ACTA ZOOLOGICA BULGARICA

Acta Zool. Bulg., March 2026, 78 (1): 75-80

Published online 22 January 2026
DOI: https://doi.org/10.71424/azb78.1.002860

Aquatic Ecology
Research Article

Catch Per Unit Effort Values and Composition of the Sparidae (Teleostei) from the Yumurtalık Coastal Waters in Iskenderun Bay

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Academic Editor: *Apostolos Apostolou*

Abstract: This study was conducted to estimate the Catch per Unit Effort (CPUE) values for sparid fishes in the Yumurtalık coastal zone, Iskenderun Bay. The specimens were collected from 2004 to 2012, using seasonal deep trawl tows and within the depth ranges of 10 to 20 meters. Thirteen species of family Sparidae were identified: *Boops boops*, *Dentex dentex*, *Diplodus sargus*, *D. vulgaris, D. annularis*, *D. puntazzo, Lithognathus mormyrus*, *Pagrus acerna*, *P. auriga, P. caeruleostictus, P. pagrus, Pagellus erythrinus* and *Sparus aurata*. Among these, the dominant species were *D. annularis*, *L. mormyrus*, *P. erythrinus* and *S. aurata*. The frequency of occurrence (FO%) of each species was calculated, with *P. erythrinus* being the most common species within Sparidae.

Key words: Sparidae, Iskenderun Bay, Catch Per Unit Effort (CPUE)

Introduction

The abundance and distribution of target species are of significant importance in order to determine the structure of fish communities in coastal waters. The sparid fishes (sea breams) in the Gulf of Iskenderun are critically important to the Turkish fishing industry. This family comprises approximately 50% of the total demersal fish catch along the Mediterranean coasts (JICA 1993). There are 21 species of family Sparidae in Turkish waters, underscoring the family's value to the fishing industry.

Although the family is cosmopolitan, most sparid species are found in the Black Sea, the Mediterranean and along the eastern coast of the Atlantic Ocean (Papaconstantinou et al. 1988). In the Mediterranean, most of the sparid fishes inhabit rocky bottoms and beds of *Posidonia oceanica* (Tortonese 1965); sand dweller species, such as *Lithognathus mormyrus*, also exist. The bathymetric range of these species extends from the shallow subtidal level to about 300 m deep, with the highest abundance occurring at depths of 20 to 100 m (Santos et al. 1995). They are typically found in shallow temperate and tropical waters, often functioning as bottom-dwelling carnivores. Certain species, such as *Sarpa salpa,* predominantly feed on sea grass and algae.

Previous studies on this family have primarily focused on their systematics, distribution, growth, age, feeding habits, by-catch ratios and selectivity

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(Whitehead 1984, Bauchot & Hureau 1986, Fisher et al. 1987, Bilecenoglu & Taskavak 1999, Pajuelo & Lorenzo 1998, Mater et al. 2003, Turan 2007). These aspects have been extensively studied in Turkish seas (Bingel 1987, Bingel et al. 1993, Gücü & Bingel 1994, Cicek 2006, Gücü 2009, Dalyan 2020, Cetin et al. 2011, Yemişken et al. 2014, Cengiz et al. 2019, Soykan et al. 2016). However, the Catch per Unit Effort (CPUE) has not been studied in the North-Eastern Mediterranean until now.

The objective of this study was to explore the seasonal abundance of sparid fishes in the depths of the western coastal waters of Iskenderun Bay.

Material and Methods

This study was conducted between 2004 and 2012 at two stations located in the coastal area between Yumurtalık and Botas in Iskenderun Bay, North-Eastern Mediterranean Sea. The coordinates of the 10 m and 20 m stations are as follows: from 35°52'08''E; 36°49'10''N to 35°54'20''E; 36°51'19''N and from 35°53'14''E; 36°48'15''N to 35°55'35''E; 36°50'23''N, respectively (Fig. 1). Data were obtained from 66 seasonal deep trawl tows at 10 m and 20 m depth contours. Each trawl was towed for one hour.

Seasonal samplings were performed utilising a commercial trawling vessel (19.2 m long, 59.66 GRS, 422 HP) equipped with a Mediterranean-Type bottom trawl net from 2004 to 2012. Seasonal trawl operations were conducted with one hour tows at the two stations at depths of 10 and 20 m, maintaining a towing speed of 1.5 knots. The trawl net employed featured a 12- meter ground gear line and an 11-meter head rope, with a mesh size of 44 mm. The samples were placed on the deck, where the fish were promptly categorised by species, enumerated and weighed.

The values of CPUE for the sparid fish were evaluated based on weight and their proportional occurrences were calculated as hourly catch rates following Avşar (2005): $a = D^* h^* X_2$ where a= Total dredged area by bottom trawl (km^2), D= Length of dredged area (m), h= Length of the buoy mouth of a trawl-net (m) and X_2= Opening rate of buoy mouth: evaluated at 0.5 by Pauly (1980).

Statistical analyses were performed using the R 2.15 statistical language and environment software (R Core Team, 2012). An interspecies similarity dendrogram was created based on the Bray-Curtis similarity index values (Bray & Curtis 1975).

Results

A total weight of 23.50 kg h^{-1} of sparid fishes were collected between 2004 and 2012, representing 13 species (Table 1).

The four most abundant sparid species were *D. annularis* (3.73 kg h^{-1}), *L. mormyrus* (3.50 kg h^{-1}), *P. erythrinus* (9.38 kg h^{-1}) and *S. aurata* (3.95 kg h^{-1}). Due to the low average CPUE values of the other species, they were categorised collectively as "others" (Fig. 2).

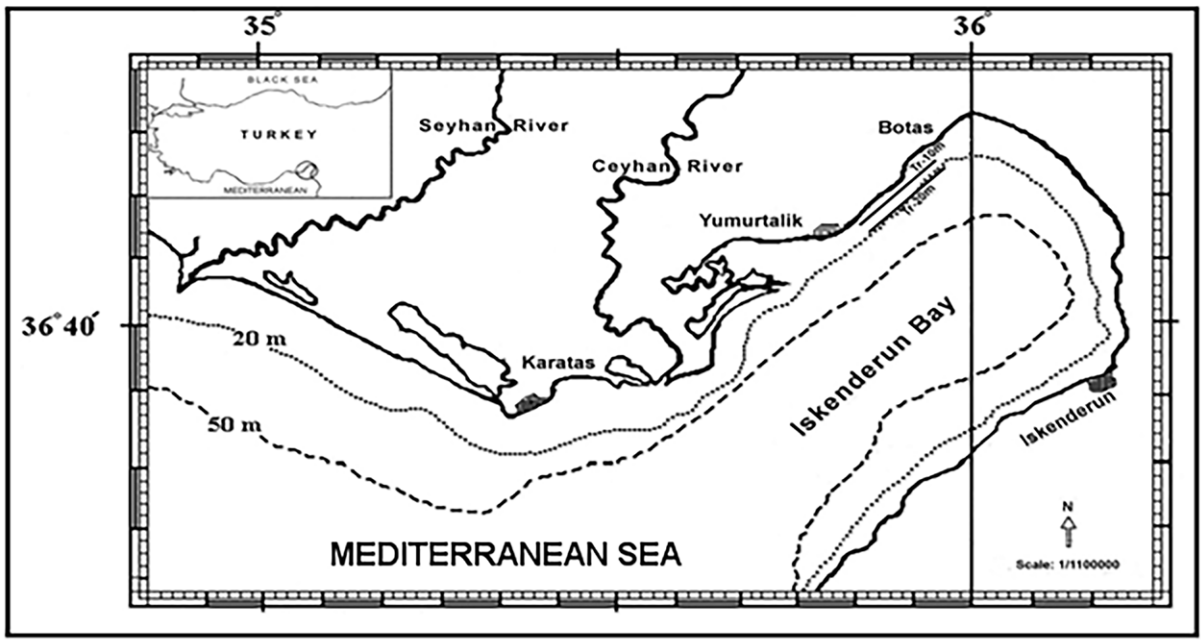


Fig. 1. Sampling area with trawling stations at 10 and 20 m

Table 1. Mean CPUE values, Standard Deviation (SD), Standard Error (SE) and Frequency of occurrence of sparid fishes (FO%)

Species	Mean	SD	SE	FO%	Tows
Boops boops	0.54	2.30	0.28	42.42	66
Diplodus annularis	3.73	1.45	0.17	86.36	66
Diplodus sargus	0.70	0.08	0.05	22.72	66
Dentex dentex	0.08	5.49	0.15	10.60	66
Diplodus puntazzo	0.03	0.43	0.05	1.51	66
Diplodus vulgaris	0.39	0.36	0.04	27.27	66
Lithognathus mormyrus	3.50	16.81	2.06	74.72	66
Pagrus acerna	0.10	4.73	0.58	16.66	66
Pagrus auriga	0.01	0.33	0.04	7.57	66
Pagrus caeruleostictus	0.05	0.32	0.03	4.54	66
Pagrus pagrus	0.96	1.23	0.15	40.90	66
Pagellus erythrinus	9.38	3.02	0.37	98.48	66
Sparus aurata	3.95	4.32	0.53	93.93	66

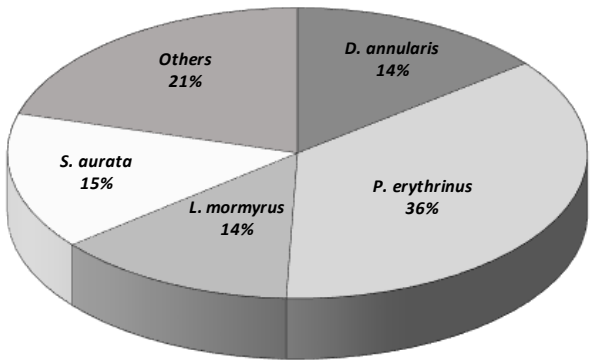


Fig. 2. Percentage composition of the most abundant sparid species

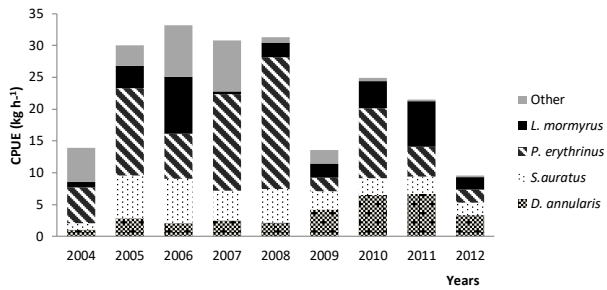


Fig. 3. Yearly mean CPUE values of the top five sparid fishes between 2004 and 2012

Other sparid species, which were not specifically analysed in this study, were less abundant. The annual variations in the specifically grouped sparid fishes are illustrated in Figure 3.

There was considerable fluctuation in CPUE values during the sampling period, the highest total CPUE value was recorded in 2006 (Fig. 3). The total CPUE values peaked between 2005 and 2008, with *P. erythrinus* being the dominant species during these years. The CPUE declined from 2004 to 2012.

The total CPUE values were highest in spring, with a notable peak observed at 38.19 kg h^{-1}. Following this peak, CPUE values decreased (Fig. 4). It was found that the CPUE values of sparid species varied seasonally, with *P. erythrinus* exhibiting the highest CPUE, followed by *S. aurata* (Table 2). The inter-seasonal and between-depth changes were statistically significant ($P < 0.01$ and $P < 0.05$, correspondingly). The inter-annual changes were also statistically significant ($P < 0.01$) and year-season interactions were found to be significant ($P < 0.05$).

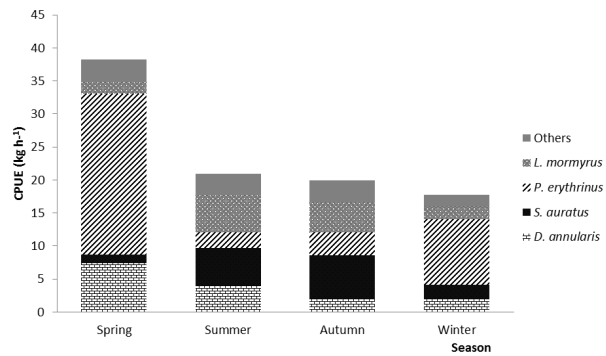


Fig. 4. Seasonal changes in catch per unit effort (CPUE) values for all sparid fishes

The total values of the CPUE obtained from 10 and 20 m were 28.22 kg h^{-1} (60%) and 18.76 kg h^{-1} (40%), respectively. *P. erythrinus* dominated at both 10 and 20 m (Fig. 5).

Table 2. Seasonal, interannual and depth-dependent changes of CPUE values of sparid

Seasons	Mean CPUE kg h^{-1}	S.D.	S.E.	Tows
Spring	38.19	31.20	8.34	14
Summer	20.24	12.80	3.01	18
Autumn	19.32	11.73	2.93	16
Winter	17.78	15.96	3.76	18
Years∑	23.49	19.91	2.45	66
10m	28.22	24.42	4.25	33
20m	18.76	12.77	2.22	33

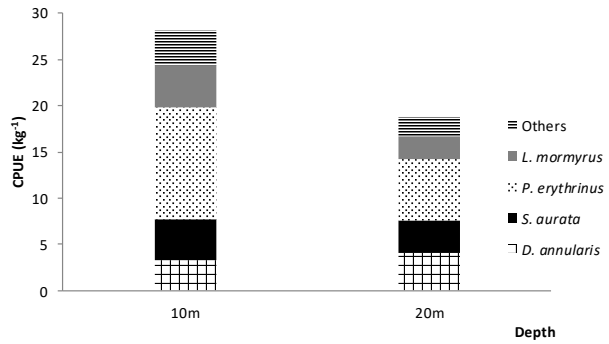


Fig. 5. Depth distribution of the total CPUE values for sparid fishes

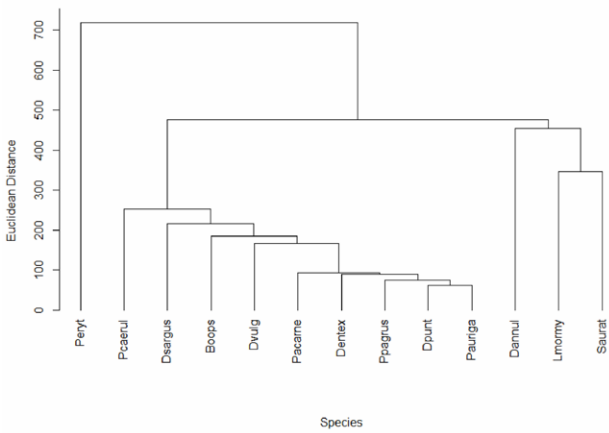


Fig. 6. Bray-Curtis similarity index values of sparid species caught in the trawl samples

The dendrogram shows that species such as *P. caeruleostictus*, *D. sargus*, *B. boops*, *D. vulgaris*, *P. acerna*, *D. dentex*, *P. pagrus*, *D. puntazzo, P. auriga* form a natural group. Additionally, *D. annularis*, *L. mormyrus* and *S. aurata* are represented in a separate group. *P. erythrinus* is not included in either group (Fig. 6).

Discussion

The sparid fishes in the Iskenderun Bay are of significant commercial importance to the Turkish fishing industry (Navarro et al. 2012, Cengiz et al. 2019). This study was conducted due to a lack of sufficient research on this subject, specifically regarding the Yumurtalık coasts. It is the first attempt to examine the biomass fluctuations of sparids in this area. Earlier studies on the stock abundance of sparid fishes was carried out in different regions and focused on the demersal fish community (Gulland 1956, JICA 1993, Bertrand et al. 2000, Can et al. 2002, Ozbilgin et al. 2006, Karakulak & Erk, 2008, Gücü, 2009, Metin et al. 2011, Gurbet et al. 2012, Cetin et al. 2011, OK 2012).

The distribution of sparid species within the demersal fish community is influenced by various environmental and climatic factors. These factors include depth, bottom structure, water body characteristics, seasonal changes, species diversity, predator-prey relationships, intra- and interspecies interactions, reproduction and alimental migration (Bianchi 1992, Koslow 1993, Gordon et al. 1995). One of the most significant factors determining fish community distribution is fishing pressure resulting from fishing activities. Therefore, to explain the changes observed in areas where CPUE values are estimated, it is essential to consider multiple factors. Due to the absence of comparable research results in the study area, it was not possible to accurately compare the CPUE values calculated in this study.

A total of 13 sparid species have been identified in the Yumurtalık coastal zone, with eight species determined to be prevalent. Among these species, *P. erythrinus* exhibited the highest CPUE value. In a study by the Japanese International Cooperation Agency (JICA 1993) on stock distribution in the region through trawl operations, as well as in Bingel's (1987) final report on the numerical fishing project in the coastal fishing areas of the Eastern Mediterranean, *P. erythrinus* was consistently reported as having the highest CPUE value. Our results align with the findings of previous research.

When considering depth layers, the CPUE value was highest in the 10 m depth layer, with small individuals of *P. erythrinus* being the most abundant. We recorded the highest total CPUE value of 28.22 kg at the station at 10 m. This observation aligns with the known behaviour of smaller individuals staying closer to coastal regions, while larger individuals inhabit rocky habitats in deeper regions or migrate to deeper areas (Golani et al. 2006). Numerous researchers have indicated that ideal habitats for these species are typically at between 10-50 m in depth (Fisher et al. 1987, Bauchot & Hureau 1986, Basusta & Erdem 2000, Mater et al. 2003, Turan 2007). Our results support these findings.

The fluctuations in CPUE values of individuals may be related to reproductive and nutritional activities (Bingel 1987, Avsar 2005). Furthermore, changes in economically important species such as *P. erythrinus* and *S. aurata* may be due to new generation recruitment (Bingel 1987).

This study may contribute significantly to the sustainable use and protection of these species in the region. Observing biomass and intensities through similar studies will help optimise the utilisation of economically valuable sparid species in the Mediterranean. Consequently, species in this family, which are crucial for regional fishing and economically valuable, should be closely monitored in future projects and research.

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Received: 07.03.2025
Accepted: 12.12.2025