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# Evidence of Nursery Area and Length-Weight Relationships for Longnose Spurdog *Squalus blainville* in the Northeastern Mediterranean

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**Research Article**

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## Abstract

Nursery areas are essential habitats for sharks, offering protection and increasing the survival of newborns. This study aims to investigate a potential nursery area for *Squalus blainville* in the northeastern Mediterranean Sea that has very scarce information in the eastern Mediterranean Sea and contributes to the length-weight relationships. We identified the location of the potential nursery area by interviewing local fishermen. We collected 48 adults and 22 embryos neonates of *S. blainville* specimens from the entrance of Iskenderun Bay on 03 April 2024. We recorded 48 longnose spurdog sharks in the catches ranging from 68.9 cm to 120.2 cm TL, which corresponded to mature individuals. The length-weight relations (LWR) of combined sexes of S. blainville were observed as $W = 0.0005 \times L^{3.0277}$ ($R^2 = 0.9303$). Our data provide evidence to recognize Iskenderun Bay as a possible nursery area for longnose spurdog sharks, meeting all the criteria proposed to identify nursery areas. These findings constitute the first documented evidence of a longnose spurdog shark nursery area in the Iskenderun Bay in Turkish marine waters.

**Keywords:** *Longnose spurdog, Nursery area, Iskenderun Bay, length-weight relationship.*



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## Introduction

The longnose spurdog *Squalus blainville* (Risso, 1827) is a demersal, medium-sized, and long-lived squalid shark (Kousteni and Megalofonou, 2015). It has been reported over a wide geographical range, from the waters of the Atlantic, Pacific, and Indian Oceans to the Mediterranean and Black Seas (Ebert and Dando 2020; Ebert et al., 2021). Compagno et al., 2005). *S. blainville* is mainly distributed on the continental shelves and upper slopes between 300-500 m depth down to about 700 m (Cannizzaro et al., 1995). It is considered an opportunistic scavenger, feeding primarily on crustaceans and teleosts (Martinho et al., 2012). Through a placental viviparity, it produces few embryos during all seasons of the year, ranging between 180 and 210 mm in total length (Kousteni and Megalofonou, 2011).

The longnose spurdog *S. blainville* is one of the most poorly studied Mediterranean shark species, although it comprises a very common by-catch of bottom trawl fisheries (Damalas and Vassilopoulou, 2011; Bengil and Başusta, 2018). It is listed as data deficient by the IUCN (Nieto et al., 2015; Finucci et al., 2021), since, despite its relatively well-studied biology (Cannizzaro et al., 1995; Merella et al., 1997; Sion et al., 2003; Kousteni and Megalofonou, 2011, 2015; Martinho et al., 2012; Eronat and Özaydın, 2014; Bengil, 2022), there is insufficient information on its distribution, population dynamics, and genetic structure to meaningfully inform extinction risk and population management models.

Currently, there is growing concern over the extent of shark catches in the Mediterranean, as their inherent characteristics make them intrinsically vulnerable to fishing pressure and pollution (Dulvy et al., 2014; Ergüden et al., 2022; Ergenler and Turan, 2024; Turan et al., 2024). Although slow growth, late sexual maturity, and low fecundity are common features among chondrichthyans, they are especially pronounced in squalids, which are characterized by a very long population doubling time of a few decades to over a century, making them highly vulnerable to overexploitation (Simpfendorfer and Kyne, 2009). In a recent study (Kousteni and Megalofonou, 2015), the minimum and maximum age recorded for *S. blainville* were 1 and 28 y, respectively, indicating not only the high longevity of the species but also the fact that it enters the trawl fishery from its first year of life.

This study aimed to contribute to filling the gaps in the biology of the longnose spurdog *S. blainville* in the eastern Mediterranean, where little is known about the biology and ecology of elasmobranch species. With this study, a new breeding area for this species in the eastern Mediterranean was identified and the importance of these areas for elasmobranch species was revealed. In addition, length-weight relationship and reproductive biology data were obtained from the individuals caught in the study and important information about the species was revealed.

## Material and Methods

A total of 48 adults and 22 neonates of *S. blainville* samples were collected at the entrance of the Iskenderun Bay from the eastern Mediterranean on 03 April 2024 by a commercial trawler. The fishing area is given in Figure 1 and covers an area of approximately 107 km² (36.203226 N, 35.389892 E; 36.098440 N, 35.512205 E- 36.168022 N, 35.331516 E; 36.058921 N, 35.452596 E). The species were identified by using Kabasakal (2020), and each specimen's total length (to within

0.1 cm) and total weight (to within 0.1 g) were measured. The presence of claspers determined the sex of each specimen.

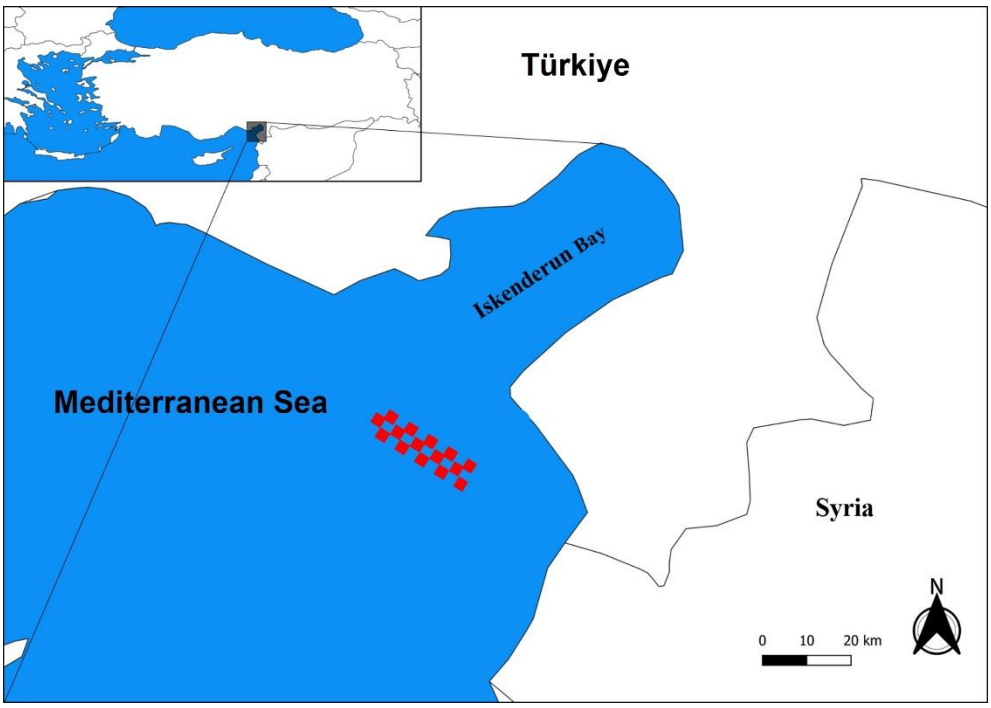


Figure 1. Map of Iskenderun Bay, eastern Mediterranean, and the trawling area where elasmobranch species were caught are shaded in red squares.

The length-weight relationship (LWR) was established following the formula of Ricker (1975):

$W = a \times L^b$

The abbreviations for the formulation parameters are as follows: $W$ is weight in grams, $L$ is the total length in centimetres, $b$ is the length-weight factor and $a$ is a constant. All samples were analysed for the LWR, with separate tests conducted for males and females. Then, the parameters were estimated by linear regression on the transformed equation:

$\log W = \log a + b \log L$

The parameters $a$ and $b$ were calculated using least-squares regression as the coefficient of determination ($R^2$). The significance of the regression analysis was determined using ANOVA (Zar, 1999). A Student's $t$-test was used to ascertain whether the $b$ values obtained from linear regressions were significantly different from the null hypothesis of isometric growth ($H_0$: $b = 3$) using the equation proposed by Sokal and Rohlf (1987).

$t_s = (b - 3) / sb$

In this equation, $t_s$ is the $t$-test value, $b$ is the slope, and $sb$ is the standard error of the slope ($b$).

Microsoft Excel 2016 (Microsoft, Redmond, WA, USA) and SPSS Statistics 19.0 (SPSS Inc., Chicago, IL, USA) were used for statistical analyses.

## Results

A total of 48 adults which are 46 females and 2 males, and 22 neonates of longnose spurdog individuals were found at the commercial trawl operation at the entrance of the Iskenderun Bay from eastern Mediterranean. The photographs and measurements of the samples obtained as a result of the trawling and photographs of these samples speedily taken from the lateral and dorsal lines are given in Figure 2. All the individuals were then immediately sent back to sea.


Figure 2. Lateral (A), dorsal (B), views of longnose spurdog specimens.

A total of 22 neonates were found at the same developmental stages (Figure 3). All of these 22 neonates were in the final developmental stage and their lengths ranged between 15.2-17.8 cm (Figure 4).

Figure 3. Neonates of *Squalus blainville* in their final stage of development.

Figure 4. Dorsal view of the *Squalus blainville* neonates.

The total length range was 68.9 cm to 120.2 cm and the total weight values ranged from 568.2 g to 2010.3 g. The length-weight relationship of *S. blainville* was calculated as $W = 0.0005 \times L^{3.0277}$ ($R^2 = 0.9303$) for all samples except for embryos (Figure 5). The *b* value, which using least-squares regression, was higher than "3" for all individuals indicates that this species exhibited positive allometric growth and was found to be statistically significant ($P < 0.05$; $t_{test} > t_{0.05,N=47} = 1.67$).

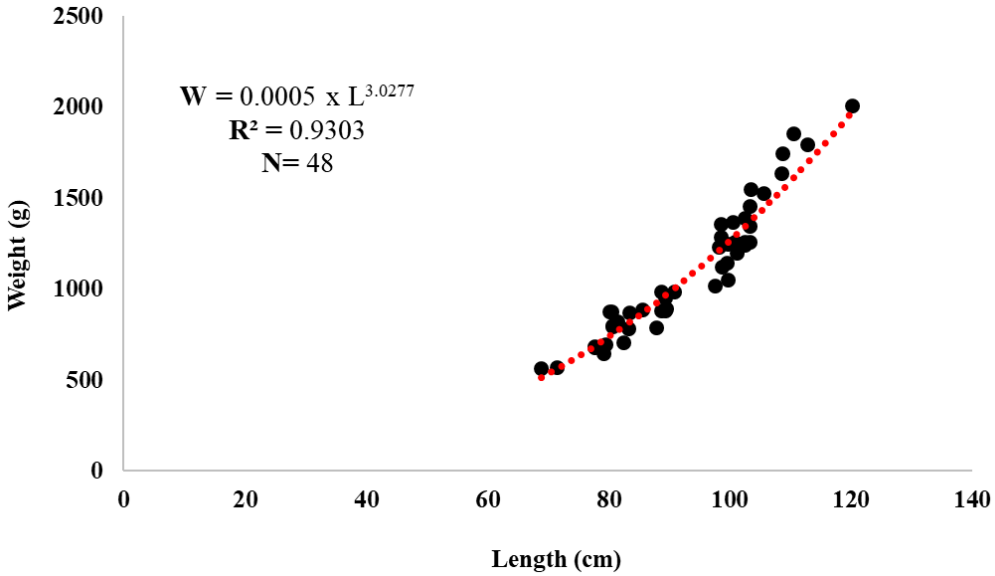


Figure 5. Length-weight relationships of *Squalus blainville* specimens.

## Discussion

Scientific data for chondrichthyans related to life parameters, particularly for the Mediterranean area, are available only for a few common species (Fowler et al., 2005). In Türkiye, limited research has

been conducted on sharks, with a significant portion focusing on distribution and bycatch data only (Yağlıoglu et al., 2015; Başusta et al., 2016; Kabasakal, 2021a,b; Gül et al., 2022; Kabasakal et al., 2023). To date, studies on *S. blainville* length-weight relationships in the Mediterranean Sea are given in Table 1.

Table 1. Length-weight relationships studies on *Squalus blainville* in the Mediterranean Sea.

| References | N | *a* | *b* | $R^2$ | Study Area |
|---|---|---|---|---|---|
| Cannizzaro et al. (1995) | 1038 | 0.0033 | 3.09 | 0.97 | Sicilian Channel |
| Merella et al. (1997) | 27 | 0.0012 | 3.37 | 0.98 | Balearic Islands |
| Pallaoro et al. (2005) | 88 | 0.0035 | 3.06 | 0.96 | Eastern Adriatic Sea |
| İşmen et al. (2007) | 299 | 0.00345 | 3.06 | 0.98 | North Aegean Sea |
| İşmen et al. (2009) | 27 | 0.0030 | 3.07 | 0.98 | North Aegean Sea |
| Bök et al. (2011) | 18 | 0.00004 | 2.48 | 0.95 | Sea of Marmara |
| Marouani et al. (2012) | 232 | 0.003 | 3.1 | 0.86 | Gulf of Gabès |
| Kousteni and Megalofonou (2011) | 292 | 0.00000007 | 3.30 | 0.99 | Eastern Mediterranean |
| Güven et al. (2012) | 177 | 0.0033 | 3.06 | 0.99 | Eastern Mediterranean |
| Eronat and Özaydın (2014) | 308 | 0.0048 | 2.96 | 0.95 | Central Aegean Sea |
| Kousteni and Megalofonou (2015) | 445 | 0.00000007 | 3.32 | 0.99 | Eastern Mediterranean |
| Lteif et al. (2016) | 11 | 0.0819 | 2.89 | 0.82 | Lebanese Marine Water |
| Öztekin et al. (2016) | 14 | 0.0053 | 2.95 | 0.97 | North Aegean Sea |
| Bengil (2022) | 184 | 0.0010 | 3.35 | 0.96 | Levantine Sea |
| Kabasakal et al. (2024) | 28 (F)<br>39 (M) | 0.00002 (F)<br>0.00005 (M) | 3.115 (F)<br>3.816 (M) | 0.79 (F)<br>0.71 (M) | Sea of Marmara |
| This study | 48 | 0.0005 | 3.0277 | 0.93 | Eastern Mediterranean |

*N*, number of samples; *F*, female; *M*, male; *a*, intercept; *b*, slope; $R^2$, coefficient of regression.

The coefficient of determination ($R^2$) for *S. blainville* was observed as 0.9303. The length-weight relationship (LWR) displayed a strong correlation between the length and weight of the specimens. Cannizzaro et al. (1995) reported the $R^2$ value of *S. blainville* at 0.97 in Sicilian Channel. Merella et al. (1997) found of $R^2$ value of *S. blainville* as 0.98 in Balearic Islands. Pallaoro et al. (2005) reported an $R^2$ value of *S. blainville* as 0.96 in the Eastern Adriatic Sea. İşmen et al. (2007; 2009) were found of $R^2$ value of *S. blainville* as 0.98 in the North Aegean Sea. Bök et al. (2011) reported an $R^2$ value of *S. blainville* as 0.95 in the Sea of Marmara. Marouani et al. (2012) found of $R^2$ value of *S. blainville* as 0.98 in Gulf of Gabès. Kousteni and Megalofonou (2011; 2015) reported an $R^2$ value of *S. blainville* as 0.99 in the eastern Mediterranean. Güven et al.

(2012) found of $R^2$ value of *S. blainville* as 0.99 in eastern Mediterranean. Eronat and Özaydın (2014) reported an $R^2$ value of *S. blainville* as 0.95 in the Central Aegean Sea. Lteif et al. (2016) found of $R^2$ value of *S. blainville* as 0.82 in Eastern Mediterranean. Öztekin et al. (2016) reported an $R^2$ value of *S. blainville* as 0.97 in the North Aegean Sea. Bengil (2022) found of $R^2$ value of *S. blainville* as 0.96 in Levantine Sea. Kabasakal et al. (2024) reported $R^2$ value of *S. blainville* as 0.93 in the Sea of Marmara. The results of the study showed a similar correlation to the previous studies. When we compared our study with other studies on *S. blainville*, it was observed that the coefficient of determination ($R^2$) results was different in each study but very close to each other (Table 1). The reason for these differences can be attributed to various factors such as gonad maturity, sex, nutrition, stomach fullness, health and preservation techniques (Turan et al., 2021; Doğdu and Turan, 2024; Uyan et al., 2024).

In our study, the result of the growth coefficient *b* values was found as 3.0277 and it was concluded that the growth type was positive allometric. Cannizzaro et al. (1995) reported the *b* value of *S. blainville* at 3.09 in Sicilian Channel. Merella et al. (1997) found of *b* value of *S. blainville* as 3.37 in Balearic Islands. Pallaoro et al. (2005) reported an *b* value of *S. blainville* as 3.06 in the Eastern Adriatic Sea. İşmen et al. (2007; 2009) found of *b* value of *S. blainville* as 3.06 and 3.07 in the North Aegean Sea, respectively. Bök et al. (2011) reported a *b* value of *S. blainville* as 2.48 in the Sea of Marmara. Marouani et al. (2012) found of *b* value of *S. blainville* as 3.1 in Gulf of Gabès. Kousteni and Megalofonou (2011; 2015) reported a *b* value of *S. blainville* as 3.30 and 3.32 in the eastern Mediterranean, respectively. Güven et al. (2012) found of *b* value of *S. blainville* as 3.06 in eastern Mediterranean. Eronat and Özaydın (2014) reported a *b* value of *S. blainville* as 2.96 in the Central Aegean Sea. Lteif et al. (2016) found of *b* value of *S. blainville* as 2.89 in eastern Mediterranean. Öztekin et al. (2016) reported a *b* value of *S. blainville* as 2.95 in the North Aegean Sea. Bengil (2022) found of *b* value of *S. blainville* as 3.35 in Levantine Sea. Kabasakal et al. (2024) reported an *b* value of *S. blainville* as 3.02 in the Sea of Marmara. The *b* value is directly related to the body shape of fish and may vary with the habitat or diet (Ricker, 1975). A *b* value close to 3 indicates that the body weight of the fish increases in parallel with the growth in length. Our study showed positive allometric growth. However, some previous studies have found negative allometric growth (Bök et al., 2011; Eronat and Özaydın 2014; Lteif et al., 2016; Öztekin et al., 2016). The minor discrepancies in the *b* values can be attributed to a multitude of factors, including variations in environmental conditions, biological parameters, population size and sampling methodologies e.g. (Ricker, 1975; Ergüden and Doğdu, 2020; Doğdu and Turan, 2021).

The presence of nursery areas, small juveniles, and pregnant females is necessary to declare an area as a nursery (Heupel et al., 2007). Heupel et al. (2007) suggested that an area requires three criteria to be identified as a nursery: (1) species are more commonly encountered in the area than other areas (2) species tend to remain or return for extended periods, and (3) the area or habitat is repeatedly used across years. The data obtained in our study and previous studies in the region prove that this region is a breeding area for elasmobranch species (Yağlıoğlu et al., 2015; Başusta et al., 2021; Akyol and Şen, 2022).

In conclusion, our data provide evidence to recognize Iskenderun Bay as a nursery area for longnose spurdog sharks *Squalus blainville*, meeting all the criteria proposed to identify nursery areas

(Castro, 1993; Heupel et al., 2007). These findings constitute the first documented evidence of a longnose spurdog shark nursery area in the Iskenderun Bay in Turkish marine waters.

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**Conflict of Interest**

The authors declare that for this article they have no actual, potential or perceived conflict of interest.

**Author Contributions**

C.T., S.A.D. and A.S. performed all the experiments and drafted the main manuscript text. Authors reviewed and approved the final version of the manuscript.

**Ethical Approval Statements**

No ethics committee permissions are required for this study.

**Data Availability**

The data used in the present study are available upon request from the corresponding author.

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