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First Data on Distribution and Biology of *Squalus blainvillei* (Risso, 1826) from the Eastern Mediterranean Sea

by

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Abstract

Longnose spurdog *Squalus blainvillei* was sampled along the Greek coasts of the northern Ionian Sea during September-October 1999 and April 2000. A professional motor powered vessel, equipped with a bottom trawl-net with stretched mesh size of 20 mm in the cod-end, was used. The hauls were taken, from down to dusk, between 300 and 1200 m of depth.

A total of 733 individuals were collected between 312 and 788 m. Most of them were distributed in the depth range of 300-500 m in both surveys. The percentage of females on the whole sampled population was 47.5% in September-October and 54.5% in April.

A wide size-range, up to maximum total lengths of 785 mm in females and 664 mm in males, was found. Specimens smaller than 300 mm were found in both September-October and April as well as mature individuals of both sexes. The smallest mature females and males measured 580 and 412 mm respectively. The size at first maturity was 601 mm in females. At length greater than 510 mm all males were mature. The percentages of ripe females were 52.8% in September and 30.3% in April. The length-weight relationship was performed in both females and males.

Introduction

Squalus blainvillei (Risso, 1826) is an ovoviviparous demersal shark distributed in the whole Mediterranean down to about 700 m (Whitehead *et al*., 1984). Studies on its sistematics and biology have been mostly carried out in the Western-Central side of this basin (Ledoux, 1970; Quignard, 1971; Capapé, 1975; Cannizzaro *et al*., 1995) while in the Eastern side, although its occurrence was recorded since long time (Ondrias, 1971; Papaconstantinou & Tortonese, 1980; Papaconstantinou, 1986), the knowledge on its population biology is still rather scanty and completely lacking in some areas, such as the Ionian Sea. In this basin, along the Italian coasts, although the demersal resources have been investigated for a long time (e.g. Matarrese *et al*., 1996) *S. blainvillei* was never found. On the contrary, along the Greek coasts of the Ionian Sea, where the commercial fishing is only carried out up to depths of 400 m, the longnose spurdog was recently found to be abundant during some surveys carried out with the aim of studing deep-water shrimps *Aristeus antennatus* and *Aristaeomorpha foliacea*.

The increasing investigation of the deep-sea resources (down to 800 m) in the Eastern Mediterranean and the fact that sharks are species particularly vulnerable to the overexploitation because of their k-selected life-history strategy (Stevens *et al*., 2000) stimulated the authors to collect basic biological information on elasmobranch species, among which *S. blainvillei*. The aim of this paper is to provide preliminary information on the distribution, reproduction and population structure of *S. blainvillei* in the Eastern Ionian Sea.

Materials and Methods

Data were collected during two trawl surveys (September-October 1999 and April 2000) carried out in the Eastern Ionian Sea off Northern Greece (Eastern Mediterranean). The study area is between Kerkira and Zakintos. Here trawl fishing only occurs as far as 400-500 m in depth (Fig. 1).

The sampling was carried out between 300 and 1200 m using a commercial vessel. It was equipped with a nylon otter-trawl net with 40 mm stretched mesh (20 mm side) in the cod-end. The horizontal and vertical net openings were measured for each depth by means of the SCANMAR sonar system. The vessel speed, measured using GPS, was maintained at 2.5-2.8 knots. Sampling was restricted to daylight hours and the hauls lasted one hour each on average.

For each specimen of *S. blainvillei* the total length (TL) to the nearest mm and the weight (g) were measured. Sex and maturity stage of gonads were determined macroscopically according to Stehmann (1998). For males, clasper length (CL) was taken from insertion to tip, to the nearest mm. The relationship between the length of claspers and total length was computed by means of linear regression.

Statistical differences between changes in the number of females and males with survey were determined using the G-test (Sokal & Rohlf, 1969). The length-frequency distributions (20 mm size classes) of the whole sampled population by depth and of females and males for each survey were performed. The length/weight relationship for females and males was computed according to the power curve function $W = a{*}TL^b$ (by using Ln trasformation) where *a* is the intersect and *b* the allometric coefficient (or slope). The linear regression equations for the two sexes were compared statistically using the Chow-test (Koutsoyiannis, 1977). This test verifies if there is a significant difference between both the slope (b) and the intersect (a) of two regression lines estimated from two different samples.

Considering that the proportion of immature individuals in the sampled population might vary monthly, the percentage of ripe females and males in each survey was computed starting from the size at first maturity. This size, considered as the size at which 50% of the individuals in the population are mature, was determined for females, for the pooled data of September-October and April, using the logistic curve showing the percentage of mature individuals by size class.

Results

S. blainvillei was found between 312 and 788 m of depth, although most of the specimens were sampled in the 300-500 m bathymetric stratum (Fig. 2). A wide size-range with several modal components was shown in both sexes and surveys. The maximum total lengths in females and males were 785 mm and 664 mm respectively (Fig. 3). Small specimens (<300 mm) were collected in both surveys. The smallest individuals of both sexes measured 190 mm TL; they were without external yolk sac.

Weight of females ranged from 47 to 2666 g, and males weighed between 38 and 970 g. The size-weight relationship was computed for the total length (TL) expressed in millimeters and body weight (W) in grams. The functions were as follows:

Females: $W = 0.000001018{*}CL^{3.25}$, $r = 0.994$, $n = 112$
Males: $W = 0.000001746{*}CL^{3.16}$, $r = 0.986$, $n = 67$

The Chow-test gave significant differences between the length-weight relationships of the two sexes ($F^* = 3.66$, $p<0.01$).

The sex ratio was around 50% in both September-October and April. There were no significant differences between changes in the number of females and males with cruise ($G_1 = 2.95$, $p>0.05$).

The smallest mature females and males measured 580 and 412 mm respectively (Fig. 4-5). The size at first maturity in females was 601 mm (Fig. 6). At length greater than 510 mm all males were mature. The percentages of ripe females were 97.1% in September-October and 100% in April. The percentages of mature males were 60.2% and 33.2% in the former and latter survey respectively. For 5 and 6 stage females, uteri contained from 2 to 6 embryos. Their size ranged from 45 of 220mm TL.

The relationship between clasper length and total length is given by the equation: CL= -26.79 + 0.14 TL; r^2=0.88; n=62. The linear regression plot, with indication of immature and mature males, is shown in Fig. 7 (a-c). Although a significant regression was computed, two clusters appear to be evident for the whole process (Fig. 7a): the length of claspers increases with size in immature specimens (Fig. 7b), while it may show similar values for different sizes in mature individuals (Fig. 7c).

Discussion

The depth range where *S. blainvillei* was caught is in agreement with other observations in Mediterranean (Quignard, 1971; Papaconstantinou and Tsimenidis, 1979; Cannizzaro *et al*., 1995). Although sex and size segregation in the shark populations have long been known as a phenomenon to avoid cannibalism both for pelagic and demersal species (e.g. Springer, 1967), the present study would indicate that the longnose spurdog is mostly distributed between 300-500 m without such segregations. Reproductive adult were found together with juveniles in the same samples. Cannizzaro *et al*. (1995) found both juveniles and adults within 565 m in depth. No data on cannibalism was reported for this species by Quignard (1971) and Capapé (1975).

Although the largest embryos measured up to 220 mm TL, the size at birth may be around 190 mm, confirming Ranzi (1932) observations. Cannizzaro *et al*. (1995) reported that the yolk sac is always present up to lengths of about 200 mm. Sizes at maturity for sharks examined in this study are in agreement with previous studies (Quignard, 1971; Cannizzaro *et al*, 1995). The development process of claspers confirms male maturation. The litter size was also in agreement with Quignard (1971).

Since only two surveys were considered in this study, it is not possible to make conclusions about the seasonal cycle of reproduction. However, the finding of mature specimens, both females and males, and young-of-the-year in both September-October and April would confirm a prolonged reproductive period during the year (Quignard, 1971; Cannizzaro *et al*, 1995). Continuous reproductive activity is known for other species of deep-sea sharks, both in Mediterranean (e.g. Tursi *et al*., 1993) and Ocean (e.g. Yano and Tanaka, 1988; Girard & Du Buit, 1999). Considering the vulnerability of the sharks to overfishing (e.g. Stevens *et al*., 2000), such a prolonged reproduction throughout the year could make up for the late maturity and low fecudity as far as the survival strategy of the species is concerned. However, the distribution of both juveniles and mature individuals at same depths where exploitation on deep-water shrimps might start off Greece, should imply management strategies to mitigate the undesirable effects of *S. blainvillei* overexploitation.

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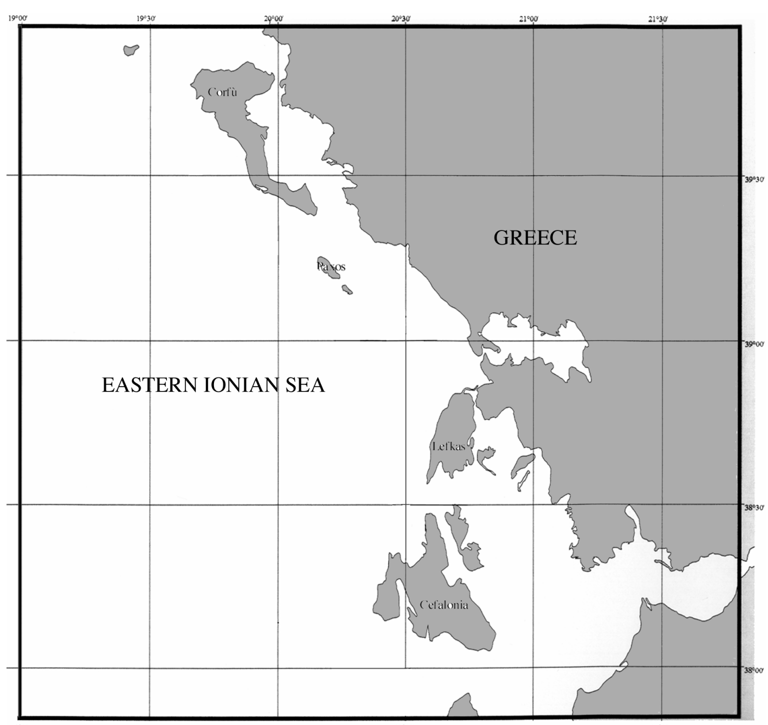

Fig. 1 – Map of the investigated area in the eastern Ionian Sea (Mediterranean Sea).

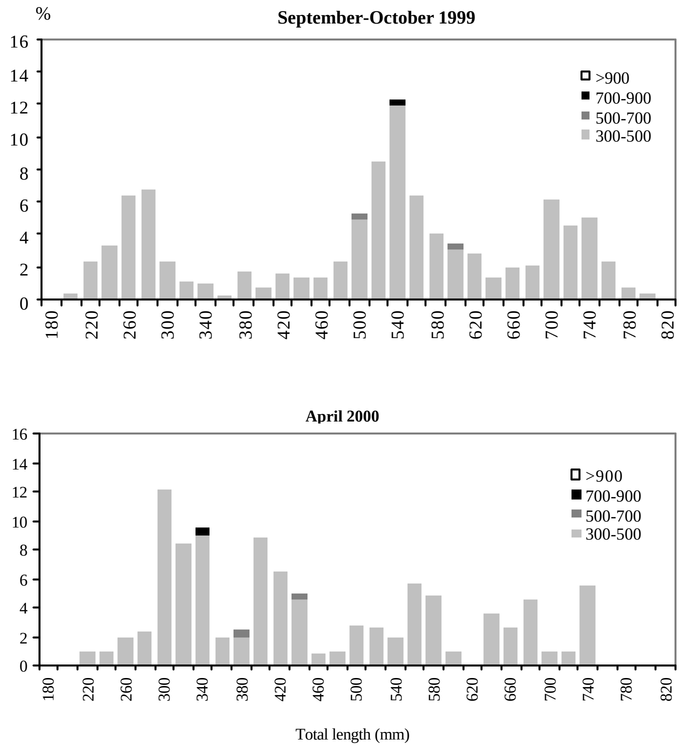

Fig. 2 - Length-frequency distribution, by depth, of *Squalus blainvillei* caugth along Greek coasts of the northern Ionian Sea during September-October 1999 and April 2000.

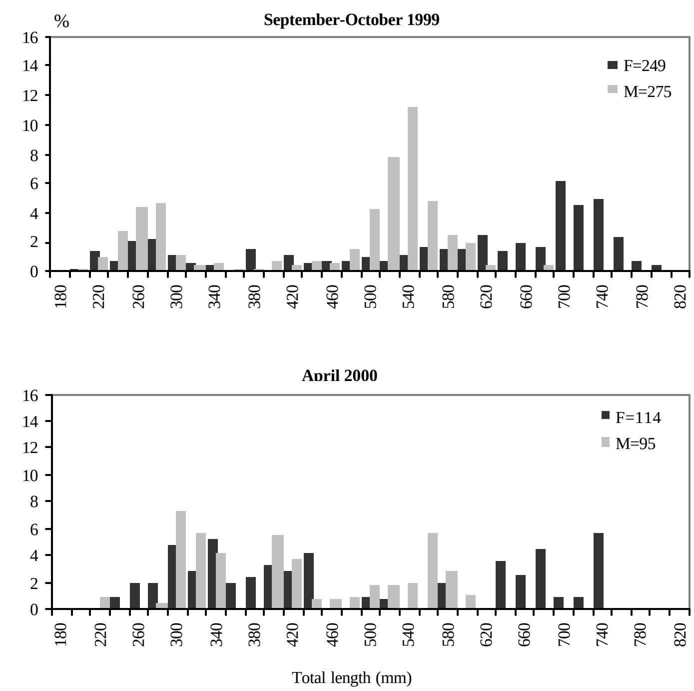

Fig. 3 - Length-frequency distribution, by sex, of *Squalus blainvillei* caugth along Greek coasts of the northern Ionian Sea during September-October 1999 and April 2000.

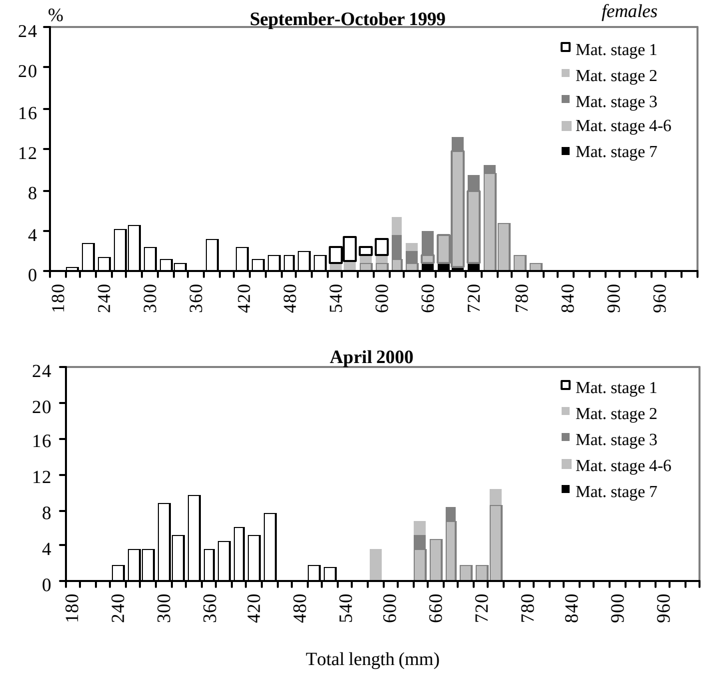

Fig. 4 - Length-frequency distributions by maturity stage of gonads of *Squalus blainvillei* females caugth along Greek coasts of the northern Ionian Sea during September-October 1999 and April 2000.

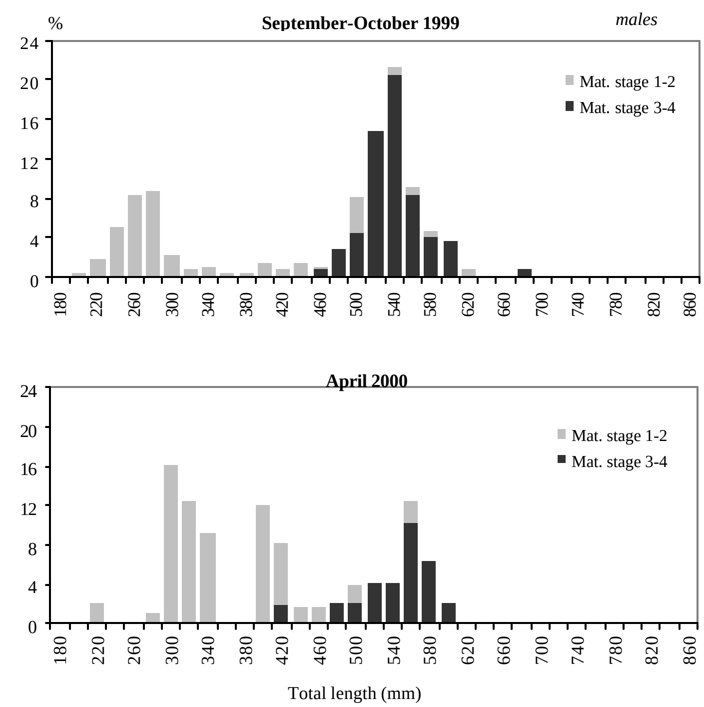

Fig. 5 - Length-frequency distributions by maturity stage of gonads of *Squalus blainvillei* males caugth along Greek coasts of the northern Ionian Sea during September-October 1999 and April 2000.

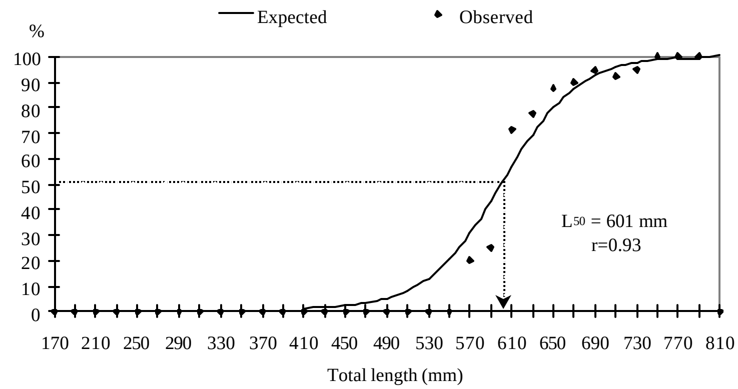

Fig. 6 - Expected and observed percentage by size of females of *Squalus blainvillei* caugth along Greek coasts of the northern Ionian Sea during September-October 1999 and April 2000, with indication of size at first maturity (L_{50}).

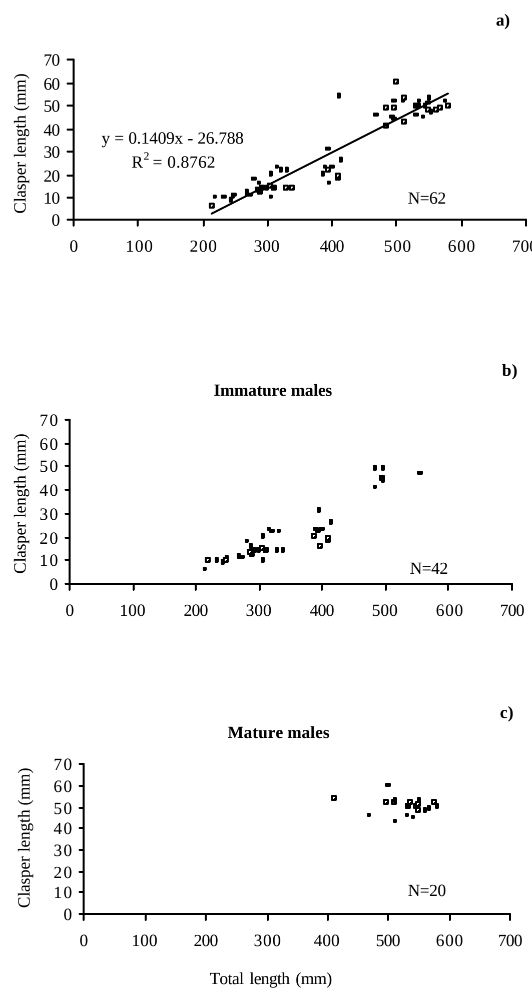

Fig. 7 - The linear regression plot: a) between clasper length and total length of *Squalus blainvillei* ; b) immature males; c) mature males.