



First Record of the Red-mouthed Goby *Gobius cruentatus* Gmelin, 1789 (Actinopterygii: Gobiidae) along the Bulgarian Black Sea Coast

Tihomir Stefanov^{1*} & Radek Šanda²

¹ National Museum of Natural History, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel Blvd., 1000 Sofia, Bulgaria; E-mail: tishos@gmail.com; ORCID ID: <https://orcid.org/0000-0003-1084-8358>

² Department of Zoology, National Museum, Václavské nám. 68, 115 79 Prague 1, Czech Republic; E-mail: rsanda@seznam.cz; ORCID ID: <https://orcid.org/0000-0001-8514-3948>

Abstract: One adult specimen of red-mouthed goby *Gobius cruentatus* Gmelin, 1789 was found in the coastal waters of the Black Sea in Bulgaria. The specimen was caught on 23 September 2023 during an underwater ichthyological survey near the town of Chernomorets. It represents the first record of this species for the western Black Sea coast and for Bulgaria.

Key words: *Gobius cruentatus*, Gobiidae, Black Sea, range expansion

Introduction

Gobius cruentatus Gmelin, 1789 is a small to middle-sized goby distributed in the eastern Atlantic, occurring from southwest Ireland to Senegal as well as in the whole Mediterranean (Miller 1986). The main habitat of the species is inshore rocky areas but also occurs in sandy substrates with stones and boulders as well as in sea-grass meadows (Miller 1986). *Gobius cruentatus* has been found also in the Anatolian coast of the Aegean Sea and the Sea of Marmara (Miller 1986, Bilecenoglu et al. 2002). The first record of the species in the Black Sea is along the south-eastern coast near Rize and Hopa, Republic of Türkiye (Engin et al. 2007). Later, it was also found along the coast of the Crimean Peninsula coasts near Sevastopol (Boltachev et al. 2009) and near the Russian coast of Anapa and Novorossiysk (Prokof-

iev 2016). Recently, *G. cruentatus* was caught near Ordu – Fatsa harbour (Republic of Türkiye), located in the middle section of the southern Black Sea region (Aydin & Bodur 2018). This species has never been detected along the Bulgarian and Romanian coasts. Thus, the present finding is the first record of *G. cruentatus* on the western coast of the Black Sea, which significantly extends the known distribution of the species in the Black Sea region.

The advance of another fish species of Mediterranean origin into the Black Sea is part of the so-called “Mediterraneanization” phenomenon. It gained increasing attention recently because it is a direct evidence of the link between climate change and the distribution patterns of the thermophilic Mediterranean fish. The expansion of *G. cruentatus* in the Pontic area followed the main Black Sea Rim Current circulating counterclockwise in a basin-

*Corresponding author: tishos@gmail.com; ORCID ID: <https://orcid.org/0000-0003-1084-8358>

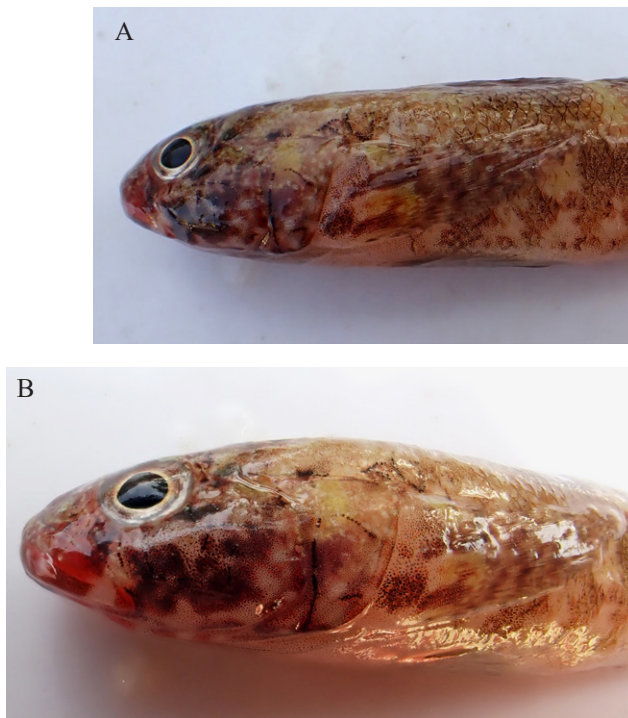


Fig. 1. A. *Gobius cruentatus* Gmelin, 1789 (78.5 mm TL) caught in the Black Sea near the town of Chernomorets: lateral view of the body, live specimen (Inv. No. BG-NMNHS-ICH-000000001276). B. Same fish, dorsal view of the head.

wide shelfbreak gyre. This could explain the latest appearance of the species along the western Black Sea coasts after its penetration through the Bosphorus Strait.

Materials and Methods

One adult male specimen of *G. cruentatus*, 78.5 mm TL (Fig. 1) was caught on 23 September 2023 along the Bulgarian coast of the Black Sea near the town of Chernomorets, GPS coordinates 42.45 N; 27.64 E (Fig. 2). The specimen was fixed in 4% formalin immediately after it was collected and a fin clip was stored in absolute ethanol 99.5 %. Later the specimen was washed and stored in 70 % ethanol and deposited in the Ichthyological Collection of the National Museum of Natural History, Sofia (Inv. No. BG-NMNHS-ICH-000000001276). It was caught in a depth of about 10 m on a sandy substrate with stones and boulders, which corresponds well with the typical environmental requirements of the species.

The specimen was measured with an electronic calliper as all measurements were made point-to-point and recorded to the nearest 0.1 mm. The method of counting fin rays and scales as well as all methods of measurements generally follow Kottelat & Freyhof (2007).

DNA was extracted from fin clip. The DNA extraction, amplification of the mitochondrial gene cytochrome c oxidase subunit I (COI), PCR

purification and sequencing follow the protocols described in Iglésias et al. (2021). Sequence was visually checked and manually aligned using the software Chromas v2.6.4 and Bioedit v7.2.6.1. Resulting sequence included a total of 664 aligned positions, and was deposited in GenBank under the Accession No. PQ757576. The sequence was compared with published data by BLAST (<https://blast.ncbi.nlm.nih.gov/Blast.cgi>).

Results

The collected specimen possessed all the typical features for *G. cruentatus* (Fig. 1): mouth and lips red, body brownish with larger dark lateral blotches, 4-5 pale blotches along the back, cheeks scaled, a total of 52 lateral scales and well-visible rows of black sensory papillae on the sides of the head. All these features pointed that it belonged to *G. cruentatus*.

The specimen caught by us possesses small differences in some of the body proportions compared to the studied material of the same species by Prokofiev (2016) and Aydın & Bodur (2018) originating from the Black Sea near Anapa (Russia) and Ordu (Türkiye), respectively (Table 1). It has a longer caudal peduncle – lpc in % of SL is 21.9 vs. 16.0–20.0; the predorsal distance is longer – pD1 in % of SL is 36.1 vs. 31.5–33.8; the first dorsal fin base is shorter – lD1 in % of SL is 12.3 vs. 14.0–19.0 and the postorbital distance is longer – poO in % of lc is 56.3 vs. 51.2–52.6. It is diffi-

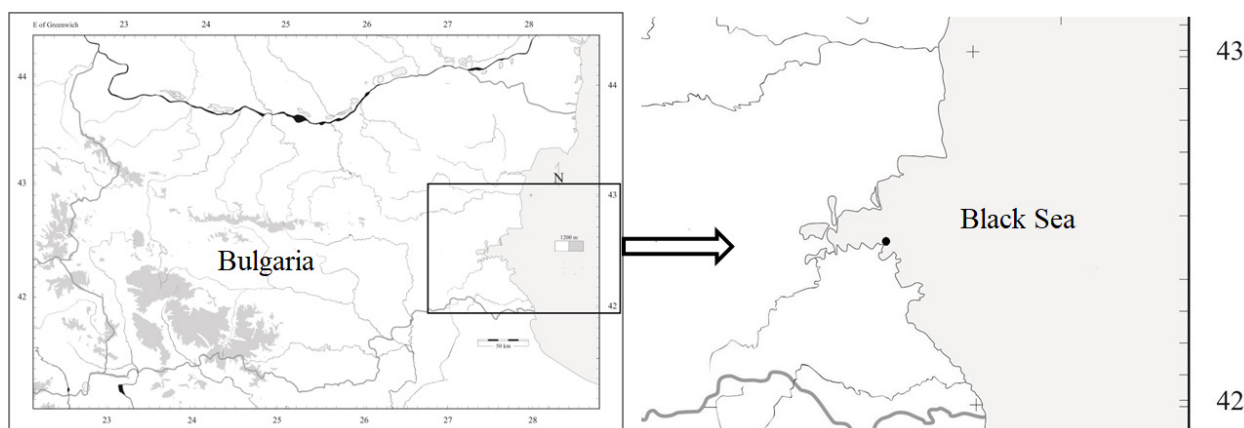


Fig. 2. Map of the locality where *Gobius cruentatus* was found along the Bulgarian coast of the Black Sea.

Table 1. Body proportions of *Gobius cruentatus* from the Black Sea and the specimen found near Chernomorets, Bulgaria. Abbreviations: TL – Total length. SL – Standard length. lc – Head length. pD₁ – Predorsal distance. pA – Preanal distance. lpc – Length of caudal peduncle. lD₁ – Length of the first dorsal fin base. lD₂ – Length of the second dorsal fin base. lA – Length of anal fin base. H – Maximum body depth. h – Least depth of caudal peduncle. prO – Preorbital distance. do – Horizontal diameter of eye. poO – Postorbital distance. D1 – Number of rays in first dorsal fin. D2 – Number of rays in second dorsal fin. A – Number of rays in anal fin. P – Number of rays in pectoral fins.

Locality	Bulgaria	Türkiye	Türkiye	Russia	Russia
	Chernomorets	Ordu	Ordu	Anapa	Anapa
Source	Our data	AYDIN & BODUR (2018)	AYDIN & BODUR (2018)	PROKOFIEV (2016)	PROKOFIEV (2016)
Sex	male	male	female	male	female
TL [mm]	78.5	108.6	112.6	-	-
SL [mm]	65.9	88.8	95.1	130	125
in % of SL					
lc	30.2	27.1	28	30.8	28
pD ₁	36.1	33.1	33.8	31.5	32
pA	56.2	56.9	61.3	58.5	57.6
lpc	21.9	-	-	20	16
lD ₁	12.3	19	18.6	15	14
lD ₂	29.4	30.9	29.6	29.6	30.4
lA	22	25.6	26.2	21.5	21.6
H	19.3	21.5	25.1	23.1	20
h	9.9	9	9.1	10.8	11.2
in % of lc					
prO	28.1	-	-	25.3	25.7
do	27.6	27.1	24.8	20.1	22.9
poO	56.3	51.2	52.6	-	-
Meristic characters					
D1	VI	VI	VI	VI	VI
D2	I+14	I+14	I+14	I+15	I+14
A	I+13	I+13	I+13	I+12	I+13
P	20	20	20	21	21
Lateral scales	52	52	54	53	52

cult to explain the obtained differences in the morphology but they are likely a result of variations in the measurement approach rather than taxonomic issues. Additionally, drawing taxonomic conclu-

sions based on morphological data from only one specimen is not enough to make any taxonomic conclusion.

Genetic comparison using BLAST based on

COI showed the closest match with published sequences of *G. cruentatus* (difference 0–1.3%), while the next most similar were various species of the genus *Gobius* Linnaeus, 1758, differing for at least 14%.

Discussion

Although the ichthyofauna of the Bulgarian Black Sea coast is comparatively well investigated (Guéorguiev et al. 1960, Stoyanov et al. 1963, Prodanov et al. 1998, Yankova et al. 2014) there is no data about the presence of *G. cruentatus*. The species is not found also by Vassilev et al. (2012) during their survey of the Black Sea gobies in Bulgaria. The specimen found near Chernomorets is the first and, up to now, the only record of this species along the western Black Sea coast and Bulgaria. The present record represents a significant range extension of *G. cruentatus* in the Black Sea.

The northward expansion of Mediterranean thermophilic species is one of the most detectable biotic responses to climate changes in the region. The increasing of the seawater temperature in the area is the main driving factor for this expansion. According to Gus'kov et al. (2022), a total of 25 new species of fish have been discovered in the Black Sea since 2014. They are predominantly Mediterranean immigrants and many of them are of the family Gobiidae, including *G. cruentatus*. It would be interesting whether the species will be discovered in new areas along the Bulgarian coast shortly and whether it will be able to establish a permanent population in the region.

Genetically, the Bulgarian specimen shared the same haplotype with specimens from northern Adriatic Sea in Croatia and southern Mediterranean Sea in France (Iglésias et al. 2016, 2021); the maximum divergence did not exceed 1.3% (unpublished sequence JF935263, Italy, locality unspecified). The observed range of genetic variability is fully congruent with the results of Čekovská et al. (2020) for this species based on another mitochondrial DNA marker, cytochrome b, and unambiguously confirm the morphological identification; any other species of the genus *Gobius* differs for at least 14 %. In general, the intraspecific variability of mitochondrial DNA markers in the genus *Gobius* is always several times higher than the maximum intraspecific variability (Iglésias et al. 2016, 2021, Čekovská et al. 2020, 2023).

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References

- Aydin M. & Bodur B. 2018. First record of the red-mouthed goby, *Gobius cruentatus* (Gobiidae) from the middle Black Sea coast. Turkish Journal of Maritime and Marine Sciences 4 (1): 63-67.
- Bilecenoglu M., Taskavak E., Mater S. & Kaya M. 2002. Checklist of the marine fishes of Turkey. Zootaxa 113: 1-194.
- Boltachev A. R., Karpova E. P. & Danilyuk O. N. 2009. Findings of new and rare fish species in the coastal zone of the Crimea (the Black Sea). Journal of Ichthyology 49 (4): 277-291.
- Čekovská K., Šanda R., Ašenbrenerová E., Kassar A., Zogaris D., Pappalardo A. M., Tarkan A. S., Vasil'eva E., Santos D., Vukić J. 2023. Cytochrome b sequencing as a tool for identification of morphologically similar mediterranean gobies *Gobius incognitus* and *Gobius bucchichi* (Actinopterygii: Gobiidae). Journal of Marine Science and Engineering 11, 2289.
- Čekovská K., Šanda R., Eliášová K., Kovačić M., Zogaris S., Pappalardo A. M., Soukupová T., Vukić J. 2020. Population genetic diversity of two marine gobies (Gobiiformes: Gobiidae) from the North-Eastern Atlantic and the Mediterranean Sea. Journal of Marine Science and Engineering 8, 792.
- Engin S., Turan D. & Kovačić M. 2007. First record of the red-mouthed goby, *Gobius cruentatus* (Gobiidae), in the Black Sea. Cybium 31 (1): 87-88.
- Gus'kov G. E., Zherdev N. A., Bukhmin D. A. 2022. New and Rare Fish Species off the Northern Shore of the Black Sea and Anthropogenic Factors Affecting their Penetration and Naturalization (Review). Ecological Safety of Coastal and Shelf Zones of Sea 1: 66-81. (in Russian)
- Guéorguiev G., Alexandrova K. & Nikoloff D. Ch. 1960. Observations sur la reproduction des poissons de long du littoral Bulgare de la Mer Noire. Bulletin de l'Institut de Zoologie 9: 255-292. (In Bulgarian)
- Iglésias S. P., Frotté L., Sellos D. Y. 2016. *Gobius salamansa*, a new species of goby (Gobiidae) from the Cape Verde Islands supported by a unique cephalic lateral line system and DNA barcoding. Ichthyological Research 63 (3): 356–369.
- Iglésias S. P., Vukić J., Sellos D. Y., Soukupová T. & Šanda R. 2021. *Gobius xoriguer*, a new offshore Mediterranean

- goby (Gobiidae), and phylogenetic relationships within the genus *Gobius*. Ichthyological Research 68 (3): 445–459.
- Kottelat M. & Freyhof J. 2007. Handbook of European Freshwater Fishes. Kottelat, Cornol Switzerland and Freyhof, Berlin, Germany. 646 p.
- Miller P. J. 1986. Gobiidae. In: Whitehead P.J.P., Bauchot M.-L., Hureau J.-C., Nielsen J., Tortonese E. (eds.), Fishes of the north-eastern Atlantic and the Mediterranean. Vol. 3. UNESCO, Paris: 1019-1085.
- Prodanov K., Dencheva K. & Ivanov L. 1998. Fish of the Bulgarian Coastal Waters. In: Maine C (ed.), Bulgarian Biological Diversity. Conservation Status and Needs Assessment, Vol. I & II. 375-393.
- Prokofiev A. M. 2016. *Gobius cruentatus* (Gobiidae) in Russian waters of the Black Sea Coast of the Caucasus. Journal of Ichthyology 56 (1): 162-165.
- Stoyanov S., Gueorguiev G., Ivanov L., Hristov D., Kolarov P., Alexandrova K. & Karapetkova M. 1963. Ribite v Chernomore [The fishes of the Black Sea]. Varna, 246 pp. (In Bulgarian).
- Vassilev M., Apostolou A., Velkov B., Dobrev D. & Zarev V. 2012. Atlas of the Gobies (Gobiidae) in Bulgaria. Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia, 112 pp.
- Yankova M., Pavlov D., Ivanova P., Karpova E., Boltachev A., Öztürk B., Bat L., Oral M. & Mgeladze M. 2014. Marine fishes in the Black Sea: recent conservation status. Mediterranean Marine Science 15 (2): 366-379.

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