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THE NORTHWARD RANGE EXTENSION OF *SIGANUS LURIDUS* (RUPPELL, 1829) REACHED ÇANAKKALE STRAIT, TÜRKİYE

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Abstract
This study indicated that the northernmost extension of invasive *Siganus luridus* (Rüppell, 1829) reached the Çanakkale Strait of Türkiye coasts. A single specimen of the dusky spinefoot *Siganus luridus* was incidentally caught using a trammel net with 32 mm mesh size at a depth of 10 meters on November 2, 2025. This individual measured 204 mm in total length and weighed 121.7 g. This individual identified as a maturing female and empty of stomach content. Morphometric measurements and meristic counts of this invasive were recorded and compared with previous studies. This updating record with biological data of this lessepsian individual contributes to future ecological assessments and monitoring studies.

Keywords: Dusky spinefoot, lessepsian migration, rabbitfish, siganidae, trammel net

Introduction
The Suez Canal opened in 1869 is one of the most important artificial waterways connecting the Mediterranean Sea and the Red Sea (Anonymous, 2025). Since the 1990s, the canal's deepening and widening have facilitated the accelerated introduction and expansion of extending alien species increasing throughout the Mediterranean basin, including along Türkiye coasts (Çınar et al., 2021; Azzurro et al., 2022). To date, approximately 80 alien marine pisces have been recorded as current in the Türkiye coasts (Çınar et al., 2021). One of the most significant drivers of these species expansion is changing climate conditions, which pose a growing threat to the stability of global natural systems (Steffen et al., 2018). Many fish species have been directly or indirectly affected by these changes, leading to shifts in their habitat preferences and geographical distributions. In response to these altered environmental

conditions, some species are migrating near the northern or southern boundaries of the geographic range or driving to higher and lower latitudes (Pörtner & Peck, 2010; Lind et al., 2022). Among the migrating alien species from Siganidae, the marbled spinefoot *Siganus rivulatus* Forsskål, 1775 and the dusky spinefoot *Siganus luridus* (Rüppell, 1829) were entered Türkiye coast. *S. luridus* was first documented in Türkiye in 1973 (Çınar et al., 2021; Gönülal et al., 2024). This species has been rapidly expanding its range along the Türkiye coast, with its last northernmost record from Edremit Bay in the Aegean Sea (Ismen et al., 2015). Also, *S. rivulatus* has reached the Gulf of Izmit in the Marmara Sea (Karakulak et al., 2020). The most conspicuous morphological difference between these species is their coloration. *S. luridus* was typically darker than *S. rivulatus* and lacked the golden-yellow stripes over their body (Vella et al., 2023). *S. luridus* inhabits shallow waters and typically at depths not exceeding 40 meters. This species feeds on a wide range of benthic algae (Whitehead et al., 1986). Thus, the expansion of this grazer species poses a threat to the native biodiversity and the chance of overall ecosystem function (Sala et al., 2011; Vella et al., 2023).

This study presents the current northernmost record of *S. luridus*, contributing to the ongoing documentation of its expanding distribution. In addition to recent knowledge on *S. luridus* provides biological data from the collected specimen to support future ecological assessments and monitoring studies.

Material and Method

A single individual of *S. luridus* was incidentally caught as bycatch by a commercial fisherman from the Çanakkale Strait, Türkiye, on November 2, 2025. The sampling occurred in a coastal area at an approximate depth of 10 meters using multifilament trammel nets with 32 mm mesh size (bar length) and an outer panel mesh size of 160 mm (Figure 1).

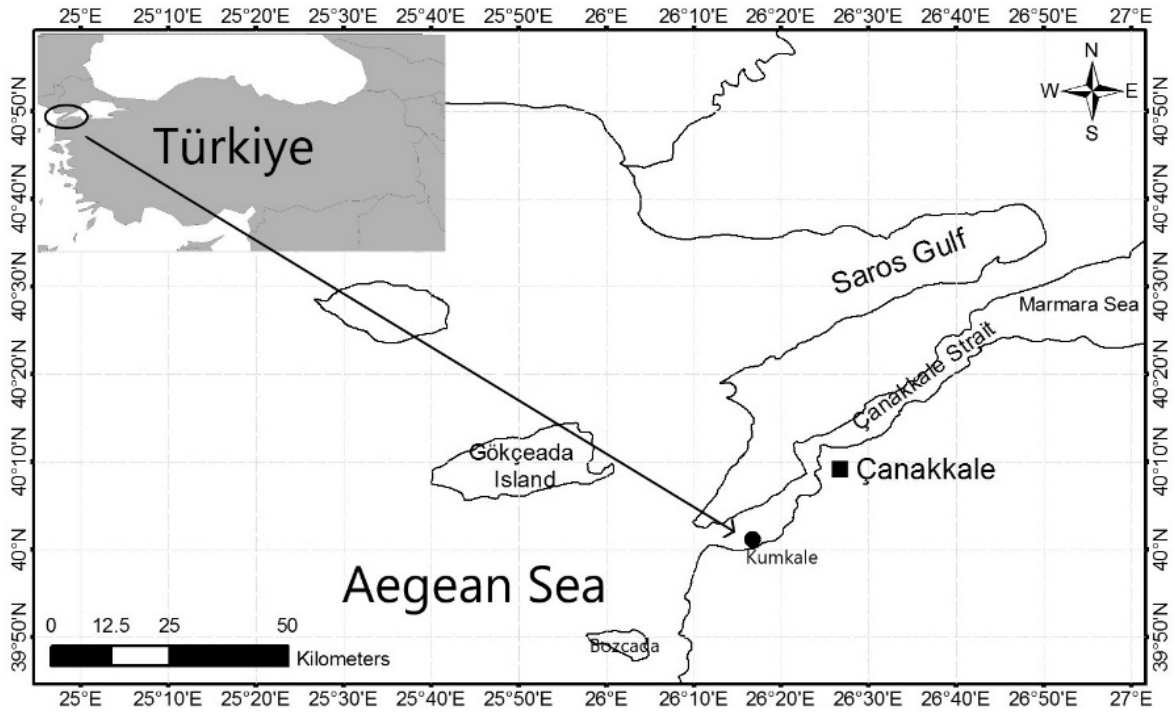

Figure 1. Sampling location of *S. luridus* in the Çanakkale Strait, Türkiye.

This specimen was transferred to the fish biology laboratory for species identification. After then, this individual was photographed and taxonomically identified based on morphological characteristics using Whitehead et al. (1986) (Figure 2).

Figure 2. Sampled *S. luridus* individual of Çanakkale Strait.

The morphometric measurements of this specimen were measured in the laboratory using a digital clipper and measuring board in millimeters (mm). Also, the meristic characteristics were counted. The total weight was measured to the nearest 0.01 g. This individual was subsequently dissected to determine sex and gonadal maturity stage through macroscopic examination of the gonads. The sexual maturity stages were classified based on Holden & Raitt (1974) as; Immature (Stage I), Maturing (Stage II), Ripening (Stage III), Ripe (Stage IV), Spent (Stage V). The gonad weight was recorded, and the stomach was dissected to assess digestive condition.

Results

A total of 21 morphometric measurements and total weight measurement were taken from *S. luridus* collected from Çanakkale Strait in this study. The total length and standard length of *S. luridus* were measured as 204 mm and 173 mm, respectively, and also the total weight as 121.7 g. The detailed morphometric measurements of *S. luridus* were recorded and compared with those reported in previous studies (Table 1).

The meristic counts of *S. luridus* determined in this study were as follows: dorsal fin rays comprised XIV spines and 10 soft rays; anal fin rays consisted of VII spines and 9 soft rays; pectoral fin contained 16 soft rays; and pelvic fin was composed of II spines and 3 soft rays.

The sex status of *S. luridus* was identified as female and the gonad gonadal development was classified as stage II (maturing) based on the observation of ovary about 1/2 the length of the body cavity. The gonad weight was measured at 1.02 g. The dissection of the stomach content revealed that the stomach was empty.

Table 1. Comparative morphometric measurements (mm) of *S. luridus* from the Çanakkale Strait and previous studies.

Measurements (mm)	Dulčić et al., 2011	Ismen et al., 2014	Akyol & Aydın, 2015	Amor et al., 2016	Jawad et al., 2024	This study
Total weight (gr)	87.6	183.1	147	-		121.7
Total length	173	220.0	197	197	141.7	201.0
Standard length	144	183.0	166	166	113.4	173.0
Body depth	-	74.0	70	22	-	67.5
Predorsal length	31	38.1	42	35.5	34.7	36.3
Preanal length	72	96.0	87	82	58.8	63.4
Prepectoral length	34	40.0	34	36	27.5	33.3
Prepelvic length	40	62.2	-	-	36.7	53.4
Caudal peduncule length	-	11.3	-	16.9	12.2	31.3
Caudal height	-	57.4	-	-	-	39.1
Dorsal fin base	104	135.2	-	116	76.3	120.9
Dorsal fin length	-	28.1	-	-	-	23.4
Anal fin base	63	81.0	-	70.5	48.1	70.9
Anal fin length	-	25.1	-	-	-	21.8
Pectoral fin length	29	34.6	-	11.6	25.2	32.1
Pelvic fin length	23	32.1	-	4.5	18.1	24.3
Head length	33	39.1	38	36	31.4	37.2
Preorbital length	9	9.8	14	12.8	10.7	15.5
Eye diameter	12	12.5	10	11.3	9.9	10.9
Interorbital width	10	10.9	-	11.5	9.7	10.7
Upper jaw length	-	7.8	-	-	-	7.7
Lower jaw length	-	6.5	-	-	-	6.2

Discussion

Approximately 80 alien marine pisces have been entered as current introductions in the Türkiye coasts by the end of 2020 (Çınar et al., 2021). These species are rapidly expanding their distribution towards the northern coasts of Türkiye with changing climate conditions. Among them, *S. luridus* has been recently recorded in the Izmir Bay (Akyol & Aydın, 2015) and Edremit Bay (Ismen et al., 2015) in the Aegean Sea. In the present study, this species was recorded in the Çanakkale Strait representing more northerly than previously reported. The Çanakkale Strait connects the Marmara Sea and the Aegean Sea (Ozturk, 2021), and this narrow corridor serves as a critical waterway and an important fishing ground for various marine species (Şen & Özekinci, 2023). This occurrence of sampling a single specimen in the incidental sample indicates a significant extension of the distribution range of *S. luridus* along the coasts of Türkiye through Çanakkale Strait, yet it does not confirm the existence of a settled or reproducing population in this region.

In the present study, a single specimen of *S. luridus* was measured as 204 mm in total length and 121.7 g in the total weight. Previous research reported that the total length of 17 *S. luridus* individuals sampled from Izmir Bay ranged between 187 mm and 255 mm, with an mean of 216.8 mm (Kara & Akyol, 2011). The total length of individuals sampled from Izmir Bay and Edremit Bay were found to be similar values (Akyol & Aydın, 2015; Ismen et al., 2015). These differences in total length and weight values across different locations are considered to be

associated with sampling using fishing gears of varying characteristics. Also, the standard length observed in earlier studies were consistent with those reported by Whitehead et al. (1986), who noted a typical range of standard length as 10–20 cm of this species (Table 1). The other morphometric measurements of *S. luridus* determined in the present study were compared to previous studies, as summarized in Table 1. The body depth, pectoral fin length, and pelvic fin length measurements reported by Amor et al. (2016) differ notably from those presented in other studies. These differences may be due to the measurements of body height instead of body depth, and the pectoral fin base and pelvic fin base instead of pectoral fin length and pelvic fin length.

The meristic characters of *S. luridus* in the present study were consistent with those reported by Whitehead et al. (1986). Among these meristic characteristics, 14 dorsal fin spines were observed in this study, whereas Vella et al. (2023) and Jawad et al. (2024) reported 13 dorsal spines. Vella et al. (2023) documented that 14-17 soft rays in pectoral fin of 21 individuals, while 16 soft rays of *S. luridus* recorded in present study. Furthermore, the meristic counts of *S. rivulatus* and *S. luridus* from family Siganidae have been stated to nearly overlap (Whitehead et al., 1986; Vella et al., 2023). The specimen caught in this study was identified as maturing female. This biological trait is knowledge regarding the reproductive condition of a newly settled population during early phases of colonization is also a key component to assess the status of invasive species and to formulate management responses (Azzurro et al., 2007). *S. luridus* is known to feed primarily on algae diet and herbivorous (Whitehead et al., 1986). So, the expansion of this grazer species may pose a threat to native algal communities (Giakoumi, 2013). But no food items were observed in the stomach of the dissected specimen in the present study.

Conclusion

Siganus luridus which an Indo-Pacific origin species is known to have progressively expanded its range to the coasts of Tunisia (Amor et al., 2016) and Malta (Vella et al., 2023) in the western of Mediterranean basin, while the present study shows northward range extension reaching to the Çanakkale Strait of Türkiye. Given this status, it is possible that *S. luridus* will see further north in the near future in first in the Marmara Sea and then potentially in the Black Sea. However, the physicochemical characteristics of these areas might be the most important factors indicating whether the species will settle or not. Also, the most curious issues will be whether it will form a colony, threat to native biodiversity or algae habitats when *S. luridus* reaches these regions. *S. luridus* determined in this study shows the growing Lessepsian migration of invasive species under rapidly changing climatic conditions of the world. This updating documentation of its expanding distribution *S. luridus* aimed to contribute future ecological assessments and monitoring studies with biological data from the sampled individual.

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Ethical approval

Ethics committee approval is not necessary for this study.

Data availability statement

The authors declare that data can be provided by corresponding author upon reasonable request.

Conflicts of interest
The authors declare that there are no conflicts of interest or competing interests.

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Contribution of authors
Yusuf ŞEN: Designing of the study, laboratory study, data analysis, writing original draft preparation.

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