Neogobius melanostomus (Pallas, 1814)	+	+	+	-	+
Pomatoschistus marmoratus (Risso, 1810)	-	+	+	-	+
Pomatoschistus microps (Krøyer, 1838)	-	-	-	+	+
Pomatoschistus minutus (Pallas, 1770)	-	+	+	+	+
Ponticola eurycephalus (Kessler, 1874)	-	+	+	-	-
Ponticola kessleri (Günther, 1861)	+	+	-	-	-
Ponticola platyrostris (Pallas, 1814)	+	+	+	-	+
Ponticola ratan (Nordmann, 1840)	+	+	+	-	+
Ponticola syrman (Nordmann, 1840)	+	+	+	-	+
Proterorhinus marmoratus (Pallas, 1814)	-	+	-	-	-
Zebrus zebrus (Risso, 1827)	-	+	+	-	+
Gobius ophiocephalus Pallas, 1814	+	+	+	-	+

Figure 2. Observed specimens of *Gobius xanthocephalus* on the Black Sea coasts of Türkiye. Photo credits: Tolga Taymaz.

Figure 3. Observed specimens of *Gobius xanthocephalus* on the Black Sea coasts of Türkiye. Photo credits: Tolga Taymaz.

2004). Records from the North Aegean and the Sea of Marmara have also recently been reported. This situation increases the likelihood that the population located south of the Black Sea may have dispersed from the Sea of Marmara.

In the Black Sea Basin, there is an urgent need for more comprehensive studies on gobies, as their distribution is influenced by key environmental factors such as salinity, temperature, and sea currents. Understanding these dynamics is crucial for assessing the ecological roles of gobies and ensuring their conservation. Enhanced research efforts will contribute significantly to our understanding of gobies and their importance in the Black Sea Basin marine ecosystem.

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Author Contributions: Conception/Design of Study – N.B.K., C.D.; Data Acquisition- N.B.K., C.D.; Data Analysis/ Interpretation- N.B.K., C.D.; Drafting Manuscript- N.B.K., C.D.; Critical Revision of Manuscript- N.B.K., C.D.; Final Approval and Accountability- N.B.K., C.D.

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Conflict of Interest: The authors have no conflict of interest to declare.

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