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A new Alien Fish from the Southern Black Sea (Sinop, Türkiye): *Sebastes schlegelii* Hilgendorf, 1880 (Scorpaeniformes, Sebastidae)

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Research Article

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Abstract

Sebastes schlegelii Hilgendorf, 1880 is an Indo-Pacific species with a widespread distribution in the coastal waters of the Far Eastern region. This study represents the first documentation of *S. schlegelii* off Sinop coast from the Southern Black Sea. The four specimens collected on 28 May 2023 and 18 June 2023 from rocky habitat at a depth of about 6 meters off Sinop coast had a total length range of 226 to 237 mm and weights ranging from 197.57 to 254.98 g. The spread of this species to the southern Black Sea coast is attributed to the transportation of early life stage individuals from the northern coast of the Black Sea to the southern coast via the cyclonic Rim Current.

Keywords: Black rockfish, exotic species, new record, Black Sea

Güney Karadeniz'de (Sinop, Türkiye) Yeni Bir Yabancı Balık Türü: *Sebastes schlegelii* Hilgendorf, 1880 (Scorpaeniformes, Sebastidae)

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Öz

Sebastes schlegelii Hilgendorf, 1880, Uzak Doğu bölgesinin kıyı sularında yaygın bir dağılıma sahip İndo-Pasifik bir balık türüdür. Bu çalışma, *S. schlegelii*'nin Sinop'un Karadeniz kıyılarından ilk kaydını temsil etmektedir. Sinop açıklarında yaklaşık 6 metre derinlikteki kayalık habitattan 28 Mayıs 2023 ve 18 Haziran 2023 tarihlerinde toplanan dört örneğin total boyları 226 ila 237 mm, ağırlıkları ise 197.57 ile 254.98 g arasında değişmektedir. Bu türün Güney Karadeniz kıyılarına yayılmasının, erken yaşam evresindeki bireylerin Karadeniz'in kuzey kıyılarından güney kıyılarına siklonik Rim Akıntısı aracılığıyla taşınmasına dayandığı düşünülmektedir.

Anahtar Kelimeler: Kara kaya iskorpiti, egzotik tür, yeni kayıt, Karadeniz

Introduction

Introduction of alien, or non-indigenous species into different habitats has been recognised as one of the major problems [1]. A non-indigenous species is considered to be any species whose historical translocation into an environment outside of its native geographic habitat has been either intentionally or accidentally man-mediated or an action of active dispersal via natural pathways [2, 3]. Several major categories make up the global vectors for alien marine species and include canals, aquaculture fisheries, and commercial shipping operations [1, 3]. The Black Sea is one of the unique seas in the world, with a 423,000 km^2 area, 547,000 km^3 volume, a maximum depth of 2212 m representing a semi-closed sea, connected with the Kerch Strait to the Sea of Azov, and with the Bosphorus and Dardanelles Straits to the Marmara and Mediterranean Seas and covered with a oxygen-poor water layer [4-7]. The Black Sea with its low species diversity creates a favourable environment for introduction of alien species. This leads to less competition, diverse habitats, and numerous available niches, and some of these species can become invasive, disrupting ecosystem stability, and functionality, and threatening native species [8, 9]. The Mediterranization of the Black Sea is one of the factors that affect the introduction and distribution of alien species in the Black Sea. The ecosystem and fish populations in the Black Sea are significantly impacted by climate change, pollution, overfishing, and illegal fishing, as well as by invasive species [10]. The black rockfish, *Sebastes schlegelii*, falls under the order Scorpaeniformes, and the family Sebastidae [11]. It is an economically significant species in aquaculture in various Asian countries, including South Korea, Japan, and China due to its rich nutritional composition, high market demand, rapid growth rate, and ability to withstand low water temperatures [12, 13]. This study presents the initial record of the black rockfish along the Sinop coast of the Black Sea. The primary aim of this investigation is to perform a comprehensive examination and documentation of the morphological characteristics of black rockfish specimens, while concurrently evaluating the present status of this species within the Black Sea ecosystem.

Materials and Methods

Four specimens were collected on 28/05/2023 and 18/06/2023 from rocky habitat at a depth of approximately 6 meters off the Sinop coast (41.927ºN, 35.090ºW) (Figure 1).

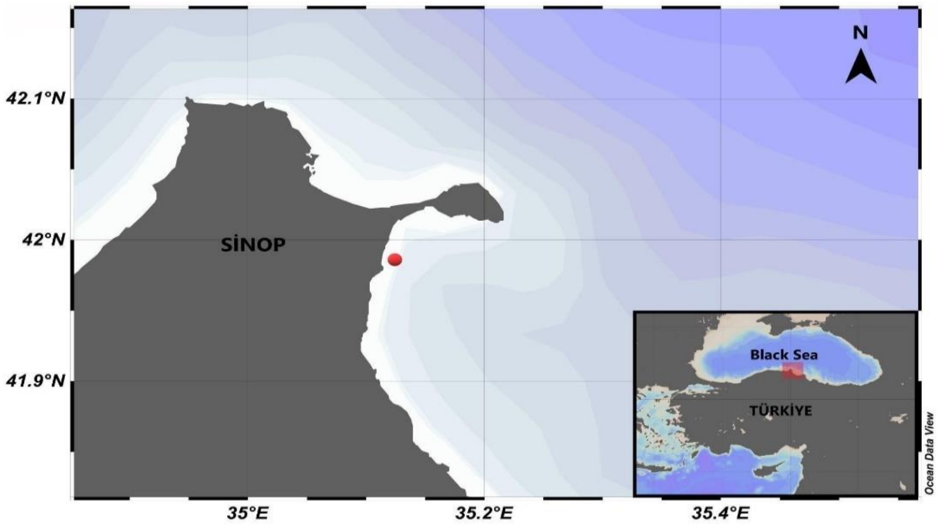

Figure 1. *Map of the region where the black rockfish species was recorded*

Fish samples were collected using a fishing line by H. C. Öztekin and K. A. Usta and identified by O. Uygun. The four samples exhibited total lengths ranging from 226 to 237 mm, standard lengths ranging from 198 to 201 mm, and weights ranging from 197.57 to 254.98 g (Figure 2). Precise morphometric measurements, including length (±0.1 mm), weight (±0.01 g), and meristic counts, were meticulously recorded. Subsequently, the fish were photographed and preserved in a 4% buffered formaldehyde-borax solution. The preserved specimen was then deposited at the Biology Laboratory of the Fisheries Faculty, Sinop University (Sinop, Türkiye) serving as a reference sample. Although it is currently unnumbered, it will be an essential resource for future reference and research purposes. Morphometric measurements and meristic counts of all captured specimens were conducted using the traditional method as described by Takács et al. [14]. The map was created using Ocean Data View v5.6 software [15].

Figure 2. *Sebastes schlegelii caught at Sinop, Southern Black Sea, Türkiye. The standard length is 199 mm.*

Results

Descriptions

The morphological characteristics of *S. schlegelii* include dorsal fin rays XIII+13, anal fin rays III+8, pectoral fin rays 18, ventral fin rays I+5, caudal fin rays 15-16, and the lateral line containing 45-47 pores. The anterior portion of the body is moderately narrow and gradually tapers towards the posterior region. The head of individuals in this species exhibit notable anatomical features, including the presence of three lacrimal spines, five preopercular spines (the second preopercular spine is the longest, while the lengths of the lower spines progressively decrease), and two opercular spines. The occipital region exhibits two flat bony projections, with the upper extremity resembling a spine in shape. Mouth large, protractile, and slightly oblique. The snout is devoid of scales. The mandible is positioned slightly anterior to the maxilla. The maxilla and mandible exhibit a continuous series of villiform teeth, while the presence of teeth on the vomer bone is evident, and no palatines are present. The tips of both the upper and lower lips display a distinct black colouration. Additionally, two oblique dark bands on the preoperculum serve as characteristic features of this species. The lateral line follows a parallel course to the dorsal profile of the body, extending from the posterior edge of the opercule to the base of the caudal fin. The pectoral fin base is positioned slightly anterior to the pelvic fin base, while the caudal fin has a round shape. Notably, there is a prominent papilla protrusion in the urogenital opening. The colouration of this species is characterised by a dark grey and brown hue, adorned with a marbled pattern consisting of small, indistinct dark spots scattered across the body. Detailed morphometric measurements and body proportions as percentages are given in Table 1.

Table 1. *The morphometric characteristics of the Sinop specimens of Sebastes schlegelii in the Black Sea (± Standard Error)*

	Present study	**[20]**	**[21]**	**[22]**	**[23]**	**[43]**	**[42]**
Number of specimen(s)	4	5	1	1	6	1	1
TL (mm)	226-237	325-391	349.6	245	230	275	311
SL (mm)	191-201	277	299.3	206	200	240	264
W (g)	197.6-255.0	710.0-1151.2		282.1	227	459.2	
Meristic counts							
Dorsal-fin rays	XIII- 13	XIII- 13	XIII-13	XIII-11	XIII-13	XIII-13	XIII-13
Pectoral-fin rays	18	18	18	18	18	18	18
Pelvic-fin rays	I-5	I-5	I-5	I-5	I-5	I-5	I-5
Anal-fin rays	III-8	III-8	III-8	III-8	III-8	III-6	III-8
Caudal-fin rays	15-16		16	15-16	15-16	15	
Pored lateral line scales	45-47	47-49	47	44	47		46
Morphometric measurements % of SL							
Predorsal length	28.7 ±0.54	34.4	31.7	27.1	27.5	33.3	29.4
Prepectoral length	32.2 ±0.45	34.6		29.8	34	37.1	33.5
Preanal length	62.3 ±0.28	68.5		66.7	64	68.8	67.8
Prepelvic length	36.9 ±0,21	38.2	34.7	39	38	22.5	39.3
Length of dorsal fin	14.0 ±0,12		16.1		11.5		
Length of pectoral fin	23.1 ±0.24	22.1	20.6	25.2	22.5	24.2	22.5
Length of pelvic fin	18.8 ±0.26	20.5	34.7	22.7	19.5		18.7
Length of anal fin	14.8 ±0.39	16	18.1	15.9			16.6
Length of caudal fin	17.2 ±0.21	21.2	17.3	13.4			20.8
Length of caudal peduncle	14.5 ±0.30	10.4	10.4	9.7	9	9.2	9.8
Dorsal fin base length	59.4 ±0.52	62.6		60.8	56	63.8	58.8
Anal fin base length	19.4 ±0.31	15.9		15.9	16.5	20.4	16.6
Maximum body depth	36.3 ±0.64			36.5	32	38.3	34.2
Minimum body depth	10.8 ±0.33						
Head length (HL)	35.0 ±0.46	37.8	31.1	34	36.5	36.7	34.3
Morphometric measurements % of HL							
Preorbital length	21.9 ±0.42	30.9	30.6	19.8			
Postorbital length	54.8 ±0.53	52.5		61.5			62.6
Eye diameter	20.6 ±0.32	19.7	18.9	18.7			17.1
Interorbital distance	24.0 ±0.68	27.1	30.9				
Maxilla length	45.3 ±0.62	45.1		45.5			35.7
Mandible length	46.7 ±0.59	46.6					

[20]Karpova et al., (2021), **[21]**Yağlıoglu et al., (2023), **[22]**Bilecenoğlu et al., (2023), **[23]**Ivanova et al., (2024), **[43]**Karadurmuş et al., (2024), **[42]**Uzer et al., (2024)

Discussion and Conclusions

This article presents an additional record of *S. schlegelii* in the Black Sea and a new record for the Sinop coastline. The Black rockfish, commonly known as the black rockfish, is a widely recognised sedentary species that inhabits nearshore rocky bottoms within a depth range of 10 to 100 meters [16]. The black rockfish is a species with a widespread distribution in the Pacific Northwest waters, including regions such as South Korea, Japan, and China [17]. The initial documented occurrence of the species outside its native habitat was observed along the Dutch coast in the North Sea [18]. Black rockfish in the Black Sea was first described as *Ephinephelus caninus* Valenciennes, 1834 off the coast of Crimea in May 2013 [19]. However, Karpova et al. [20] stated in their study that the description made by Boltachev & Karpova [19] was incorrect and revealed that this species was *S. schlegelii* by morphometric measurements and descriptions. Karpova et al. [20] reported this species from the west coast of Crimea in April 2019 and gave morphometric characteristics of the species. The study by Yağlıoğlu et al. [21], which includes the morphological and genetic record of the species detected in May 2022, is the first record from the Turkish coast in the southern Black Sea. Ivanova et al. [23] provided the first morphological and genetic record of the species from the Varna and Burgas coast in the western Black Sea, detected in May 2022 and August 2023. Bilecenoğlu et al. [22] provided morphological and genetic record of the species from the Ordu/Ünye coasts in the southern Black Sea, detected in August 2023. Uzer et al. [42] reported the species from the Şile/Istanbul coast at the south of Black Sea in December 2023, along with its morphometric characteristics. Karadurmuş et al. [43] gave its first record from the Sea of Marmara, the Gulf of İzmit in January 2024, and stated that the geographical spread of the species is rapidly expanding. This study represents the last record of the species in the Black Sea (Sinop coast of the southern Black Sea) found in May and June 2023 (Figure 3). The morphometric measurements and meristic counts in our study seem to match with literature [17, 20-23, 42, 43]. It has been emphasised that the Pacific oyster *Crassostrea gigas* which can come from farms or ships via ballast waters is the reason for the presence of this species in areas different from its natural habitat [18, 20]. Karpova et al. stated that the black rockfish juveniles may have entered the Black Sea ecosystem along with the shipments of the giant Pacific oyster *Crassostrea gigas,* which are regularly imported live to the southern coast of Crimea [20]. However, there are no *C. gigas* farms around Sinop. For this reason, the presence of this species on the coasts of Sinop may be due to several reasons. It is possible that the early life stages of this species arrived through the ballast water of ships. Therefore, it is known that this species has a resident population in the Crimea region [20]. Sinop is situated approximately 150 nautical miles south of Crimea. However, *Sebastes* spp. are demersal and sedentary species, typically distributed at a maximum depth of 100 meters [16, 17]. As the depth along this path is greater, it is thought that the population is unlikely to migrate from this area.

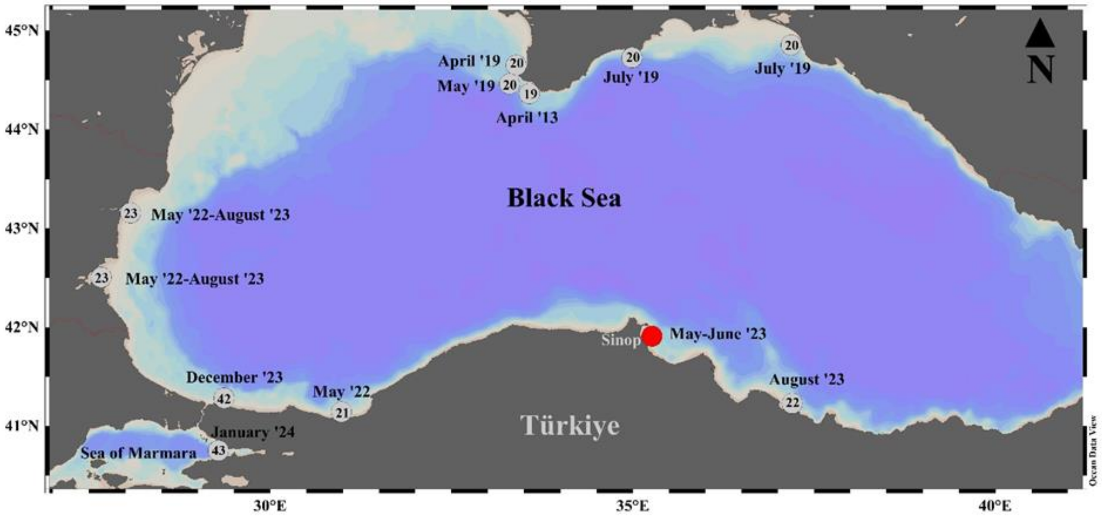

Figure 3. *Chronological distribution of Sebastes schlegelii in the Black Sea and the Sea of Marmara (Red dot indicates the current study. Gray dots denote other studies, with reference numbers of studies provided within gray dots.)*

The black rockfish is a viviparous fish with a pelagic larval stage. Following spawning, the larvae inhabit the upper water layer. The larvae and juveniles exhibit a propensity for seeking shelter amidst floating algae, proximity to logs, buoys, and various objects, or forming dense assemblages [20, 24-27]. The existing circulation pattern of the Black Sea is defined by a cyclonic rim current [28, 29]. In this context, the hypothesis posits that early life stage individuals of the black rockfish were transported from the western coast of the Black Sea to the coast of Sinop via the cyclonic current, leading to the establishment of a population. This proposition gains support from the fact that records of the black rockfish in the western Black Sea were identified in May 2022, reinforcing this assumption [21, 23]. The black rockfish, being a piscivorous predator, primarily prey on fish and shrimp species [30]. Its diet predominantly consists of small fish, including anchovies [31]. In the Turkish waters of the Black Sea, known for its abundant fish populations, particularly small pelagic species like anchovy, sprat, and horse mackerel [32], the black rockfish may find favourable feeding conditions. Furthermore, the presence of shrimp species such as *Crangon crangon*, *Palaemon adspersus*, and *Palaemon elegans* in the waters of Sinop [33] suggests that this area may serve as a favourable feeding habitat for black rockfish. It has been determined that the most effective environmental condition for the distribution of *S. schlegelii* is the bottom temperature, and it has been stated that the most suitable temperature for the species is between 3-20 °C [34]. It was determined that the optimum temperature for this species is between 5-28 °C in the experimental investigations made under aquaculture conditions [35, 36]. Despite the customary salinity protocol of approximately 30 psu for black rockfish in aquaculture settings [16, 37], a comparative study investigating the growth of juvenile black rockfish under diverse environmental conditions unveiled that optimal growth and survival outcomes were attained in brackish water environments [38]. Sinop waters, exhibit characteristics of brackish water, with an average salinity of 18 psu and annual temperature fluctuations ranging from 8 to 26°C [39, 40]. Consequently, considering the available literature, it is believed to serve as a favourable environment for the feeding and growth of black rockfish. The alien species pose a threat to the biodiversity of native species in the ecosystem and lead to significant changes in native ecosystems on a global scale [41]. Therefore, competition between *S. schlegelii* and local species sharing the same habitat and having similar trophic levels is inevitable. However, *S. schlegelii* holds significant economic value in Asian countries, primarily due to its desirable attributes that make it well-suited for aquaculture. The commercial importance of the species may create the potential for aquaculture and local fisheries in the Black Sea. The Black Sea coasts are postulated to provide a conducive ecological environment for the black rockfish, considering its ecological requirements and habitat preferences. Therefore, we posit that monitoring the present status of this species in the Black Sea and tracking the population dynamics of indigenous species occupying the same trophic level is imperative for a comprehensive understanding of the ecological implications.

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Conflicts of Interest The authors declare no conflicts of interest.

Authors Contribution 1. Author: %40, 2. Author: %20, 3. Author: %20, 4. Author: %20.

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