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DETERMINATION OF REPRODUCTIVE CHARACTERISTICS OF THE EUROPEAN CATFISH (*SILURUS GLANIS* L., 1758) IN BORCKA DAM LAKE

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ABSTRACT

This study was carried out to determine the reproductive characteristics (sex ratio, gonadosomatic index, hepatosomatic index, reproductive period, fecundity, egg size, gonadal maturity stages and length at first maturity) of the European catfish (*Silurus glanis* L., 1758) for the first time in Borçka Dam Lake. A total of 26 fishing operations were performed monthly between February 2016 and November 2017 and totally 156 European catfish specimens (99 female and 57 male) were sampled. Total lengths of all samples varied from 20.6 cm to 145.0 cm, (68.3±2.214 cm), and body weights ranged from 56.33 g to 21452 g (3090.18±307.505 g). The sex ratio (Male: Female) was calculated as 1.0: 1.74 and this ratio was statistically different from the expected value 1.00:1.00 (P<0.05).

The length at first maturity was estimated as 85.0 cm for females and 79.9 cm for males. The length and age of the smallest matured individual was 81.3 cm and 4 years in females and 78.3 cm and 3 years in males. The minimum mean monthly egg diameters were measured in May as 1.097 ± 0.0273 mm, while the maximum mean egg diameters were measured in August as 2.554 ± 0.0221 mm. The total fecundity was estimated between 30379 and 301356 (179043±335.320) number eggs. There was a strong positive relationship between total fecundity-total length and total fecundity-body weight.

The reproductive period of the European catfish in the Borçka Dam Lake was from July to September and the spawning ended completely in September. The results of this study could be useful to help sustainable fisheries management of inland fisheries resources and to provide a scientific data to further studies, also implementation of conservation and control measures in Borçka Dam Lake on the Coruh River.

KEYWORDS:
Reproduction, fecundity, egg size, length at first maturity, *Silurus glanis*, Borçka Dam Lake

INTRODUCTION

The European catfish (*Silurus glanis* L., 1758) is one of the largest freshwater fish of Europe from the family of Siluridae. It likes movement and moves alone, prefers calm waters with soft grounds [1]. *Silurus glanis*, the European catfish, also known as wels or sheatfish is native to eastern Europe and western Asia, widely distributes in the areas of central, southern, and eastern Europe, in the basins of the North, Baltic, Black, Caspian and Aral Seas. In addition, it is one of the biggest freshwater fish species which inhabits European and Asian rivers, lakes and reservoirs [2, 3, 4]. *S. glanis* has a wide distribution area in Turkey covering the regions of Marmara, Southeastern Anatolia, Aegean, Mediterranean, Black Sea and Central Anatolia, except for Euphrates and Tigris River Basins [1, 5]. In addition, it has a white, tasty and boneless meat with high protein content [6], is also a high-quality inland fish with high economic value [1].

S. glanis is a very popular species in sport fishing and has a high economic value in commercial fishing and aquaculture [3, 7]. Commercial aquaculture production of the European catfish in Turkey has been made in recent years. As of 2017, the amount of aquaculture production of this species in Turkey was 8 tons. However, the commercial catch amount of *S. glanis* obtained by capturing was 387 tons [8].

European catfish prefers slow-moving lotic or lentic waters rather deeply making them difficult to capture using conventional sampling techniques [9]. The ecological characteristics of wild populations in its distribution areas are not well known, probably due to the difficulty of sampling such a large species in large rivers or lentic ecosystems [10, 3, 4]. In Turkey, generally there are not many comprehensive studies about *S. glanis*, however, the majority of the studies conducted on this species are mainly related to age, growth and feeding habits [4, 7, 11, 12, 13, 14, 15, 16]. There are few studies reporting some aspects of the reproductive characteristics of *S. glanis* from different areas in Turkey [17, 18, 19].

To ensure the sustainability of fish stocks, each individual belonging to that species should be given at least one chance of reproduction within the life span. In order to be achieve this, first of all, determining the population and reproductive char-

acteristics of a species is of vital importance for sustainable fisheries and a healthy ecosystem. The knowledge of the length at first maturity and fecundity of a fish species is important in order to protect the stocks and to ensure a sustainable fishery. The information obtained from the fish maturity and reproduction studies can be used to determine the length and age of the fish when it reaches the sexual maturity, as well as the areas of spawning and spawning time. With the estimation of fecundity, it is possible to calculate the stock size and reproductive potential of the species. All these kinds of information contributes to the creation of rational and sustainable management strategies for the species.

There is no any study in the available literature carried out on this species in the eastern Black Sea of Turkey neither in the Borçka Dam Lake which was constructed on the Coruh River nor in the other dam lakes constructed in the same river system. From this point of view, no study has been conducted in the region on *S. glanis* which has an important economic value and there is no information about its reproductive characteristics. By determination of the reproduction characteristics of *S. glanis* in Borçka Dam Lake, important basic information will be provided for the establishment of sustainable fishery management during the planning stage of the opening of this reservoir to commercial fishing in the future. Furthermore, the results of this study are important for the efficient management of inland fisheries resources and the implementation of conservation strategies on the species.

MATERIALS AND METHODS

This study was conducted in Borçka dam lake which was built on the Çoruh River between 1999 and 2006 for electricity generation and flood control purposes and taken into operation in 2007 (Figure 1). Borçka dam is located approximately 300 m downstream of the junction of Çoruh River and Murgul Stream, 2.5 km upstream of Borçka district and 30 km northwest of Artvin province. The reservoir has 419 hm^3 volume at normal water level and a surface area of 10.84 km^2 [20], [21]. Coruh River has a total length of 431 km, within 410 km of borders of Turkey and the last 21 km in Batumi (Georgia) where the river falls into the Black Sea [20].

S. glanis samples were collected monthly from Borçka Dam Lake on the lower part of Çoruh River basin, located in the northeastern Black Sea region, from February 2016 to November 2017 by using multifilament trammel nets with various mesh sizes and baited longlines. A total of 26 fishing operations were carried out during the study. Total length (TL) of each specimens were measured to the nearest milimeter and total body weight (W) was measured with 0.1 g accuracy. Also, each individual was dissected, gonads and livers were removed

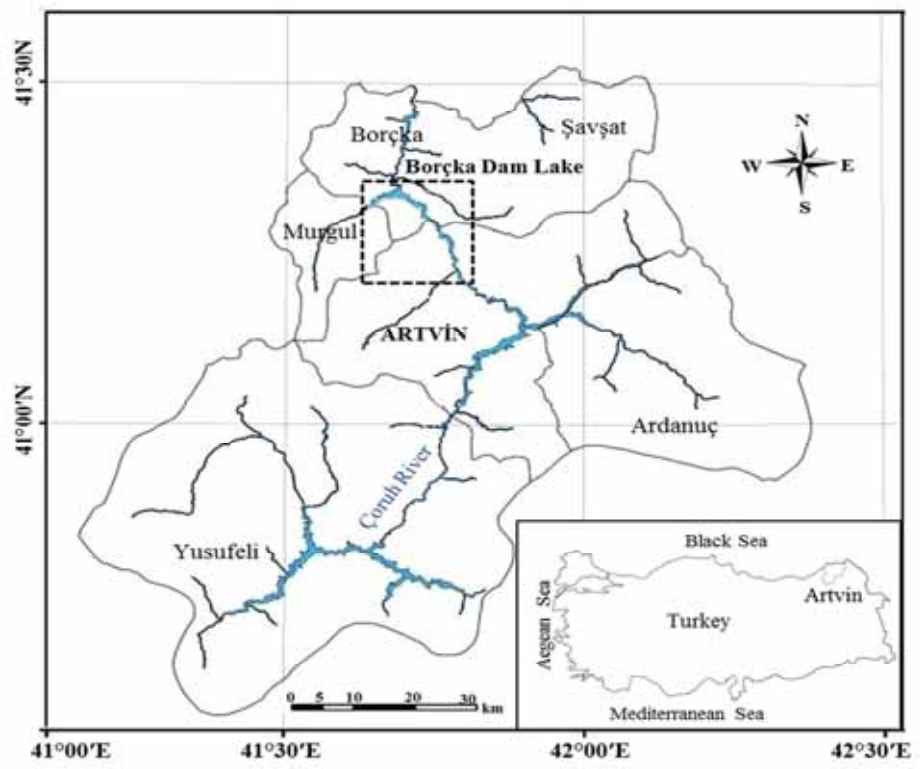

FIGURE 1
The map of the study area.

then weighted with 0.001 g accuracy and sex determination was made by macroscopic and microscopic examination of gonads by using the morphological differences of the male and female gonads such as colour and shape. Gonad maturation stages were also recorded as well as egg diameters were measured under binoculer microscope connected with Nikon NIS-Elements microscope imaging and measuring software. Age was determined from vertebraes according to Yılmaz et al. [14] and Alp et al. [7]. Water temperature was measured monthly by using the Hach HQ40D portable multimeter. The sex ratio between males and females (M:F) was calculated by using the chi-square (X^2) test [22] to determine whether this ratio was statically different from the expected value of 1:1.

Gonadosomatic Index (GSI) and Hepatosomatic Index (HSI). In fishes, during the reproduction period, large changes occur in gonad weight. The reproduction season of any fish stock can be determined by following these changes. Gonadosomatic Index is a parameter which generally facilitates the interpretation of a species' spawning season and sexual maturity process [23]. Hepatosomatic Index helps to determine the rate of energy in the liver during each period except for the reproductive period. In the reproductive period, however, most of the energy is transferred to the reproductive organs, because most of the energy will be spent on gonad development. Therefore, HSI values in reproductive periods are lower than those of outside the reproductive period [24]. To determine the spawning period of *S. glanis* Gonadosomatic Index (GSI) and Hepatosomatic Index (HSI) were calculated with following equations;

$GSI= (GW/BW- GW) \times 100$, [25];

$HSI= (LW/BW) \times 100$ [26],

where; GW: Gonad weight (g), LW: Liver weight (g), BW: Total body weight (g).

Length at First Maturity. During the sampling period, males and females sexes were determined by macroscopic and microscopic observation of gonads and gonad maturity stages were recorded. Six gonadal development stages were used to describe maturity in male and female according to Behmanesh et al. [27], such as stage I: immature, stage II: early developing, stage III: late developing, stage IV: mature or ripening, stage V: running or spawning, stage VI: spent/recovering. Individuals in stage IV and above were considered as mature in maturity calculations. A logistic function was fitted to proportion of mature specimens by 5 cm length class intervals to estimate the mean lengths at first maturity (Lm_{50}) for males and females using following formula [28].

$P =1/ (1+e^{a+b\times TL})$, $Lm_{50}= -a/b$,

where P: Proportion of mature fish in length classes, Lm_{50}: Length at first maturity (cm), TL: Total length (cm), a: intercept, b: slope.

Fecundity. The fecundity of *S. glanis* was estimated from 16 mature females prior spawning. For this purpose, 1 g subsamples were taken separately from the anterior, middle and posterior parts of each ovaries and mature ovaries were fixed in Gilson's solution to ensure complete dissociation of the eggs from connective tissues [29]. After weighing the sub-samples, the eggs in each subsample were counted manually under a microscope and then egg diameter was measured by using Nikon NIS-Elements microscope imaging and measuring software. The fecundity was estimated using the gravimetric method with following formula,

$F = (n\times G) /g$,

where F: Fecundity, n: number of eggs in the subsample, G: Total weight of the ovary, g: weight of the sub-sample [30]. The relationships of total fecundity with total length and body weight were represented with the equations:

$F = aL^b$,

converted to linear form as

$Ln (F)= Ln (a)+ b \times Ln (L)$,

$F = aW^b$,

converted to linear form as

$Ln (W)= Ln (a) + b \times Ln (W)$,

where, F: Fecundity, TL: Total length of fish (cm), W: Body weight of fish (g), a and b: regresyon coefficients [29].

RESULTS

A total of 156 European catfish specimens were sampled during the study. Total lengths of all samples varied from 20.6 cm to 145.0 cm, with a mean length of 68.3±2.214 cm, and body weights ranged from 56.33 g to 21452 g with a mean weight of 3090.18±307.505 g. In the sampling period, the total length of males varied from 28.2 cm to 145.0 cm (75.18 ± 3.721), and body weight from 162.39 g to 21452 g (3797.01 ± 518.605). The total length of females varied from 20.6 cm to 135 cm (64.34 ± 2.786) and body weight from 56.33 g to 15577 g (2683.22 ± 386.917). Of the total fish caught, 99 (63.46%) were females and 57 (36.54 %) were males. The sex ratio (Male: Female) was calculated as 1.0: 1.74 and this ratio was statistically different from the expected value of 1.00:1.00 ($\chi 2_{(1;0.05)} = 0.461 < 3.841$, $P<0.05$).

Spawning Season. Monthly mean GSI values varied from 0.166 to 3.003 in 2016 and 0.094 to 3.483 in 2017 for females and from 0.03 to 0.455 in 2017 for males. The highest mean GSI values for females (3.483 ± 0.819) and males (0.455 ± 0.155) were found in August 2017, while the minimum values were recorded in March and May. According to the mean GSI values, GSI values of female individuals started to increase regularly since May and June. GSI values in female and male individuals reached their maximum values in August. Hovewer, it was observed that GSI values started to decrease

from September. This gradual increase in the mean GSI indicates that spawning activities of *S. glanis* in the study area mostly occured in July and August and ended completely in September. Variations in the mean GSI indicate that *S. glanis* has an active reproduction period during the months of July and August to September (Figure 2).

Hepatosomatik Index (HSI). Mean HSI values were calculated for both the sexes monthly. The maximum HSI values for females were recorded as 2.7 in March 2016 and 2.05 in May 2017 while the minimum values were were recorded between July and September (1.08 and 1.05) in 2016 and August-September (1.01 and 1.02) in 2017. The maximum HSI values for males were recorded as 1.66 in October 2016 and 2.66 in May 2017, while the minimum values were were recorded as 1.00 in July 2016 and as 0.81 in August 2017. Both sexes in 2016 and 2017 recorded a significant decrease in July-September, while the mean HSI values began to increase generally from October. Monthly variations in the mean HSI values showed a similar trend for both sexes. The mean HSI values were highest from March to June before the reproduction period, while the minimum values were recorded at the spawning period (Figure 3).

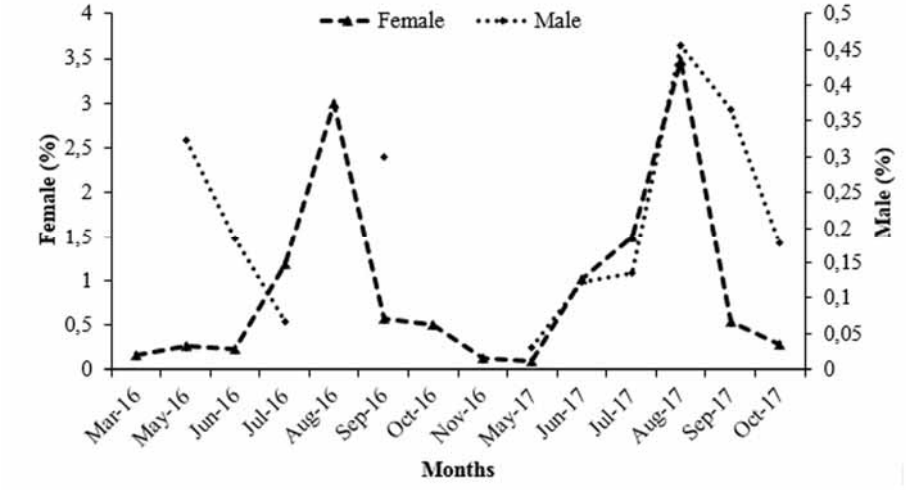

FIGURE 2
Monthly variations in the mean GSI values of the female and male *S. glanis*

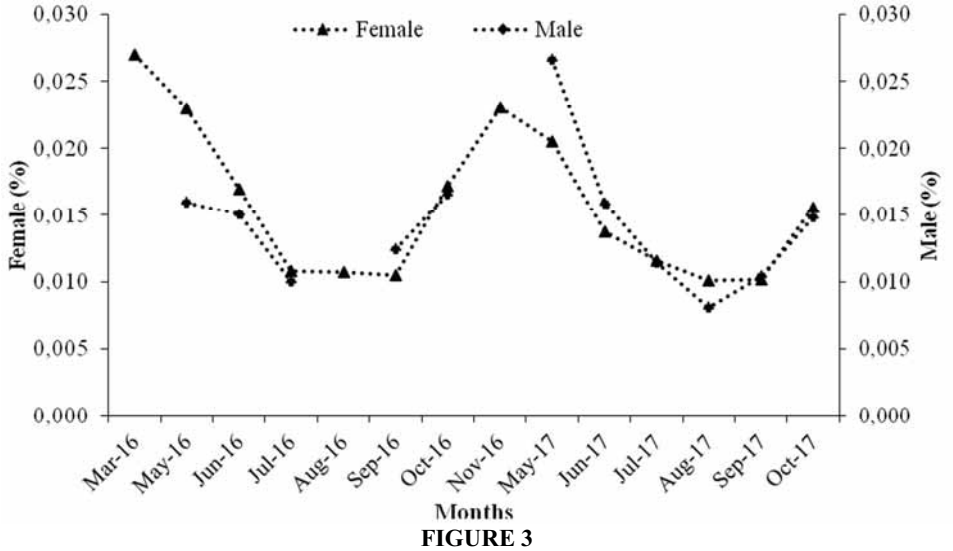

FIGURE 3
Monthly variations in mean HSI values of the female and male *S. glanis*

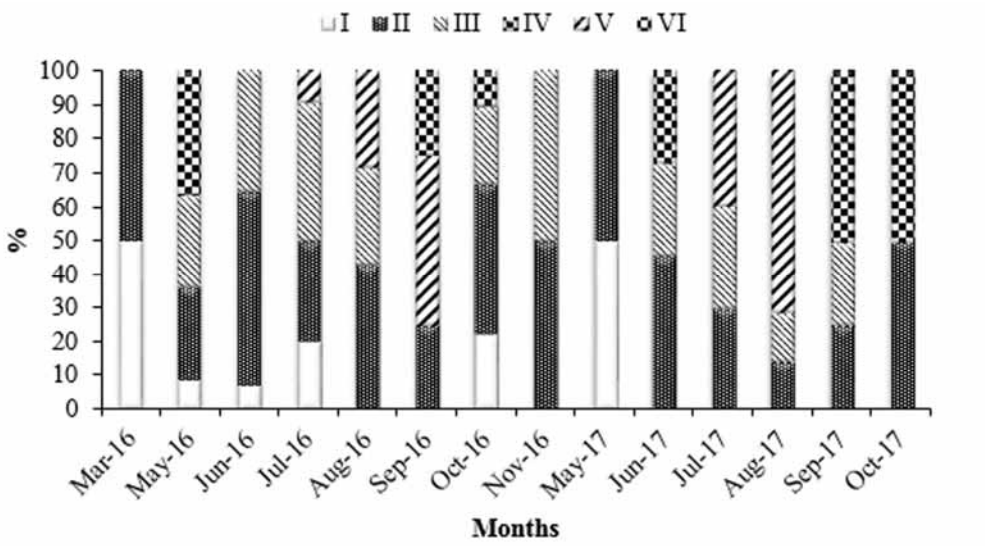

FIGURE 4
Monthly percentage (%) distribution of different gonadal maturity stages of female *S. glanis*

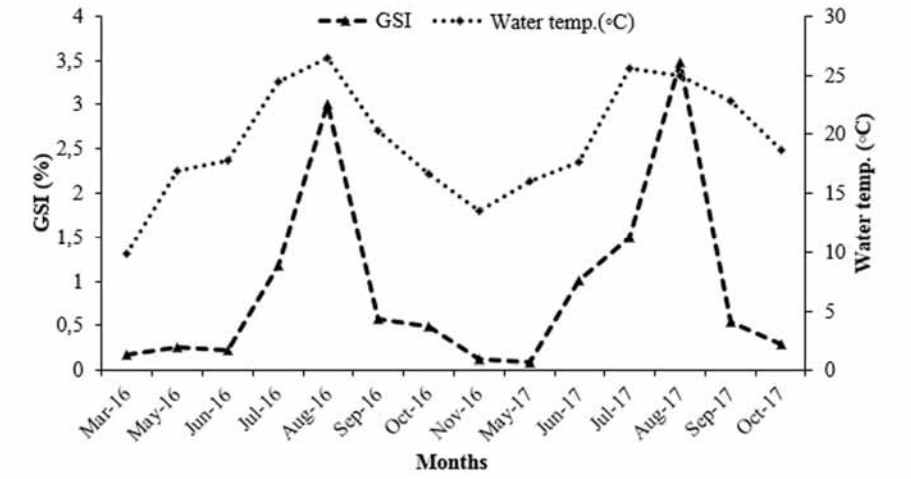

FIGURE 5
The relationship between GSI values and water temperature for female *S. glanis*

Monthly Distribution of Gonadal Maturity Stages. Gonad maturity stages of female *S. glanis* were determined macroscopically and classified into six stages. According to the percentage (%) distribution of the different maturity stages of females indicates that immature (stage I) individuals occur almost throughout the year. Stages II and stage III were recorded during all the study period. Stage IV appears for the first time during May and June. Running/Spawning individuals (stage V) appeared from July to September while the spent-recovering fish (stage VI) was first seen from September by a substantial proportion. By evaluating the observed maturity stages, the results indicated that there was a prolonged spawning period for *S. glanis* from July to September in the study area (Figure 4).

GSI and Water Temperature Relationship. In the present study, water temperatures during the reproduction period was measured as 24.4ºC in July, 26.4 ºC in August and 20.3 ºC in September, respectively (Figure 5). The peak values of water temperature and the mean GSI of female *S. glanis* showed almost a similar trend in reproductive period.

Length at First Maturity. The mean size at first maturity (Lm_{50}) was estimated as 85.0 cm for female and 79.9 cm for male (Figure 6). The minimum size of mature fish was observed in 81.3 cm total length at age of 4 for females and in 78.3 cm total length at age of 3 for males.

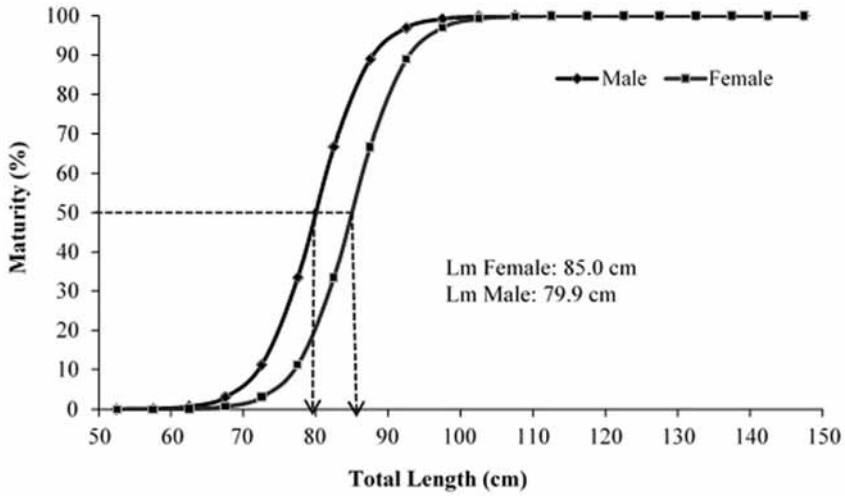

FIGURE 6
The mean length at first maturity (L_m) of male and female *S. glanis*

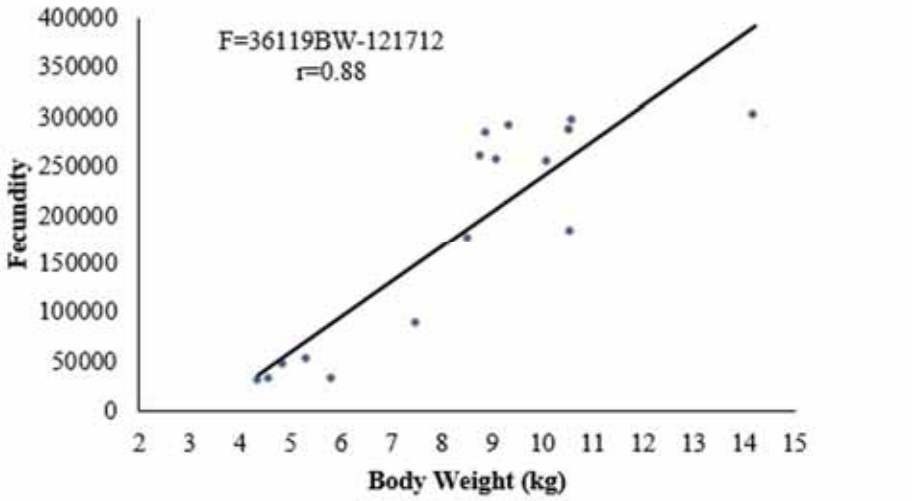

FIGURE 7
The relationship between total fecundity and body weight of *S. glanis*

Fecundity. It was determined that the number of eggs in the ovaries of the examined female individuals varied from 30379 to 301356. The minimum number of eggs was found in a fish with 90 cm length, while the highest numbers of eggs were obtained from the fish in 125 cm length. The mean length and weight of the fish samples were 107.152 ± 3.199 cm and 8.327 ± 1.654 kg, respectively. The mean fecundity was calculated as 179043 ± 335.320 and the relative fecundity for each kg of female fish was 20159± 2573 eggs. A strong and positive linear relationship was found between the total fecundity and body weight expressed as F = 36119BW–121712 (r = 0.88) and also a strong and positive linear relationship were observed between the total fecundity and total length expressed as F = 9971TL-889158 (r = 0.91) for *S. glanis* (Figure 7).

It was determined that the total fecundity increased with the overall total length of fish and increasing body weight. The correlation coefficients indicated that there was a strong positive relationship between total fecundity- total length (r =0.91) and total fecundity- body weight (r =0.88) of *S. glanis* inhabiting Borçka Dam Lake (Figure 8).

In the present study, the mean monthly egg diameters of *S. glanis* were measured as 1.097±0.0273 mm (0.901-1.850 mm) in May, 2.163±0.0672 mm (1.023-3.141 mm) in June, 2.519±0.0610 mm (1.422-3.290 mm) in July, 2.554±0.0221 mm (1.543-3.323 mm) in August, 2.547±0.0595 mm (1.181-3.310 mm) in September, respectively (Figure 9).

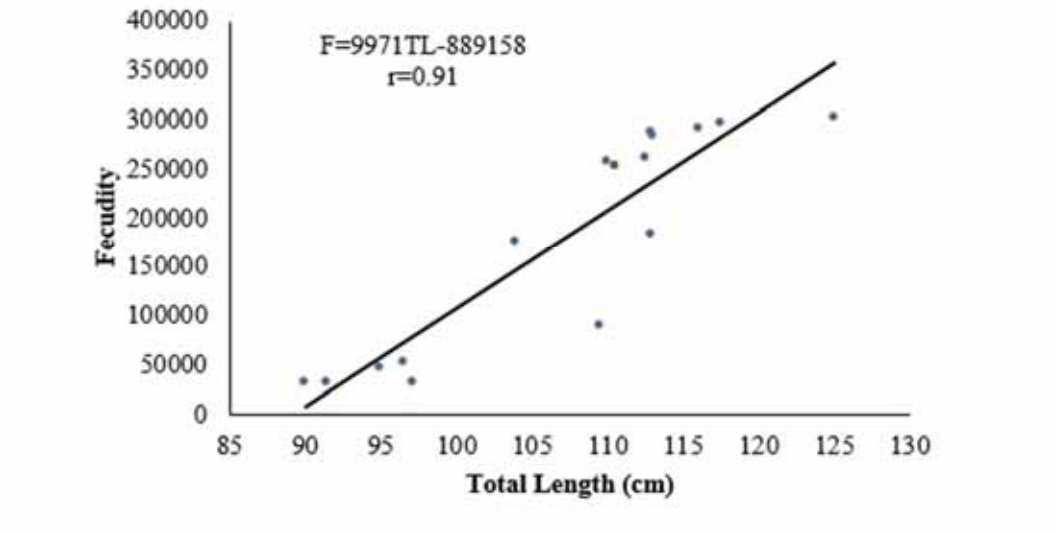

FIGURE 8
The relationship between total fecundity and total length of *S. glanis*

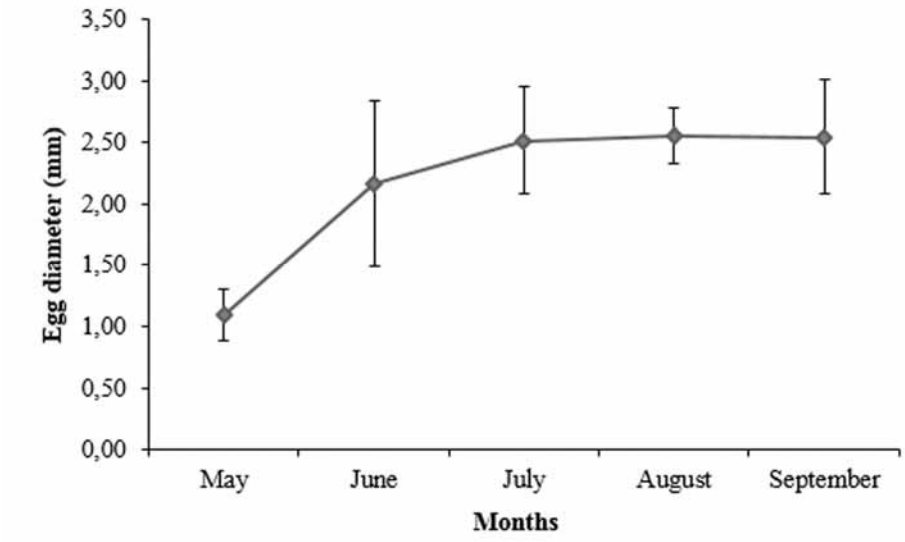

FIGURE 9
Monthly variations in mean egg diameters of *S. glanis*

The mean egg diameters were measured as minimum before the reproduction period in May and June, while the maximum mean egg diameters were recorded during spawning from July to September.

DISCUSSION

The total length of all fish caught varied between 20.6 cm and 145.0 cm, with mean length of 68.3 ± 2.214 cm, while the body weights ranged from 56.33 to 21452 g, with an average body weight of 3090.18 ± 307.505 g. In previous studies, the length and weight distributions of *S. glanis* were reported from Menzelet Reservoir between 33.4 - 195 cm and 220–48000 g [18], 22.3–52.4 cm and 68–920 g from Hirfanlı Dam Lake [12], 29.5–103 cm and 165–7600 g from Altınkaya Dam Lake [13], and 19.5-68.7 cm and 54-2195 g from Lake İznik [15]. The length and weight ranges obtained in this study were lower than obtained by Alp et al. [18] in Menzelet Reservoir, but higher than the other studies reported above. It is considered that varying environmental characteristics, food availability, sampling period and the use of different fishing gears and sampling methods in the studies are thought to lead to these differences.

In the present study carried out in Borçka Dam Lake, the sex composition of totally caught 156 fish samples was composed of 36.54% (57) males and 63.46% (99) females. The sex compositions reported from different areas such as 44.9% male and 55.1%

female from Menzelet Reservoir [18], 50.62% male and 49.38% female in Hirfanlı Dam Lake [12], 26.56% male, 60.94% female and 12.50% unsexed in Altınkaya Dam Lake [13], 50.9% male and 49.1% female in İznik Lake [15], 59.09% male and 40,91% female in Çelik Lake [16], 44.75% male and 55.25% female in Menzelet Reservoir [7], also as 47% male and 53% female in Sıddıklı Reservoir [19]. The results in this study were found similar to those obtained from prior studies by Alp et al. [7], [18] in Menzelet Reservoir, by Yılmaz et al. [13] in Altınkaya Dam Lake and by Yazıcı et al. [19] in Sıddıklı Reservoir in favor to females while in other studies the sex ratio between males and females was found to be higher in favor of males. It is considered that this difference may be due to varying habitat characteristics, sampling period and the use of different fishing gears and sampling methods in the studies.

In the present study, it was determined that the GSI values calculated for female and male individuals showed a significant increase after June and reached the highest values in August in both years. According to monthly changes in GSI, it was determined that the reproduction of *S. glanis* in Borçka Dam Lake occurs between July to September. Alp et al. [18] reported the reproduction period of this species in the Menzelet Reservoir in Seyhan River in Kahramanmaraş from June to August, while Akyurt [17] reported this period from May to July in Karasu Stream in Iğdır, also Yazıcı et al. [19] reported the reproduction period of *S. glanis* in the Sıddıklı Reservoir in Kırşehir from April to June. The spawning period of *S. glanis* from Dnieper Delta was reported from April to July, while in the Volga Delta spawning occurs from mid May to mid July [31]. The water temperatures were measured varying from 20.3 °C to 26.4 °C in the reproduction period of *S. glanis.* The peak values of water temperature and the mean GSI of female *S. glanis* showed almost a similar trend during the reproductive period. Copp et al. [3] reported that spawning of *S. glanis* starts when water temperatures reach a minimum of 18-22 ºC. In other studies, conducted in different araes of Turkey, Akyurt [17] reported the water temperatures between 16-18 ºC during the reproduction season in Karasu Stream, while Yazıcı et al. [19] reported these temperatures in the spawning period between 14.9 - 20.8 ºC from April to June. The reproduction period of *S. glanis* varies depending on environmental conditions, latitude and climatic characteristics of different habitats, depends primarily on the water temperature, also day length and geographic location [3, 17, 19].

Monthly variations in the mean HSI values showed a similar trend for both sexes. The mean HSI values were recorded depends rom March to June before the reproduction period, while the minimum values were recorded during spawning. However, GSI and HSI values showed a reversal trend on a monthly basis. Hepatosomatic Index helps to determine the rate of energy in the liver during each period except for the reproductive period. In the reproductive period, however, most of the energy is transferred to the reproductive organs, because most of the energy will be spent on gonad development. Therefore, HSI values in reproductive periods are lower than those of outside the reproductive period [24].

The length at first maturity of *S. glanis* inhabiting Borçka Dam Lake was estimated as 85.0 cm for female and 79.9 cm for male. The minimum total length of mature fish was observed at 81.3 cm at 4 years for females and at 78.3 cm at 3 years for males in the present study. The males of *S. glanis* in the study area attained sexual maturity at a smaller total length than females. In many studies, it was reported that males of *S. glanis* reach sexual maturity at a smaller size and early age than that of females [3, 18]. Our findings are quite compatible with the previous studies. In the literature, only one study has been found in Turkey that reporting the length and age at first maturity of *S. glanis*. In that study conducted by Alp et al. [18] in Menzelet Reservoir, the smallest mature male was 83.0 cm in total length and at 3 years old, whereas the smallest mature female was 86.0 cm in total length and at an age of 4 years. In the same study, the total length at first maturity was reported as 78.82 cm in males and as 87.05 cm in females. In addition, Akyurt [17] reported the age of sexual maturity as 2-3 years for males and as 3-4 years for females in Karasu River. Age at sexual maturity in *S. glanis* was reported as 3-4 years with varying total lengths in general [3]. Kuzishchin et al. [31] reported that males reach sexual maturity at age of 4 and females at age of 5 in the lower Volga at where *S. glanis* represented by a long-lived late-maturing group in that region. In the Volga Delta *S. glanis* matures at 3 or 4 year of their life at an average length of 60 cm [31]. The age at first sexual maturity in different *S. glanis* populations shows almost a similar pattern, while the minimum size at first sexual maturity presents significant differences [18]. Copp et al. [3] reported that growth in *S. glanis* considerably varies depending on habitat, temperature, food supply and geographical location. Also, Harka [33] and Alp et al. [18] stated that the growth rate of *S. glanis* for river populations is slower than that of reservoir populations as a result of the feeding regime or physical factors such as the water temperature profile. Harka [33] noted that the construction of dams and reservoirs changed the environmental factors of this ecosystem in favor of *S. glanis* growth mainly due to elevations in the temperature of certain surface waters of the reservoir. According to these statements, size at sexual maturity in *S. glanis* may vary with sex, geographic location, feeding and food supply, also the number of samples used in maturity estimates.

The total fecundity estimated in the present study varied from 30379 to 301356 eggs/fish, with a mean fucundity of 179043±335.320 eggs/fish while the relative fecundity was 20159 eggs/kg. Alp et al. [18] reported the total fecundity from Menzelet Reservoir ranged from 9033 to 340461 with a mean fecundity of 87108 ± 20992 and reported the relative

fucundity as 8443±1114 eggs/kg. Akyurt [17] reported the relative fecundity as 12700 eggs/kg fish from Karasu River. Yazıcı et al. [19] found the total fecundity between 9018 and 75938 egg/fish with a mean fecundity of 46343±25012 egg/fish from Sıddıklı Reservoir. The total fecundity from the Dnieper delta was reported varying from 136000 to 467000 eggs [31]. Wiśniewolski [34] estimated the total fecundity based on 15 females ranging from 34700 to 788000 in the rivers of Vistula and Bug in Poland. Copp et al. [3] noted the total fecundity ranging from 14600 to 354000 eggs in different native populations. Mukhamediyeva and Salnikov [35] reported the total fecundity from Khauzkhan Reservoir between 96250 and 353910 number of eggs. The fecundity of *S. glanis* shows significant variations depending on fish size, age, season, geographic location, water temperature, feeding habits and food abundance and food supply [3, 18]. A strong linear relationship between the fecundity-total length (r=0.91) and fecundity-body weight (r=0.88) were determined in the present study. However, the fecundity increased with increasing length and weight of fish. Similar findings and relationships were also reported by Akyurt [17], Alp et al. [18] and Yazıcı et al. [19] who reported strong correlations between fecundity-length and fecundity-weight in *S. glanis* inhabiting different habitats from Turkey.

In the present study, the monthly mean egg diameters of *S. glanis* were measured as minimum 1.097±0.0273 mm in May and maximum 2.554±0.0221 mm in August. During the reproduction period, the mean egg diameter between July and September was found as 2.540±0.011 mm. Akyurt [17] reported the mean egg diameter in the reproduction period of this species as 2.500 mm from Karasu Stream. The egg diameter of *S. glanis* in Menzelet Reservoir varied between 1.000 mm and 3.630 mm, and the mean egg diameter was 2.130 mm [18]. Yazıcı et al. [19] reported the egg diameters between 1.091 mm and 2.465 mm in Sıddıklı Reservoir. According to the results of this study, egg diameters of *S. glanis* were similar with those reported in the previous studies.

CONCLUSION

The present study provides the first information on the sex ratio, reproduction period, length at first maturity, fecundity, egg diameter and monthly gonadal development stages of *S. glanis* inhabiting the Borçka Dam Lake. The results indicated that females were dominant in the sampled population of *S. glanis* in the study area. The males of *S. glanis* attained sexual maturity earlier than females. The comprehensive and detailed studies on *S. glanis* in Turkey are quite limited due to the difficulties in obtaining throughout the year of this species which is one of the economic important inland fish. Therefore, information on the reproductive biology of this species could not be obtained sufficiently in its distribution areas. Information on the reproductive characteristics such as sex ratio, length and age at first sexual maturity, gonadal development and fecundity of *S. glanis* is essential in terms of implementation of scientific and rational measures to regulate its sustainable fishing and conservation. Knowledge of the length at first maturity of this species helps to set a minimum landing size of the fish which has great importance in fishery management. Furthermore, the knowledge of length at maturity and spawning season specifies the period and the size of the fish which should be protected, therefore, it is important for the proper management and conservation of fish stocks. Considering the study area related to *S. glanis*, this study is the first one conducted in Borçka Dam Lake on the lower part of Coruh River, it is also important in terms of providing essential results in reproductive characteristics of *S. glanis*.

It was concluded that this study will contribute to the decision-making authorities in fisheries management, also to protect their stocks by revealing the reproductive characteristics of the species, to ensure their sustainability and to provide a scientific data to further studies. In addition, the specified length of 90 cm minimum legal fishing size in the notification numbered 4/2 that regulates amateur fishing activities [36] for *S. glanis* was assessed to be suitable for the conservation and sustainability of its stocks. However, the current seasonal fishing ban in Borçka Dam Lake for *S. glanis* is between 1 April and 30 June. It is recommended that seasonal fishing ban for this species should be implemented between 1 May and 31 August all over the region considering the reproduction period of *S. glanis* in accordance with the results of the present study. Furthermore, carrying out serious protection and control activities in the Borçka Dam Lake and similar habitats where commercial fishing is completely prohibited are crucial in terms of preventing illegal fishing activities.

ACKNOWLEDGEMENTS

We want to thank Prof. Dr. Cemalettin Şahin, Yusuf Ceylan, master students Yunus Dedeoğlu and Erhan Öztürk for their help during the samplings. Thanks are also extended to A. Muhtar Küçüksönmez and Ali Öztürk for their logistic support during the field studies at Borçka Dam Lake. This study was supported by Research Fund of the Recep Tayyip Erdogan University. Project Number: 2015.53001.103.03.08.

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Received: **21.06.2019**
Accepted: **14.11.2019**

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