

**First record of *Sebastes schlegelii* Hilgendorf, 1880 along the Turkish Black Sea coast –  
new addition to the alien species inventory**

***Sebastes schlegelii* Hilgendorf, 1880 türünün Türkiye'nin Karadeniz kıyısından ilk kaydı –  
yabancı tür envanterine yeni bir ilave**

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**ABSTRACT**

*Sebastes schlegelii* is a typical bottom dwelling boreal species, whose native distribution range includes Japan, Korean peninsula and China. This northwest Pacific originated species has recently been recorded from the Crimean and Caucasian coast (northern Black Sea), whose introduction was assumed to be either by ballast waters or the acclimatization of *Crassostrea gigas* (Pacific oyster). On 16 August 2023, a single *S. schlegelii* specimen with 20.6 cm standard length and 282.1 g in weight was captured off Ünye, Ordu coast (southeastern Black Sea), which was previously an unreported fish from the Turkish marine waters. Detailed morphometric and meristic characteristics are presented in the paper, and species identification was further confirmed by genetic analysis. Available information reveals this alien species to be fished regularly, although in small quantities, indicating a presumably established population in the region. The species should be treated as a potentially invasive fish, since it may negatively influence to the local biodiversity through interspecific competition. Close monitoring of its existing population is strongly suggested.

**Keywords:** Alien species, Human-mediated introduction, Biological invasion, Sebastinae

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## ÖZET

*Sebastes schlegelii*, doğal dağılım alanı Japonya, Kore yarımadası ve Çin'i kapsayan tipik bir demersal boreal türdür. Kuzeybatı Pasifik kökenli bu tür, yakın zamanda Kırım ve Kafkasya kıyılarında (Kuzey Karadeniz) kaydedilmiş olup, ekosisteme girişinin ya gemilerin balast suları ya da *Crassostrea gigas*'ın (Pasifik istiridyesi) yetiştiriciliği ile alakalı olduğu varsayılmaktadır. 16 Ağustos 2023 tarihinde Ordu Ünye açıklarında (Güneydoğu Karadeniz) 20,6 cm standart boyda ve 282,1 g ağırlığında bir *S. schlegelii* örneği elde edilmiş olup, türün daha önce Türkiye denizlerinde var olduğuna dair bir kayıt bulunmamaktadır. Bu makalede detaylı morfometrik ve meristik karakterler sunulmuş olup, tür tayini genetik analiz ile de doğrulanmıştır. Mevcut bilgiler, söz konusu yabancı türün küçük miktarlarda da olsa düzenli olarak avlandığını ortaya koymakta ve bölgede muhtemelen başarılı bir popülasyonun oluştuğunu göstermektedir. Bu tür potansiyel olarak istilacı bir balık olarak kabul edilmelidir, zira interspesifik rekabet yoluyla yerel biyolojik çeşitliliği olumsuz yönde etkileme ihtimali bulunmaktadır. Mevcut popülasyonun yakından takip edilmesi büyük önem taşımaktadır.

**Anahtar sözcükler:** Yabancı tür, İnsan kaynaklı katılım, Biyolojik istila, Sebastinae

## 1. INTRODUCTION

Rockfishes of the genus *Sebastes* are represented by 108 species worldwide (Froese and Pauly, 2023), majority occurring around an Asian center near Japan in the north Pacific and north American center off the Gulf of California (about 96 sp.), with very few numbers of species also distributing in the north Atlantic, south Pacific, and south Atlantic (Love et al., 2002). Rockfishes are live bearing (ovoviviparous) species, characterized by having a suborbital stay, a round pectoral fin, 13 to 15 dorsal fin spines, ridges and spines on head, and venom glands on spines of dorsal, anal and pelvic fins (Kai et al., 2013; Froese and Pauly, 2023). Taxonomy of the genus is currently a matter of dispute, since it includes morphologically similar species with significant overlaps in morphometric and meristic characters, and many species showing great variation in body coloration depending on their habitat, which causes significant difficulties in precise identification based solely on morphology (Chen, 1986; Kai and Nakabo, 2013). There is also no complete agreement on the family assignment for *Sebastes*; some authors place the genus under Sebastidae based on an extensive examination of myological and osteological characters (i.e., Ishida, 1994), while others prefer

maintaining the subfamily Sebastinae under Scorpaenidae regarding the results of comparative analysis of the complete mitochondrial genomes of rockfishes (Jia et al., 2020).

According to a recent critically assessed and updated checklist of Mediterranean marine fishes, no representatives of *Sebastes* were confirmed to occur in any parts of the basin (Kovačić et al., 2021). However, the dogtooth grouper (*Epinephelus caninus*) record given a decade ago from the southwest Crimean coastal waters by Boltachev and Karpova (2013) turned out to be a misidentification of the Korean rockfish *S. schlegelii* Hilgendorf, 1880, in which additional individuals of the species were recently collected from the same region as far as to Caucasian coast along the northern Black Sea (Karpova et al., 2021), indicating the presence of an established population. This boreal species has a very limited natural distribution range in the northwest Pacific, including Japan, Korean peninsula, and China (Froese and Pauly, 2023), and its occurrence in the Black Sea strongly indicates a human mediated introduction, either by ships ballast waters or during the acclimatization of the Pacific oyster (*Crassostrea gigas*) (Karpova et al., 2021).

This interesting fish has started to appear in the artisanal fishery catch along the eastern Black

Sea coast of Turkey by the early March 2023, and the authors have received several photographs of the captured individuals (including juveniles) from the local fishermen since then, but collection of a specimen for precise species identification has recently been possible. With reference to the existence of several closely related species with similar appearances among the genus *Sebastes*, we carried out both morphological and molecular analyses for the identification process, which positively revealed the species to be *S. schlegelii*. The Korean rockfish is not only a first record for the Turkish marine ichthyofauna, but also a new addition to the existing list of alien species (Çınar et al., 2021). This paper aims to present the occurrence of *S. schlegelii* along the Turkish Black Sea coast, by briefly discussing its potential invasion in the area.

## 2. MATERIAL AND METHODS

On August 16, 2023, a single specimen of *S. schlegelii* was captured off the Ordu/Ünye coast (eastern Black Sea coast of Türkiye) from a depth of 5 m using a trammel net (Figure 1). The fish was immediately photographed and transferred to the laboratory (Fatsa Faculty of Marine Sciences, Ordu University) for further analysis.

All morphometric measurements and meristic

counts were performed on the fresh specimen. Body proportions were expressed as percentages of standard length (SL) and head length (HL). Measurements and counts are as defined by Eschmeyer (1965, 1969), while terminology of spines follow Randall and Eschmeyer (2001). SL was measured from the tip of the snout, and the last two soft rays of both dorsal and anal fins were counted as single rays. Following Kai et al. (2013), body depth 1 was measured as the distance between the origins of the first dorsal fin spine and the pelvic fin spine, body depth 2 as the distance between the origins of the last dorsal fin spine and the first anal fin spine.

For genetic analysis, DNA was extracted from fin tissue 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 FishF1 and FishR1 (Ward et al., 2005). The PCR mixture and amplification protocol was the same as used by Ward et al. (2005). Sequencing was carried out by MacroGen Europe (Amsterdam, Netherlands). Sequence was manually checked, by ChromasPro v.1.5 (Technelysium Pty. Ltd., Australia). The 5' terminal with high background and 3' primer sequence were trimmed. 655bp of COI sequence is deposited in the NCBI GenBank under the accession number OR523689.



**Figure 1.** Lateral view of the fresh *Sebastes schlegelii* specimen (20.6 cm SL) captured off Ordu coast, Black Sea (Türkiye).

### 3. RESULTS AND DISCUSSION

Proportional morphometric characters of the single *S. schlegelii* individual are presented in Table 1, which also includes a comparison with previous data given by Karpova et al. (2021). Description of the specimen is as follows. Body robust, slightly compressed laterally, with large head covered with spines. Three lachrymal spines, third one slightly pointing posteroventrally. Nasal, preocular and postocular spines are present; the superior cranial spines and suborbital ridge are weakly developed. Five spines on the preopercle, second one the longest. Opercle with two flattened spines, upper one larger than the lower, both directed posteriorly; lower opercular spine slightly extends its posterior margin. Supracleithral spine simple with acute tip. Dorsal fin continuous with 13 spines and 11 soft rays, gradually increasing in length to 5th spine, thereafter decreasing in length to 12th spine, 13th spine longer than 12th spine, forming anterior support of soft dorsal fin. Broad based and fan like pectoral fins with 18 rays. Pelvic fins thoracic with one spine and 5 soft rays. Anal fin with 3 spines and 6 soft rays. Caudal fin rounded, with 15 rays. Body covered by ctenoid scales. Lateral line with 44 pored scales. Mouth large, oblique; maxilla without ridge running along its length and extending to posterior rim of eye. The ground color of the body is light brown, with many dark spots scattered irregularly. The belly is light green to grayish. Two distinct dark bands extend radially from the eye, upper one extending to the first preopercular spine, lower one to the fourth preopercular spine. Maxilla with a dark stripe. A dark brown blotch located over the pectoral fin base. Morphometric measurements, meristic counts and the color of the Turkish Black Sea

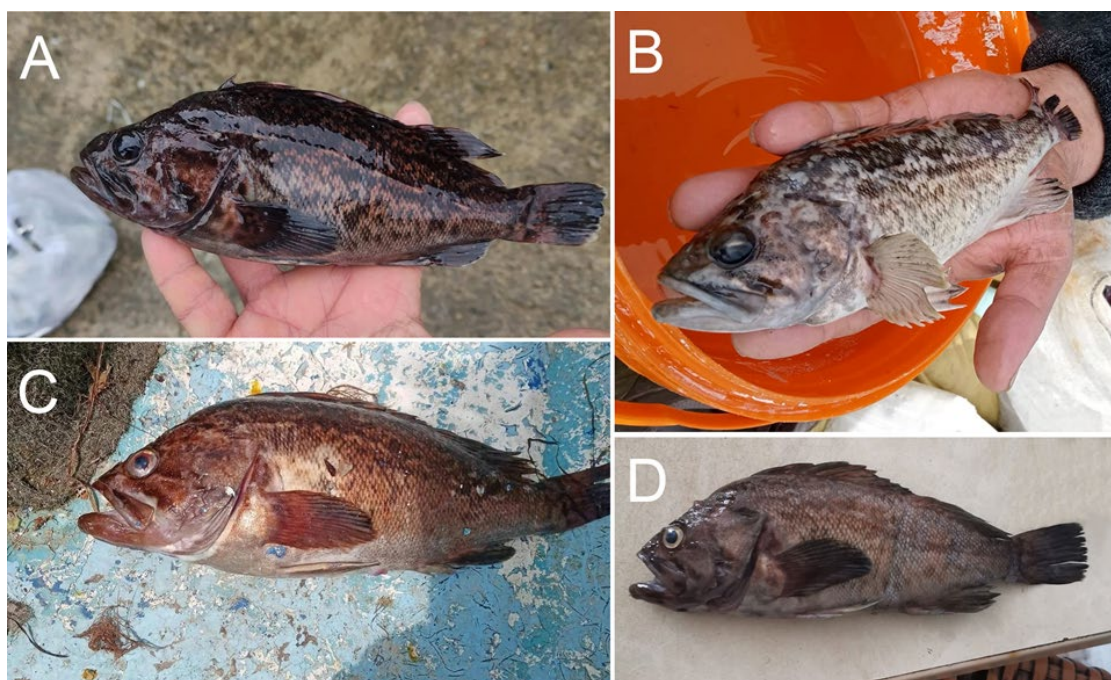
individual are in accordance with previous descriptions of *S. schlegelii* in its native range (Hilgendorf, 1880; Steindachner and Döderlein, 1884; Chen, 1986) and its introduced ecosystems (Kai and Soes, 2019; Boltachev and Karpova, 2013; Karpova et al., 2021).

There are only a few different proportions, such as predorsal, postorbital and snout lengths (see Table 1) in comparison to specimens previously captured from the Black Sea (Karpova et al., 2021), which may be related to the size of the examined individuals. Despite of these minor morphometric differences, the NCBI Blast analysis revealed that the generated COI sequence is 100% identical with *S. schlegelii* from Gyeonggi-do, south Korea (NC\_005450; Kim and Lee, 2004) and Yeosu, south Korea (HM180869; Kim et al., 2012), providing further genetic support on the correct identification.

First observation of *S. schlegelii* along the eastern Black Sea coast of Türkiye was made on March 06, 2023, in which an approximately 18 cm SL specimen was captured from a depth of 10 m off Giresun using a trammel net (60 mm mesh size) (Figure 2A). An additional individual was later captured at a depth of 8 m from Perşembe/Okçulu coast (Ordu) again with a trammel net (56 mm mesh size) (Figure 2B). The occurrence of the species was also a subject to the regional newspapers, and the news of a captured individual (erroneously presented as a dusky grouper, *Epinephelus marginatus*) from Gideros (Kastamonu, Cide) was shared (Figure 2C; Ünal, 2023). The last photograph shared by the artisanal fishermen was from Fatsa coast of Ordu (Figure 2D). According to the local fishermen of Ordu, *S. schlegelii* is regularly being captured for the last couple of months, although in relatively small quantities.

**Table 1.** Proportional measurements of *Sebastes schlegelii* specimen, in comparison with the previous Black Sea records (Karpova et al., 2021).

	Karpova et al. (2021)	Present Study
Number of specimens	5	1
TL, cm	32.5-39.1	24.5
SL, cm	27.7-33.1	20.6
W, g	710.0-1151.2	282.1
(% of SL)		
Body depth 1	-	36.5
Body depth 2	-	30.1
Caudal peduncle depth	10.2-10.5	9.7
Predorsal length	33.0-35.8	27.1
Postdorsal length	12.5-13.1	13.3
Prepelvic length	37.4-38.9	39.0
Preanal length	67.8-69.2	66.7
Prepectoral length	33.6-35.5	29.8
Distance between pelvic and pectoral fins	4.7-5.2	4.7
Distance between pelvic and anal fins	18.8-30.2	22.4
Dorsal fin base length	62.5-62.7	60.8
Anal fin base length	15.5-16.4	15.9
Pectoral fin length	21.2-22.9	25.2
Pelvic fin length	20.3-20.6	22.7
Caudal fin length	21.1-21.2	13.4
Head length	35.5-40.1	34.0
(% of HL)		
Snout length	29.7-32.0	19.8
Upper jaw length	47.2-49.4	45.5
Eye diameter	18.3-21.1	18.7
Postorbital length	52.5-52.5	61.5



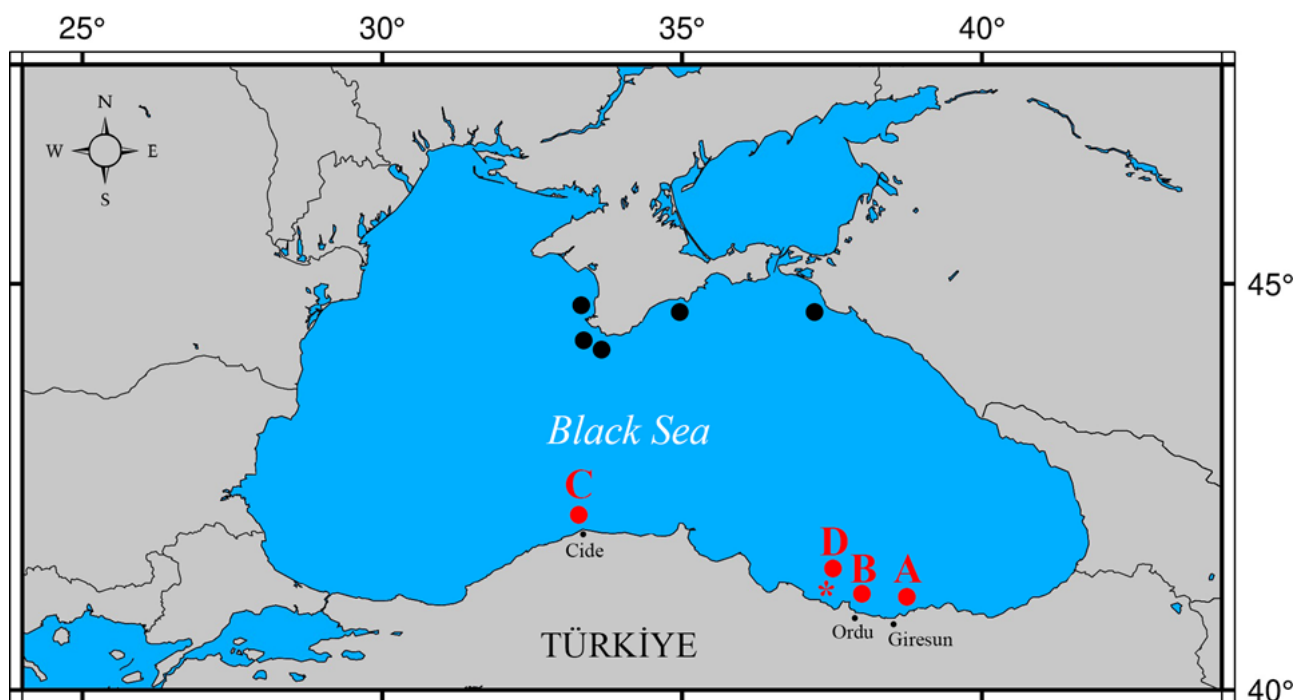
**Figure 2.** Previous sightings of *Sebastes schlegelii* from the Turkish Black Sea coast. A) Giresun (March 06, 2023, 10 m depth), B) Ordu/Perşembe (April 27, 2023, 8 m depth), C) Kastamonu/Cide (June 13, 2023, depth unknown), D) Ordu/Fatsa (June 16, 2023, depth unknown).



The photographic evidence clearly indicates that the species has already spread through a large area along the Turkish Black Sea coast (Figure 3), and a wider distribution range should be suspected.

*Sebastes schlegelii* is mainly a marine species inhabiting depths ranging 3 to 100 m and can also be found in brackish waters and even entering estuaries of rivers, which is one of the most common rockfishes in the Northwestern Pacific coasts (Parin et al., 2002; Dylidin et al., 2021). It can attain a total length of 65 cm and over 3 kg in weight (Froese and Pauly, 2023). Similar to its congeners, the species is carnivorous feeding mainly on fish (Gobiidae, Engraulidae, Ammodytidae), shrimps (*Alpheus sp.*) and crabs

(Zhang et al., 2014) and can display cannibalistic behaviour (Park et al., 2007). *Sebastes schlegelii* is a commercially exploited fish throughout its native distribution range, and also an important cultured species for stock enhancement; artificially raised juveniles have been released to enhance fisheries production since the 1980s (Wang et al., 2017). Despite of their diversity in form and function, *Sebastes spp.* are generally limited to cool-temperate ecosystems, while warm, oligotrophic waters represent a significant barrier to their spread (Hyde and Vetter, 2007), yet *S. schlegelii* represents a unique case and can survive wide range of water temperatures from 5° to 28°C (Chen et al., 2021).



**Figure 3.** Records of *Sebastes schlegelii* from the Black Sea. Black dots retrieved from Karpova et al. (2021), red dots denote observations from the Turkish coastline, letters correspond to individuals presented in Fig.2 (locality of the captured individual in this study indicated with an asterix).

Pacific oysters (*C.gigas*) are one of the most globalized highly commercial bivalves that have been introduced to 66 countries outside their native range (northwest Pacific) for aquaculture purposes (Herbert et al., 2016). They were first introduced to the northern Black Sea coastal waters from the Sea of Japan during the 1980s, with active attempts for its acclimatization since

then (Krapal et al., 2019; Aydın and Gül, 2021). Establishment of Pacific oyster sea farms have been continuing along the Crimean coast during the last two decades without any quarantine measures taken, and this activity have been suggested as the major and most rational explanation for the introduction of northwest Pacific originated *S. schlegelii*, without ruling

out the possibility of passive transport in ballast water tanks of a ship (Karpova et al., 2021). Above mentioned vectors are also suspected for the Korean rockfish introduced to the Dutch coastline (Kai and Soe, 2009). Following the first occurrence of *S. schlegelii* in the northern Black Sea during 2013, four additional adult individuals were collected from Crimean and Caucasian coasts in 2019 from depths of 3 to 15 m, indicating the presence of an established population (Karpova et al., 2021). The species have rapidly reached the southern Black Sea coasts, especially the southeastern region, presumably by the larval and/or juvenile dispersal through the prevailing currents. Korean rockfish adults are not capable of extending their ranges, since they are characterized by strong site fidelity (Zhang et al., 2015), but the pelagic larvae and juveniles of this species can easily migrate to great distances (Gudkov, 2010). The pelagic juvenile phase of *S. schlegelii* may last several months to a year, in which they utilize different habitats including the drifting seaweeds, suggesting their opportunistic habitat selection (Moser and Boehlert, 1991; Nagasawa and Domon, 1997).

With reference to the sudden occurrence of the species along the Turkish Black Sea coast with observations from discrete localities, we may assume the establishment of *S. schlegelii* is an ongoing process in the region. In case that the species increases its population density, multifaceted impacts maybe expected. Competition with the native black scorpionfish (*Scorpaena porcus*) for food and space seems to be quite likely, as also suggested by Karpova et al. (2021). Due to the high commercial value of the species in the NW Pacific, it may also contribute to the artisanal fishery catch of the Black Sea. Most *Sebastes sp.* are known to bear venom glands in dorsal, anal and pelvic fins, but no envenomation caused by Korean rockfish were reported and Froese and Pauly (2023) considers the species to be harmless to humans.

#### 4. CONCLUSIONS

The semi-enclosed Black Sea, which has long been deteriorated by the combined effects of

eutrophication, habitat loss, increased annual sea surface water temperatures and overexploitation of natural resources, is one of the most prone ecosystems in the world to the invasion of alien species. The basin is characterized by high primary production, brackish water body, low local species richness and wide biotope diversity, which provide favorable conditions for the introduction of alien taxa that can establish successful populations at unoccupied ecological niches, especially in the absence of local competitors (Zenetos et al., 2003; Leppäkoski et al., 2009). Although Black Sea hosts the least number of alien species (28 sp.) along the Turkish coast, an increase of 25% in the alien inventory was observed during the last decade (2010-2020), indicating the rapid changes in the local diversity and the necessity of urgent measures to be taken (Çınar et al., 2021).

*Sebastes schlegelii* can survive wide ranges of temperatures (5° to 28°C; Chen et al., 2021) and is highly tolerant to waters with varying salinities (i.e., estuaries, brackish waters; Dyldin et al., 2021), and Black Sea ecosystem perfectly meet these conditions. As a precautionary approach, every single alien species, casual or established, should be treated as potential invaders, underlining the necessity and importance of carrying out bioecological research to better understand their life histories. So, the sudden appearance of Korean rockfish in Türkiye should thus be taken seriously, and closely monitored.

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#### AUTHORSHIP STATEMENT

#### CONTRIBUTION

**Murat BİLECENOĞLU:** Conceptualization,

Methodology, Writing - Original Draft, Writing-Review and Editing, Data Curation. **M. Baki YOKEŞ**: Methodology, Validation, Formal Analysis, Writing-Review and Editing, Data Curation. **Mehmet AYDIN**: Conceptualization, Methodology, Resources, Writing - Review and Editing, Data Curation, Supervision.

## CONFLICT OF INTERESTS

The author(s) declare that for this article they have no actual, potential or perceived conflict of interests.

## ETHICS COMMITTEE PERMISSION

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