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Length-Weight Relationships, Reproduction, Hepatosomatic Index of The Lesser Spotted Catshark, *Scyliorhinus canicula* [L.] The Sea of Marmara, Turkey

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Abstract

Some biological aspects of 91 lesser spotted catshark Scyliorhinus canicula [L.] were examined. The samples were caught with trawl hauls from Bandırma Bay in the years of 2013-2014. Total lenghts of fishes ranged from 18.0-47.4 cm while their weights ranged from 28.78-583.78 g. It was observed that lenght-weight increased allometrically. As the overall sex ratio [male and female] was 1.12:1, it was not found statistically significant [p>0.05]. The mature females were determined to spawn successively at least two eggs each batch. HSI values were estimated not to have significant differences between males and females [P>0.05].

Keywords: *Bandırma Bay, Scyliorhinus canicula, growth, sex ratio.*

Marmara Denizi'nde benekli kedi balığı, *Scyliorhinus canicula* [L.]'nın hepatosomatik indeksi, üremesi, boy-ağırlık ilişkisi

Özet

91 benekli kedi balığı, Scyliorhinus canicula (L.)'nın bazı biyolojik özellikleri incelenmiştir. Örnekler 2013-2014 yıllarında Bandırma Körfezi'nden trol çekimleri ile yakalanmıştır. Balıkların toplam boyları 18,0-47,4 cm, ağırlıkları ise 28,78-583,78 gr. arasında olup, boy-ağırlık ilişkisi allometrik olarak arttığı gözlenmiştir. Eşey oranı 1.12:1 olup, istatistiksel olarak önemli bulunmamıştır (p>0.05). Olgun dişilerin her

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batında ardı ardına en az iki yumurta bıraktıkları belirlenmiştir. Hepato-somatik değerlerinin erkek ve dişiler arasında önemli farklılıklara sahip olmadığı hesaplanmıştır [p>0.05].

Anahtar kelimeler: *Bandırma Körfezi, Scyliorhinus canicula, büyüme, eşey oranı.*

1. Introduction

The lesser spotted-catshark is most common small shark inhabiting particularly over sandy or muddy bottoms at about 30-110 m depth according to Fishbase [1]. is distrubuted in the Mediterranean and the Atlantic [2]. It is oviparous, with a single egg laid per oviduct at a time [3]. Capape et al. [4] pointed out maturity, reproduction of small-spotted catshark from the northern coast of Tunisia. In Turkish coast, previous studies involved morphology [5], distribution and biology [6]. Despite *S.canicula* is the the most abundant shark in Turkey, it has never had a high commercial value [6, 7]. Although the more recent list of elasmobranch species from Turkish Seas has included a total of 28 confirmed species [8, 9], the information on the distribution, bio-ecological aspects and population structures of these species are stil scarce.

The aim of the present paper was to study growth, reproduction, and hepatosomatic index of this species in Bandırma Bay.

2. Material and methods

Trawling was done only during daytime at depths ranging from 45 to 60 m Bandırma Bay [The Sea of Marmara] [40°25'3''N 28°2'22''E] monthly between October 2013 and April 2014. Duration of hauls was about 2 hours with a speed of 2 miles per hour. The trawl was equipped with a 22 mm streched mesh size at the cod-end.

In this study, A total of 48 females and 43 males were examined. Total length [TL] and total weight [W] of each fish were measured to the nearest 0.5 cm and 0.1 g., respectively. Dissected parts [liver and gonad weight] also weighed to the nearest 0.01 g. For length and weight frequency distributions, 0.5 cm and 50.0 g. class intervals were carried out. The length-weight relationship was estimated by the equation: $W=a^{*}L^{b}$, where W is the weight in grams, TL the total length in cm, b the growth exponent factor, and a is a constant [y-intercept] [10].

The gonads were macroscopically examined to determine the sex and reproductive stage according to Capapé *et al.* [11] and Rodriguez-Cabello *et al.* [12]. Sex ratio was analyzed [on the basis of macroscopic classification]. In this study, size at first sexual maturity [L_{50}] was defined as the size class at which 50% of individuals are mature [10].

Physiological condition and fish stoutness were determined from the hepatosomatic index [HSI%]. Hepatosomatic index HSI=[liver weight/gutted weight]×100] estimates the relative size of the liver to body weight [13].

3. Results

3.1. Length–frequency distribution

Males ranged from 18.0 to 44.50 cm, whilst the range of for females 21.0-47.4 cm TL. Modal length groups were 25.0–30.0 cm, which represents 39.5% and 33.3% of the total number of specimens, respectively (Figure 1).

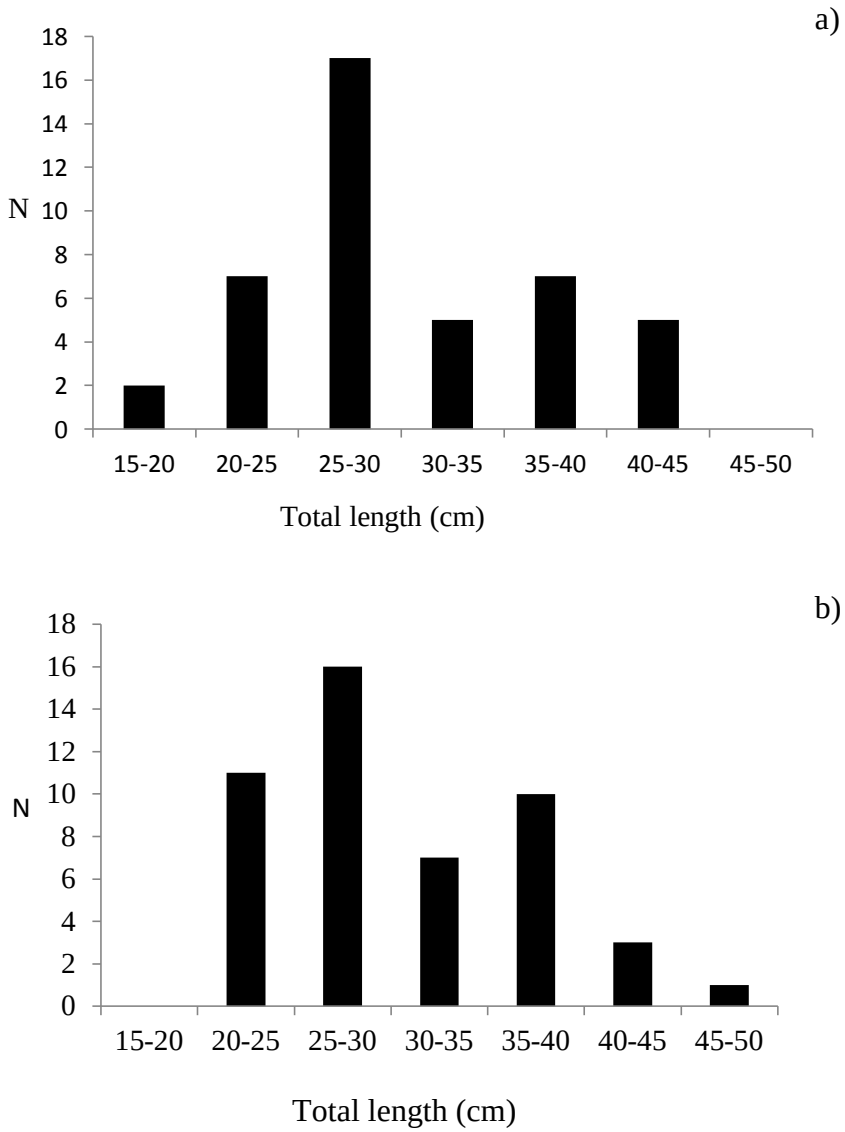

Figure 1. Length frequency distribution of Scyliorhinus canicula in Bandırma Bay a) male, and b) female.

3.2. Weight–frequency distribution

Total weights ranged from 28.78-583.78 g for males whilst the range for females 42.55-524.70 g. Differences in the mean length and weight values were not statistically significant between sexes. Modal weight groups were 75.00–225.00, 90.00-140.00 g. which represents 46.51% and 20.83% of the total number of specimens, respectively (Figure 2).

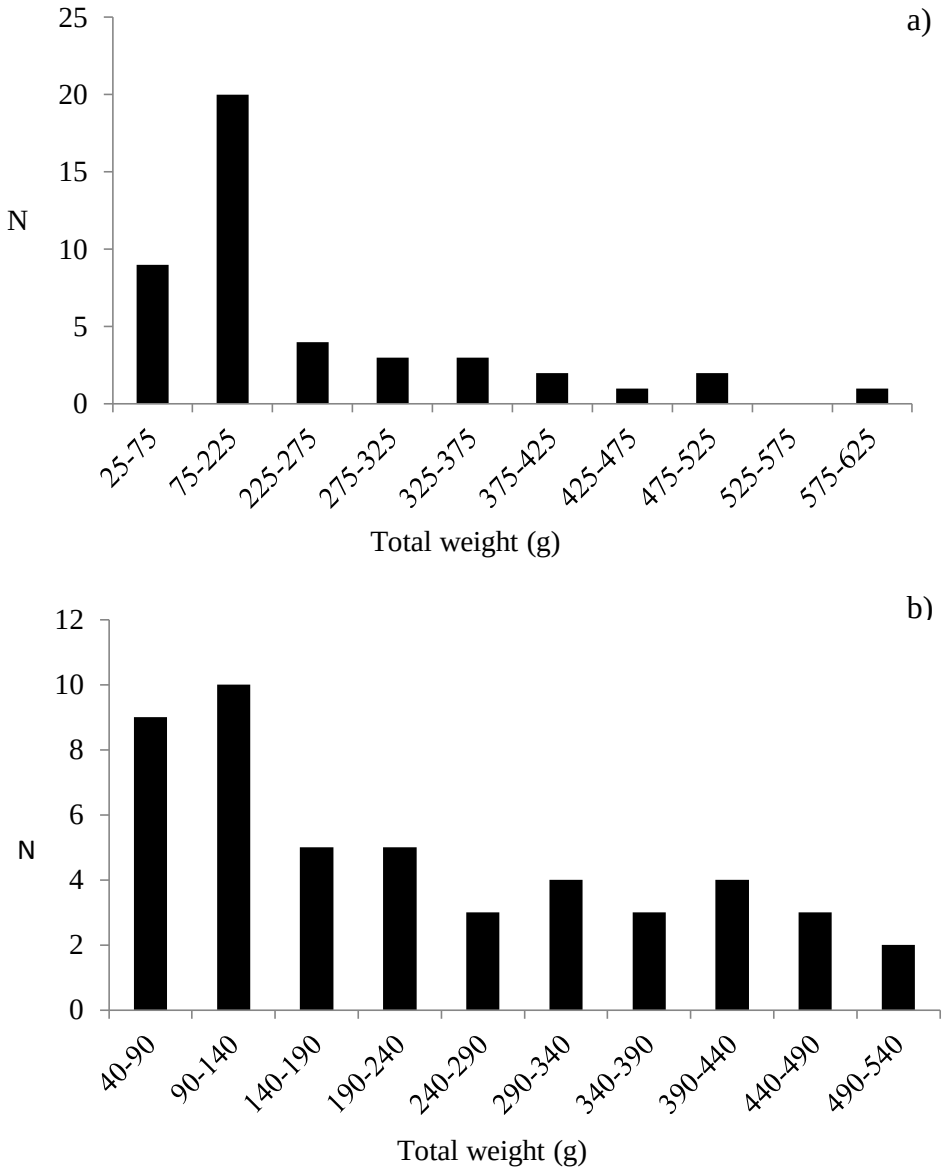

Figure 2. Weight frequency distribution of Scyliorhinus canicula in Bandırma Bay a) male, and b) female.

3.3. Length-weight relationships

While negative allometric growth was observed for females, positive allometric growth was for males (Figure 3).

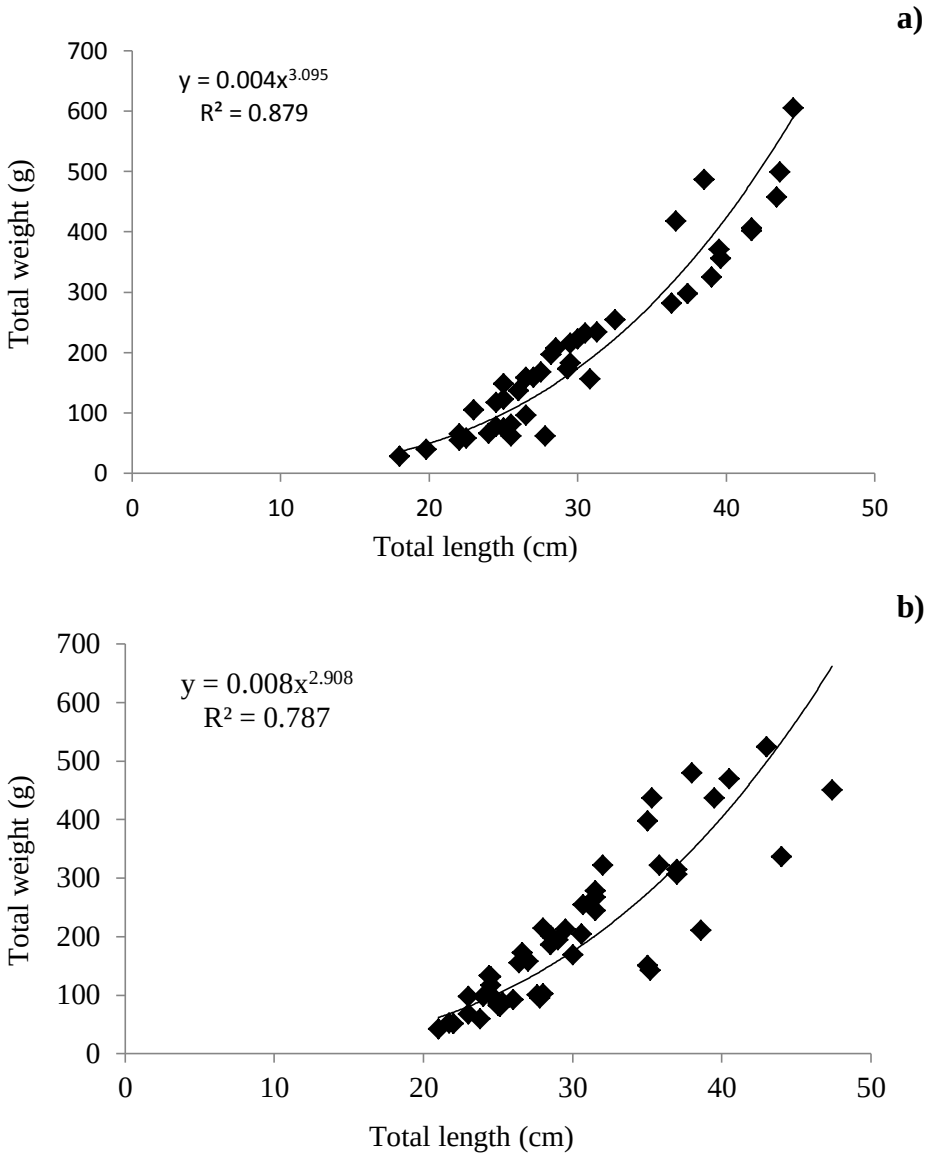

Figure 3. Length-weight relationship of Scyliorhinus canicula in Bandırma Bay a) male, and b) female.

3.4. Sex ratio and reproduction

The overall female: male ratio (1.12:1) [on the basis of macroscopic classification] was not significantly different from 1:1 ratio ($p > 0.05$). According to macroscopic identification**,** it was seen that the mature females spawned successively at least two eggs each batch in Figure 4.

Clasper length (cm) increased with total length (cm) (Fig. 5a), and this increase was rapid between 32.5 cm and 44.5 cm TL. The width of the nidamental gland (cm) also increased with total length (cm) (Fig. 5b), exhibiting rapid growth between 40.0 cm and 47.4 cm TL.

The clasper length (CL) as well as the width of the nidamental gland (NGW) increased with total length in more profound way than any other reproductive organ and demonstrated the differentiation from one stage of maturity to the other in Figure 5, 6.

Figure 4. The 3rd.stage view of Scyliorhinus canicula ovarium.

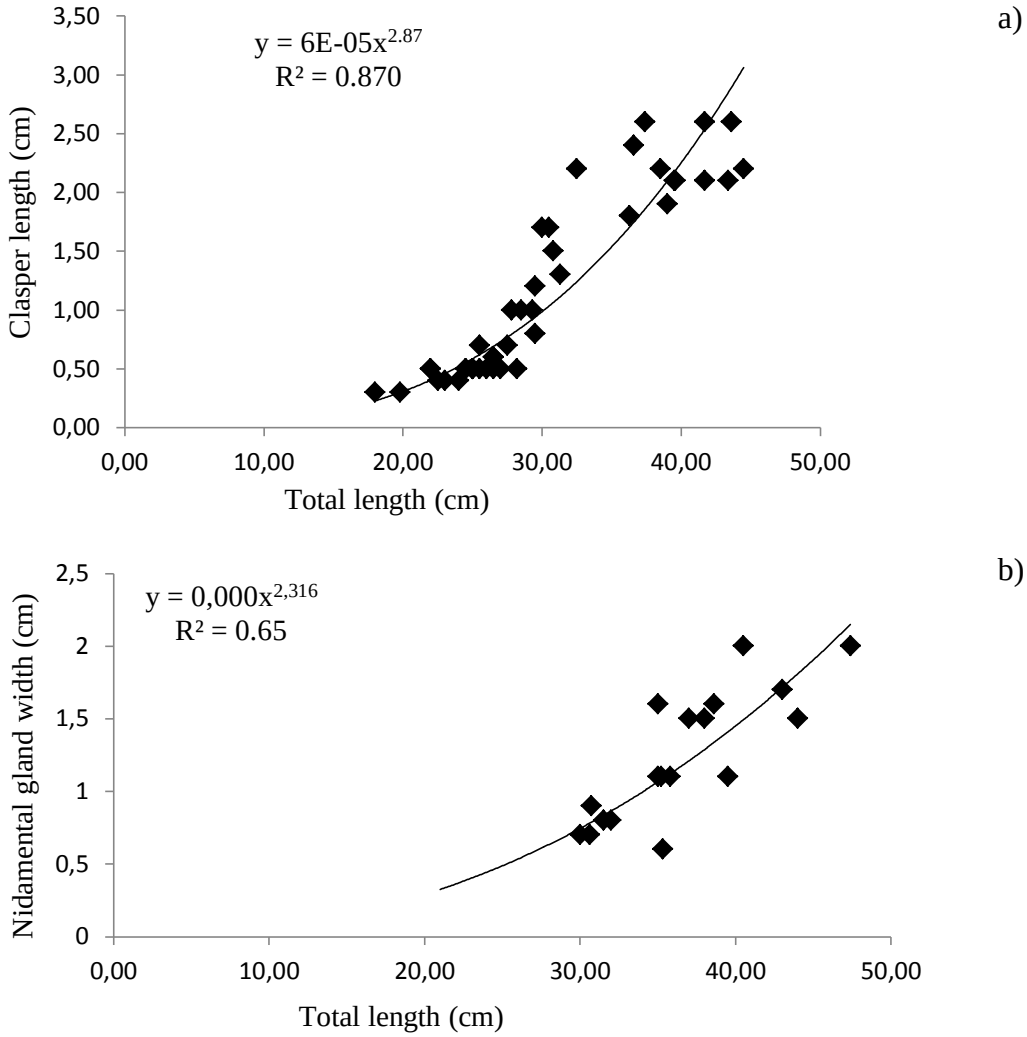

Figure 5. The relationship between clasper length and total length in Scyliorhinus canicula in Bandırma Bay a) male, and b) female.

3.5. Hepatosomatic index [HSI %]

Hepatosomatic index [HSI %] values of males and females were estimated as 4.6±0.06, 4.0±0.03, respectively with no statistically significant (t-test, $p>0.05$).

4. Discussion

S. canicula is consired as a common species in the northern Aegean Sea [7, 9, 14]. Previous studies on the small-spotted catshark in the world are concerned with weight-length relationships [15], sexual dimorphism [5, 16] and its depth distribution pattern in the North Aegean Sea [17], sexual maturity and fecundity in Aegean Sea [18]. The present study reports for the first time basic information on the reproductive biology of the species in the area, providing data on the structure of sexual organs, sex ratio, and egg case deposition. Our results showed that smallspotted catshark reaches bigger sizes and reproduces at even bigger lengths in the Sea of Marmara in comparison with Bristol Channel [19] and Mediterranean Sea [18, 20]. Variations in maximum size and size at maturity could be attributed, as in other shark species, to genetic or environmental factors and physiological conditions [18].

The maximum length of small-spotted catshark in Atlantic waters has been documented as 1000 mm [21], but specimens exceeding 800 mm are rarely observed [22]. Compagno [21] and Ivory et al. [22] documented the maximum length of small-spotted catshark in Atlantic waters as 1000 mm but specimens exceeding 800 mm, respectively. Capape et al. [20] noted maximum length 55 cm for males, 51 cm for females from the Gulf of Lion, while Sanchez et al. [23] presented maximum length 65 cm for all individuals from Galicia and Cantabrian Sea. Some researchers confirm our findings [6, 11, 12, 19, 24, 25, 26]. As the previous studies carried out along Turkish coasts, Geldiay [27] and Akşiray [28] established that maximum lengths were 80 cm and 150 cm, respectively while Cihangir et al. [6] noted total lengths of 54.6 cm males and 51.7 cm for females. Filiz & Bilge [15] and Türker Cakir *et al.* [29] gave the maximum lengths as 50.9 cm and 78.6 cm for the north Aegean Sea. The findings of our study are nearly in agreement with the previous assessments, except for findings by Geldiay [27], Aksiray [28] and Türker Cakir et al. [29]. This variation may be due to diferent stages in ontogenetic development, as well as diferences in condition, length, age, sex and gonadal development [30]. The size distribution of the two sexes in the Sea of Marmara was almost similar and mean sizes did not show statistically significant differences. This finding confirms the results by Kousteni et al. [18] noted that no difference of sexes and sizes occurs in the population in the Aegean Sea.

The present study showed that that the parameters that distinguish mature from immature specimens are the weight and width of the nidamental gland in females and clasper outer length in males. Similar observations were made for clasper length and nidamental gland width in previous studies in the Mediterranean Sea [18] and Atlantic Ocean [19, 22] but the lengths above which the onset of maturation was observed were higher in the Atlantic Ocean than in the Aegean Sea and The Sea of Marmara.

The slope (b) values of the length–weight relationship each sex (b= 3.095 for male, b= 2.908 for female] showed that weight increased with length in positive and negative allometry, respectively. For the same species, (b) values were given as 3.10 2,869, and 3.26 by Türker Cakir et al. [29], Demirel and Dalkara [31] and Filiz & Bilge [15] gave the b values as 2.93, 3.10 and 3.26, respectively. As seen, b values for Bandırma Bay was found to be close to the estimated for the north Aegean Sea.

The population consisted of 53%female and 47% male. In this study, the sex ratio was 1.12:1 (F: M) with no significantly diferent from 1:1 (t-test, $p>0.05$). Although the sex

ratio in most of the species was close to1, this may vary from species to species, difering from one population to another of the same species, and may vary year after year within the same population [32]. The result in sex ratio is not consistent with the study carried out in Bristol Channel [19], but confirms with other studies carried out in different parts of the Mediterranean at depths ranging between 200 and 500 m [11, 12, 26]. Females are known to predominate in July in the Cantabrian Sea [12]; in January and June in the Bristol Channel [19]; in summer from the northern Aegean Sea of Turkey [6]. As there have been no regular sampling per month, a comparison of results could not have been made exactly.

Egg lying occurs throughout the year, expect for a break during the autumn [6, 12, 19, 20, 33]. While Cihangir et al. [6] and Türker Çakır et al. [34] found that one egg capsule in each oviduct canal of female from the northern Aegean Sea, by a macroscopic approach, it was seen that adult female fish also carried two egg capsules each batch in Bandırma Bay in this study (Fig. 4). Our observations confirm the relevant literature. Kousteni et al. [18] found the maximum proportion of egg-carrying females in spring in Aegean Sea but, they could not suggest a specific egg-laying season in the Aegean Sea. We could caught the specimens in July due to lack of technical facilities. However, a more specific monthly sampling programme targeting a larger sample of mature and adult specimens throughout the year, including winter, spring and autumn, could give more precise and complete information about the egg deposition period in the the Sea of Marmara in the future.

The hepatosomatic index shows an allocation of energy to the liver during every period except reproduction, when part of the energy is used for gonad maturation [13]. Craik [35] mentioned that liver weights of females were more than liver weights of males in pre and during vitellogenesis while Craik [35] pointed out that HSI values were higher in females than males and varied in two sexes according to seasons. While the monthly mean values of mature male HSI showed the highest values in March, the HSI of adult females did not showed significant monthly variations off the Languedocian coast [southern France] [11], suggesting that liver plays an important role in life cycle of the latter [18, 36]. In the study, HSI was calculated as 4.0 for males 4.6 for females. HSI monthly reached high values, between 6.2 and 8.3 for males and between 6.5 and 10.0 for females in southern France with similar values reported by Capapé [37] for *S. canicula* from the Tunisian coast, and data given by Olivereau & Leloup [38]. On the other hand, Cihangir et al. [6] reported that no difference was determined between sexes, except for spring in accordance with this study in Bandırma Bay. The variation of this index is considered to be a normal situation for them as they attain maturity.

5. Conclusion

This study showed that sustainable efforts need to be improved and enlarged in order to preserve the species which has been listed under “least concern” in IUCN Red List of Threatened Species [39], as as well as for other elasmobranch species for all Turkish waters.

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