

## Biological Aspects of Black Scorpionfish, *Scorpaena porcus* (Linnaeus, 1758) in the Western Coast of Libya

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### Abstract

Growth, age and reproduction of the black scorpion fish, *Scorpaena porcus* have been studied. A total of 551 fish were collected from western coast of Libya from March 2012 to April 2013. The total length ranged from 10.2 to 24.8 cm and the total weight ranged from 25.7 to 289.6 gm. The ratio of females to males was 3.8:1. The length weight relationship was negative allometric,  $W = 0.031 L^{2.84}$  ( $R^2 = 0.92$ ) for the combined sexes. The age ranged between 1 to 6 years for all fish, whereas the dominant age was 1<sup>st</sup> year. The Von Bertalanffy growth equation was fitted on basis of mean length-at-age  $L_{\infty} = 23.96$  cm,  $k = 0.678 \text{ year}^{-1}$ , and  $t_0 = 0.058$  year. The spawning time extend four months, from June to September. This study has presented some important information on *S. porcus* in the Libyan water that can provide a contribution to other studies such as stocks assessment, as well as giving some biological information.

Keywords: Libya; Reproductive; South Mediterranean; Black scorpionfish; *Scorpaena porcus*.

### المستخلص

تم دراسة النمو والعمر والتكاثر لسمكة الشكورفو *Scorpaena porcus*. بالشاطي الغربي الليبي في الفترة من مارس 2012 إلى إبريل 2013، وجمعت لهذا الغرض 551 سمكة، وتراوح الأطوال لهذه المجموعة من 10.20 إلى 24.80 سم بينما كانت الأوزان من 25.7 إلى 289.6 جم. تبين من النتائج أن نسبة الإناث أعلى من الذكور 3.8:1. وكان النمو لومتري سالب لكل أفراد هذه السمكة، كما تراوح العمر ما بين السنة و 6 سنوات، وكان أغلب الأفراد عند عمر سنة. أوضحت معادلة Von Bertalanffy لحساب النمو أن  $L_{\infty} = 23.96$  سم، وكان معامل  $k = 0.678$  أما  $t_0$  فكانت = 0.058 سنة. نستنتج من الدراسة أن موسم التكاثر لهذا النوع كان في الفترة من يونيو إلى سبتمبر. تساهم هذه الدراسة في وضع أسس للمعلومات البيولوجية لهذه السمكة في المياه الليبية ودعم لدراسات أخرى كتحقيق المخزون.

## Introduction

Scorpaeniformes include almost 1000 teleostspecies widely distributed in the temperate and tropical sea. The family Scorpaenidae is a commercially important fish that is distributed throughout the Mediterranean Sea and also in the Eastern Atlantic from the British Isles to Morocco, but rare to Senegal, the Azores, and the Canaries (Nelson, 1994; Johnson, 1993). *S. porcus* feeds on Phycophyta, Spermatophyta, Polychaeta, Mollusca, Crustacea and Pisces (Pallaoro and Jardas, 1991). Several Studies were carried out on this species that highlighted the growth, and some biological aspects in the Mediterranean Sea, such as, Bradai and Bouin (1988, 1990) in Gabes Gulf, Morey et al. (2003) in the eastern Mediterranean and Akalin et al. (2011) in İzmir. Also Goncalves et al., (1997) studied its growth in the north of Portugal coast, Moutopoulos and Stergiou (2002) in Greece coast, Ferri et al. (2010) on the eastern Adriatic Sea.

Celik and Bircan (2004) studied the reproductive characters of this species in Dardanelles Sea. Libyan studies about this species included the ecological aspects of the family Scorpenidae along the Libyan coast (Assughayer et al., 2008), whereas Shakman and Kinzelbach (2007) recorded it as an economic species in the Libyan coast. There is no comprehensive study about this species in Libya. Therefore, the present study aims to provide new findings on age, growth and reproduction of *S. porcus* along the western Libyan coast of the south Mediterranean Sea.

## Material and Methods

A total of 551 fish of *S. porcus* were collected, directly from fishermen catches in the western area of Libya, in the period between March 2012 to April 2013. Fish samples were transferred to the laboratory and total length (T.L) was measured in the natural body position to the nearest centimeter. Total weight (W) and gonad weight (Wg) were measured to the nearest 0.01 g. Sex was determined macroscopically according to the shape and appearance of the gonads. Maturity stages were assessed according to Bariche et al. (2003); stage I immature, stage II beginning of maturation (resting), stage III ripe, stage IV spawning, and stage V spent. Otolith pairs were removed for each length group, cleaned, and stored in dry conditions. The female to male (F:M) ratio was calculated using only mature individuals. The relationship between length and weight was established as  $W = aL^b$ , where W is total body weight (g), L is total length (cm), and a and b are coefficients (Petrakis and Stergiou, 1995). The parameters a and b of the length weight relationship were estimated according to linear regression analysis of log-transformed data. The degree of association between variables was calculated by the determination coefficient ( $R^2$ ). The otoliths covering all size classes sampled were used to determine age. The latter was determined according to Shakman et al., (2008). Age estimations were made by 2 independent readers. Growth was analyzed by fitting the von Bertalanffy growth function to size-at-age data using standard nonlinear optimization methods (Sparre and Venema, 1998). The function  $L_t = L_\infty [1 - e^{-k(t-t_0)}]$  was applied to the data, where  $L_t$  is the fish length (cm) at time t (year),  $L_\infty$  is the asymptotic length (cm), k is the growth coefficient ( $\text{year}^{-1}$ ), and  $t_0$  (year) is the hypothetical time at which the length is equal to zero. The spawning

period was established based on monthly variation in the gonadosomatic index (gI) using the equation  $gI = \frac{Wg}{W} \times 100$ , where  $Wg$  is the gonad weight (g) and  $W$  is the total weight (g) of the fish (Shakman et al., 2008).

## Results

Length-frequency distribution of *S. porcus* was given in Fig. 1. The dominant length classes were 15.0 -15.9 cm, but the minimum value was 10.1 cm and the maximum 24.8 cm. The length of 551 individuals of *S. porcus* ranged from 10.2 to 24.8 cm (mean=16.4) and the weight ranged from 25.7 to 289.6 g (mean=94.3 g). Length-weight relationship was expressed as  $W = 0.031 L^{2.84}$  ( $R^2 = 0.92$ ) (Fig. 2). The exponent  $b$  of the total length  $\pm$  weight relationship indicates negative allometric growth ( $b=2.84$ ). The correlation coefficient “ $R^2$ ” which measures the association between length-weight regression parameters;  $R^2$ -values was greater than 0.80 (0.92).

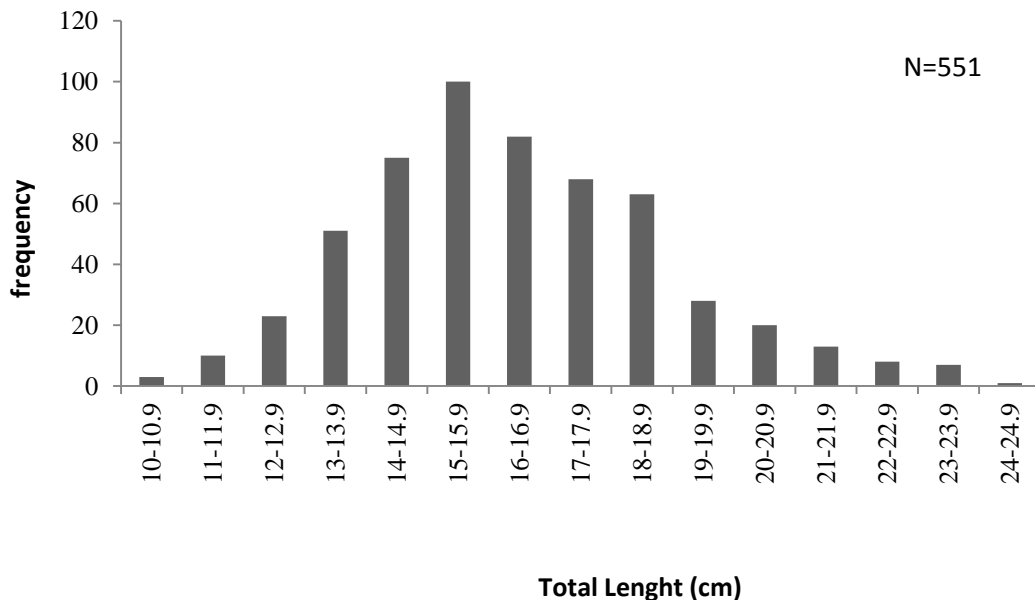


Fig. 1. Length-frequency distribution of *S. porcus* in the western coast of Libya.

The age determined by otolith (Fig. 3). The classes age of *S. porcus* ranged from 1 to VI, but the most dominant age class was I. Growth parameters calculated by von Bertalanffy were  $L_{\infty}=23.96$  cm,  $K:0.678$  per/year and  $t_0=0.058$  year (Fig. 4). The sex ratio was statistically highly significant (3.8:1) (Fig. 5).

Monthly variations in macroscopic maturity stages of male (Fig. 6a) and female (Fig. 6b) displayed synchronicity. Stage IV is absent in males because it merged with stage V as one stage. *S. porcus* spawn from April to September; the females began the

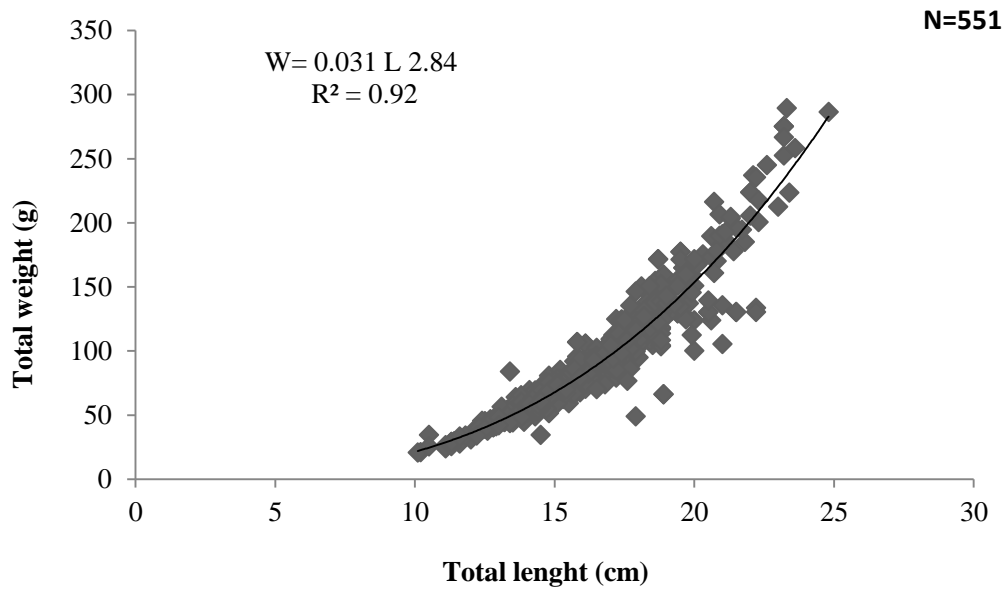


Fig. 2. The length-weight relationship of *S. procus* in the western coast of Libya.

ripe stage (stage III) before males, whereas it extends in females from March to June, but from June and September in males. Immature male (stage I) was exhibited monthly, except on April, also, resting stage (II) present monthly, but the maximum values were on March and April (~100%). Spent stage (V), however, extends from October to December. In females, resting stage was exhibited at all months except during spawning period and the dominant stages were IV and V (Fig. 6b).

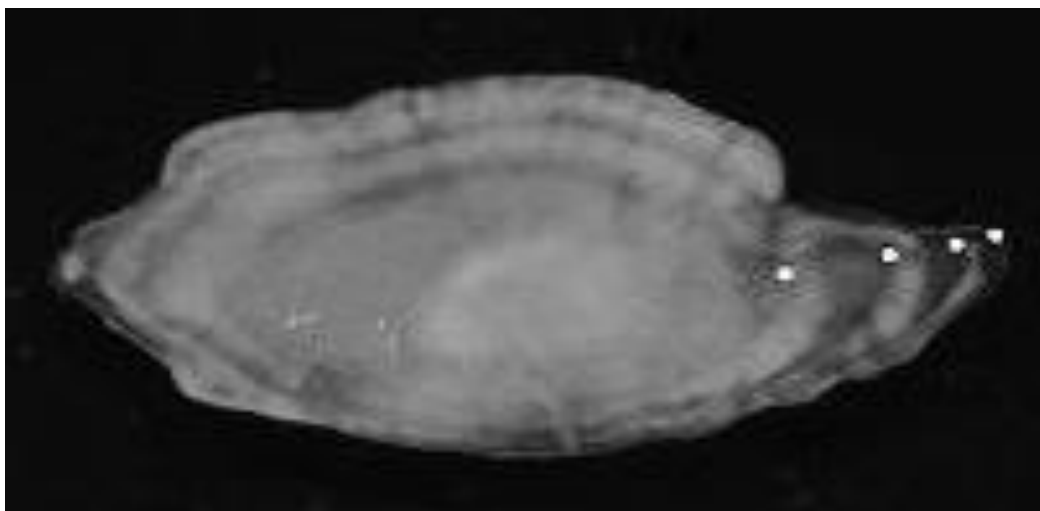


Fig. 3. The otolith of *S. procus* in the western coast of Libya.

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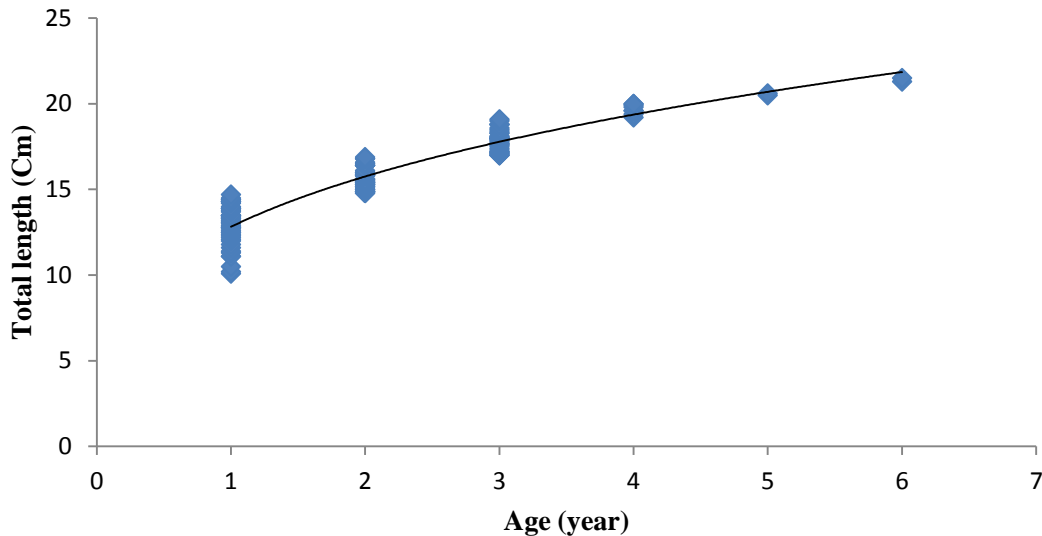


Fig. 4. Von Bertalanffy growth curve of *S. porcus* in the western coast of Libya.

Gonadosomatic index (gI) for all individuals are shown in Figure 7. It illustrates that spawning extends between June and September, and observed to the gonadosomatic index increased from June and peaked in August, and then declined until December.

The range of total length of *S. porcus* was 10.2-24.8 cm but some differences were observed in other studies; in the black sea it ranged between 4.6 to 31.7 cm (Demirhan and Can, 2009) and in the Aegean Sea it ranged between 7.0 to 40.5 cm (Petrakis and Stergiou, 1995). Moutopoulos and Stergiou (2002), however, reported that the maximum length was 26.0 cm. Also, Dulcic and Kraljevic (1996) reported that the maximum length was 27.5 cm. The likely reasons for these differences is the use of different sampling instruments (trawl net, gill net... etc.), collection of samples from different areas, depths, geographic locations, associated environmental conditions and food diversity. The present study conforms to Dulcic and Kraljevic (1996) and Matic – Skoko et al. (2006).

The length-weight relationship is a practical index of the condition of fish. In fisheries studies, the condition factor is an essential biological parameter needed to understand the suitability of the environment for good living of fish (LeCren, 1951). Moreover, it is very important for growth study, as can be seen on Figure 3b (value was 2.84). A value of 3 indicates that the fish grow isometrically; but less or more than 3 indicate positive or negative allometric growth (Tesch, 1971). The present study mentions that growth of *S. porcus* is negative allometric (b value close to 3). This result agrees with Demirhan and Can (2007 and 2009) in southern eastern Black Sea, Petrakis and Stergiou (1995); Moutopoulos and Stergiou (2002); Akalin et al. (2011) in Turkey, and Valle et al. (2003) in Mediterranean Sea. Conversely, it conflicts with Bilgin and Celik (2009); may be due to maturation, spawning period, environmental conditions and food availability (Weatherley and Gill, 1987; Wootton, 1990).

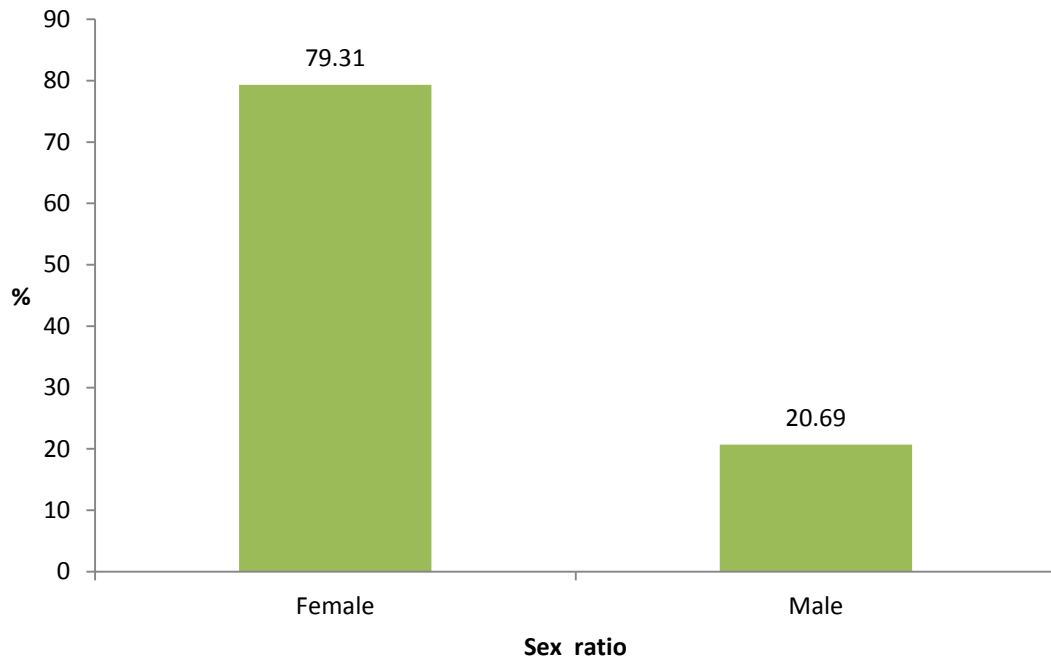


Fig. 5. Sex ratio of *S. porcus* in the western coast of Libya.

### Discussion

The age of the black scorpion fish ranged from 1 to 6 years, which is similar with those reported by other researchers (Bradia and Bouin, 1988; Koca, 2002; Demirhan and Can, 2009; La Mesa et al., 2010) and differ with other studies, wherefrom, the maximum age was eight years (Bilgin and Celik, 2009; Scarcella et al., 2011), and eleven years (Jardas and Pallaoro, 1992). Perhaps, the reasons were geographic location, mortality, genetic variations and ecological conditions (Dutka-Gianelli and Murie, 2008). Von Bertalanffy growth parameters of *S. porcus* showed constants  $L_{\infty}=23.96$  cm,  $k = 0.678 \text{ year}^{-1}$ ,  $t_0= 0.058\text{year}$ . This result conflicts with Matic-Skoko et al. (2006) in Adriatic Sea, they found constant  $L_{\infty}= 68.20\text{cm}$ ,  $K = 0.084\text{year}^{-1}$ ,  $t_0= 1.378\text{year}$ . Taylor (1958) mentioned that the growth variation is affected by temperature difference.

The sex ratio contrasts with the study of Bilgin and Celik (2009) (1:1.36), Demirhan and Can (2009)(1:1.6) in the Black Sea and Ferri et al., (2010)(1:1) in Adriatic Sea. On the other hand, the male of *S. porcus* was predominating in some studies (Kaim-Malka and Jacob, 1985; Koca, 2002; Celik and Bircan, 2004). These variations among previous reports and this study are due to mortality, reproduction, sex activity (Motos and Uriarte, 1991), depths, study area (Pashkov et al., 1999), local isolation (Wearmouth and Sims, 2008), physiological and physical factors and habitat ethology

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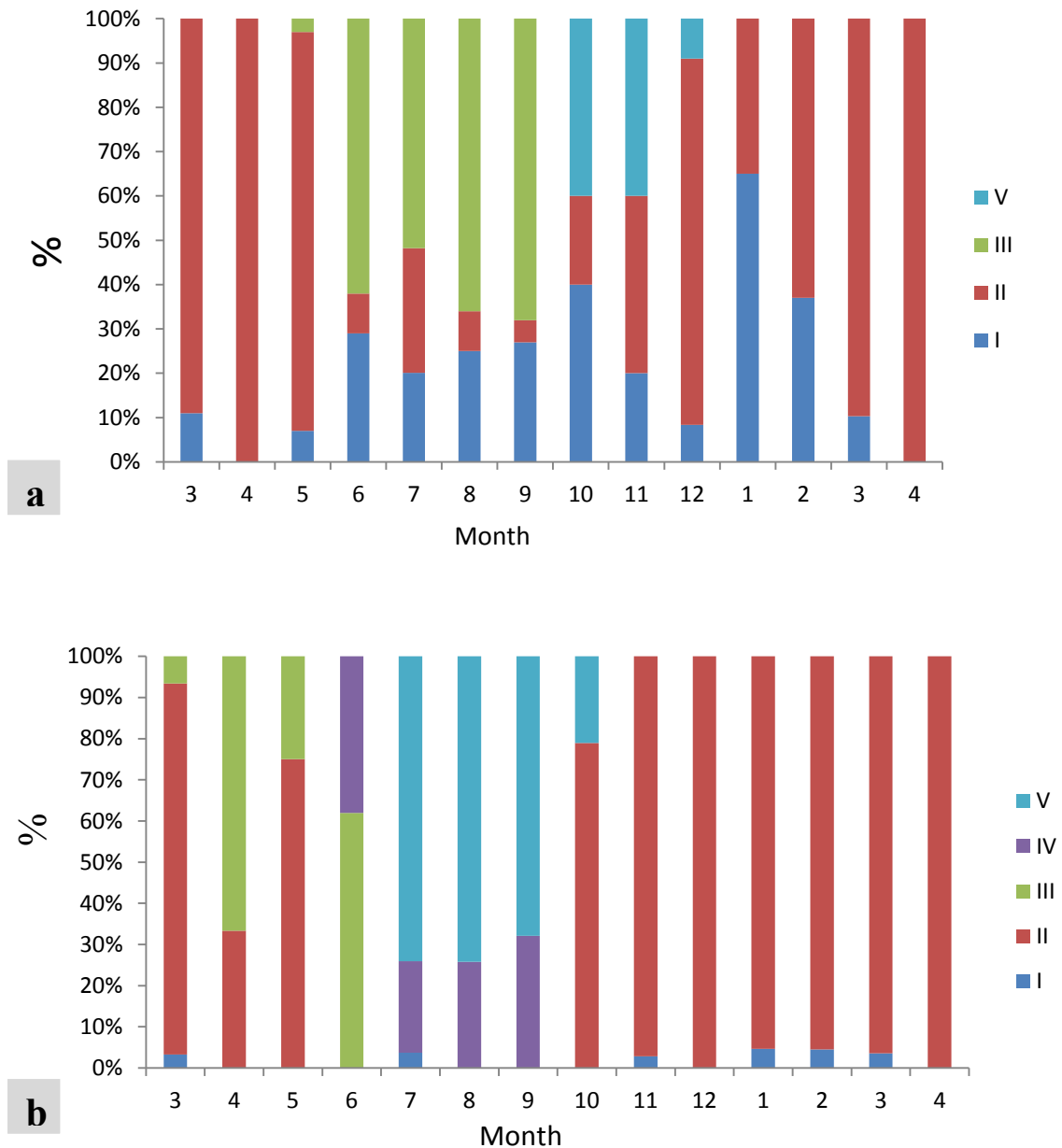


Fig. 6. The maturity stages of *S. porcus* (a) male and (b) female in Tripoli coast (I=immature, II=mature, III=ripe, IV=spawning and V=spent).

(Bilgin and Celik, 2009). Also, difference in sex ration as function of size is explained by different growth parameters and migratory behaviors of males and females of the species (Turner et al., 1983; Moreno and Morales-Nin, 2003).

From gonadosomatic index (gI) and maturity stages, the spawning period of *S. porcus* was between June to September, while the immature stages were observed during autumn and winter but started to mature on summer. The spawning process proceeds in female than in male. The present result agrees with other studies in the Mediterranean Sea (Bradai and Bouain, 1990), Marmara Sea (Ünsal and Oral, 1996)

and Black Sea (Celik and Bircan, 2004; Bilgin and Celik, 2009). This study covered part of important biological information about this important species in the Libyan coast which serves the specialists on local, regional and international level in setting programs and laws.

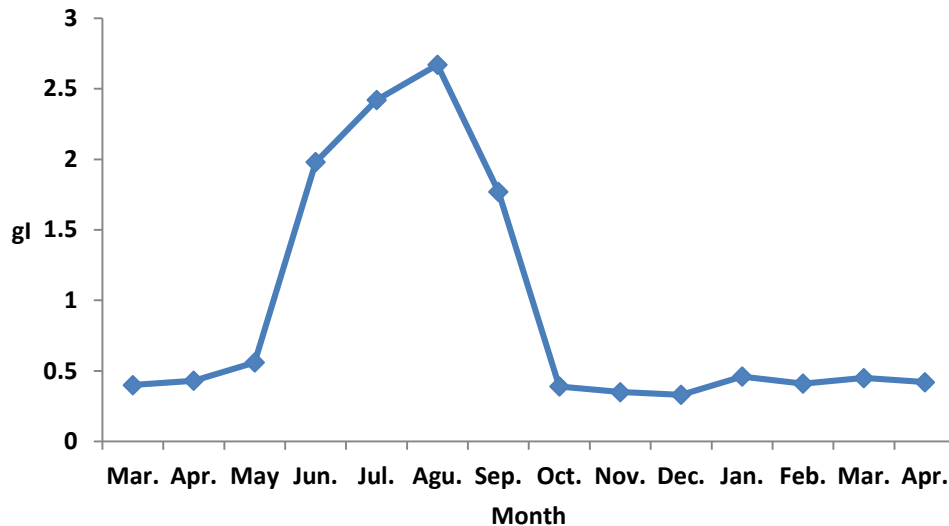


Fig. 7. Gonadosomatic index (gI) of *S. proculus* in the western coast of Libya.

### Acknowledgements

We would like to thank the fishermen and the fishermen's Union for their collaboration with us.

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