



## Reproduction Properties of Wels Catfish (*Silurus glanis*, L., 1758) Inhabiting Sıddıklı Reservoir

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### ABSTRACT

In this study, some reproduction properties (sex ratio, reproduction period, egg diameter and fecundity) of *Silurus glanis* inhabiting Sıddıklı Reservoir were investigated. A total of 200 samples were caught between September 2015 and August 2016 from different regions of Sıddıklı Reservoir. Sex ratio was calculated as 0.88:1.00 (Female: Male). The sex ratio was not statistically different from the expected 1.00:1.00 ( $\chi^2= 0.841$ ,  $P>0.05$ ). The values of gonadosomatic index (GSI) varied from 0.033 to 11.80 in females and 0.008 to 0.451 in males. According to GSI values, reproduction period of the *S. glanis* in Sıddıklı Reservoir was determined to be between April and June. The mean total fecundity and egg diameter were calculated as 46343 eggs/individual and 1.758 mm, respectively. Relative fecundity for each kilogram of female fish was 13000 eggs. The strong relationships between total fecundity-length and total fecundity-weight were determined ( $r^2>0.80$ ).

**Keywords:** Kırşehir, fecundity, gonadosomatic index, reproduction season, egg diameter.

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### Sıddıklı Barajı'nda Yaşayan Yayın Balığı (*Silurus glanis*, L., 1758)'nin Üreme Özellikleri

**Öz:** Bu çalışmada Sıddıklı Barajı'nda yaşayan Yayın Balığı, *Silurus glanis*'nin bazı üreme özellikleri (eşey oranı, üreme periyodu, yumurta çapı ve fekondite) araştırılmıştır. Eylül 2015- Ağustos 2016 tarihleri arasında Sıddıklı Barajı'nın farklı bölgelerinden toplamda 200 örnek yakalanmıştır. Eşey oranı 0,88:1,00 (Dişi: Erkek) olarak hesaplanmıştır. Dişi:Erkek oranı beklenen 1,00:1,00 değerinden istatistiksel olarak farklı çıkmamıştır ( $\chi^2= 0,841$ ,  $P>0,05$ ). Gonadosomatik indeks değerlerine göre, Sıddıklı Barajı'ndaki Yayın balıklarının üreme sezonunun Nisan-Haziran ayları arasında olduğu belirlenmiştir. Ortalama total fekondite ve yumurta çapı sırasıyla 46343 yumurta/birey ve 1,758 mm olarak hesaplanmıştır. Nisbi fekondite her bir kilogram balık ağırlığına karşı 13000 yumurta olarak belirlenmiştir. Fekondite-boy ve Fekondite-ağırlık arasında kuvvetli ilişkiler tespit edilmiştir ( $r^2>0,80$ ).

**Anahtar kelimeler:** Kırşehir, fekondite, gonadosomatik indeks, üreme sezonu, yumurta çapı.

#### Alıntılama

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### Introduction

The population characteristics of fish, especially reproduction information, are very important data in the evaluation and management of fish stocks (Froese 2004). The data such as sex ratio, length of first sexual maturity, maturation cycle and spawning period are the main parameters of reproduction biology studies (Reddy 1979). To understand the physiology of the fish reproduction, seasonal and developmental changes of the gonads need to be

examined with macroscopic and microscopic observations (Priyadharsini et al. 2013). Gonadal development and reproduction season form the basis for future work on the breeding frequency of the population (Chakraborty et al. 2007).

*Silurus glanis* L., 1758 is a species of fish that is consumed by people and has high economic value. Many countries have been cultivating for many years (Linhart et al. 2002). *S. glanis* inhabits in slow-flowing, large and medium-sized rivers, lakes with

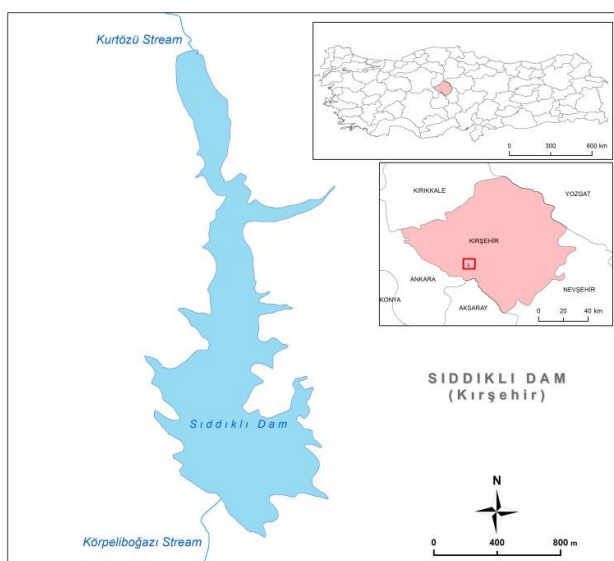
stagnant water deposits and intense vegetation (Kottelat and Freyhof 2007). The *S. glanis* entered Turkey through the Trakya region and showed the distribution in the Marmara, Southeastern Anatolia, Aegean, Mediterranean, Black Sea and Central Anatolia regions (Geldiay and Balık 2007; Polat and Uğurlu 2011).

In Turkey, there have been a few studies about the reproductive biology of *S. glanis* (Akyurt 1988; Alp et al. 2004). Therefore, in this study, it is aimed to reveal some reproductive characteristics of *S. glanis* inhabiting Siddıklı Reservoir.

## Material and Methods

### Study Area

Siddıklı Reservoir located near Siddıklı Küçükboğaz Village, 40 km west of Kırşehir province, was built for irrigation. The surface area of Siddıklı Reservoir (Figure 1) is 1.65 km<sup>2</sup>. Reservoir is used for irrigation of, 4945 ha agricultural area in the region. In addition, fishery activities are carried out economically in the Siddıklı Reservoir (Anonymous 2011).



**Figure 1.** Geographic position of Siddıklı Reservoir.

### Sampling Methods

Fish samples were monthly caught from different regions of the Siddıklı Reservoir between September 2015 and August 2016 using gillnets (25x25, 30x30, 35x35 and 40x40 mm) and trammel nets (45x45, 50x50, 55x55, 60x60, 65x65, 70x70, 75x75 and 80x80 mm). A total of 200 *S. glanis* specimens were caught during the study period.

### Laboratory Processes and Data Analyses

The total and standard lengths of the specimens were measured to the nearest  $\pm 1$  mm and weighed with a precision of  $\pm 0.01$  g. Sex determination was made by macroscopic and microscopic examination of gonads.

Whether the female to male ratio in the sample is statistically different from the expected 1: 1 ratio was determined by applying the chi-square ( $\chi^2$ ) test (Zar 1999).

Gonadosomatic Index (GSI) values of male and females were used to determine the reproduction season. The following formula was used to calculate this index (Devlaming et al. 1982).

$$GSI = \frac{G_w}{W} \times 100$$

$G_w$  is the gonad weight and  $W$  is the fish weight.

The number of eggs in fish ovaries was calculated by gravimetric method (Le Cren 1951).

$$F = \frac{n \times G}{g}$$

$F$  is the total number of eggs in the ovary,  $n$  is the number of eggs in the sample from the ovary,  $G$  is the weight of the ovary (g), and  $g$  is the weight of the sample taken from the ovarium (g). Relative fecundity was calculated by dividing total fecundity with total weight of fish. After eggs of *S. glanis* photographed, egg diameters were measured by the Mshot image analysis system. The relationships of total fecundity-length and total fecundity-weight were determined using exponential and linear regression models. The model obtained high correlation value was chosen model explaining to relations.

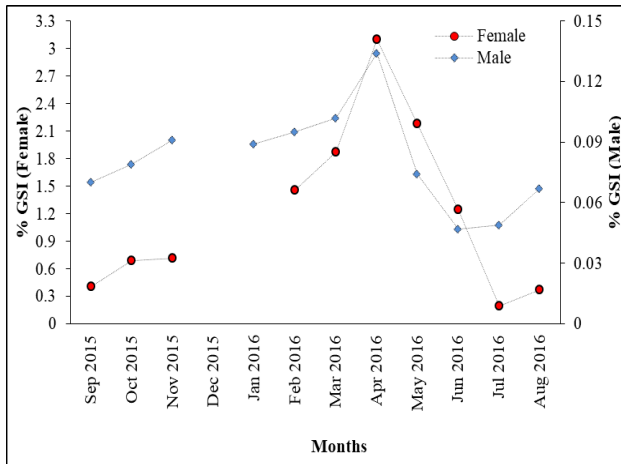
## Results

### Sex ratio

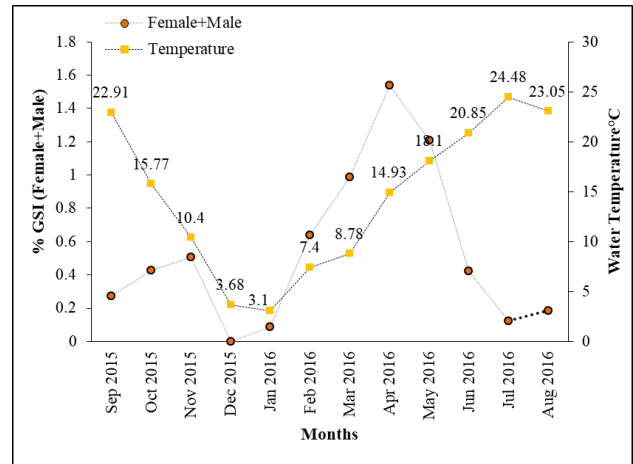
During the study, a total of 200 individuals were examined. Of the total fish examined, 94 (47.0%) were females and 106 (53.0%) were males. Sex ratio was determined as 0.88:1.00 (Female: Male). This ratio was not statistically different from the expected 1.00:1.00 ( $\chi^2 = 0.841$ ,  $P > 0.05$ ).

### Reproduction period

Monthly variations in the mean GSI values of the female and male individual and temperature values were shown in Figure 2 and 3, respectively. The values of GSI were varied from 0.03-11.80 in females and 0.008-0.451 in males. Also, descriptive statistics of GSI values in female, male and all individuals were showed in Table 1. The gonadosomatic index (GSI) of this species was the highest in April when water temperature was 14.9 °C. The GSI value of female and males increased from February to April. After April, the GSI showed a sharp decrease until June when water temperature was 20.8 °C. Monthly GSI changes in all samples showed that the reproduction period occurred between April and the end of June (Figure 2). The water temperature in reproduction period was measured as 14.9 °C in April 18.1 °C in May and 20.8 °C in June, respectively.



**Figure 2.** Seasonal changes in gonadosomatic index in female and male *S. glanis* inhabiting Siddıklı Reservoir.



**Figure 3.** The relationship between GSI values and water temperature for all individuals.

**Table 1.** Descriptive statistics of GSI values.

Months	Female		Male		All Individuals	
	N	Avg ± Sd (Min-Max)	N	Avg ± Sd (Min-Max)	N	Avg ± Sd (Min-Max)
January	-	-	2	0.089±0.099 (0.018-0.159)	2	0.089±0.099 (0.018-0.159)
February	2	1.455±1.033 (0.725-2.186)	3	0.095±0.073 (0.011-0.146)	5	0.639±0.908 (0.011-2.185)
March	2	1.869±0.099 (1.799-1.939)	2	0.102±0.035 (0.077-0.127)	4	0.986±1.022 (0.077-1.939)
April	9	3.096±0.384 (2.357-3.469)	10	0.134±0.117 (0.042-0.451)	19	1.537±1.543 (0.042-3.469)
May	14	2.176±1.467 (0.165-6.495)	12	0.074±0.051 (0.025-0.205)	26	1.206±1.504 (0.025-6.495)
June	12	1.244±3.328 (0.070-11.80)	25	0.047±0.017 (0.026-0.095)	37	0.425±1.900 (0.026-11.80)
July	18	0.193±0.084 (0.033-0.428)	17	0.049±0.050 (0.021-0.236)	35	0.124±0.101 (0.021-0.428)
August	10	0.374±0.348 (0.144-1.126)	16	0.067±0.087 (0.015-0.358)	26	0.185±0.267 (0.015-1.126)
September	9	0.406±0.172 (0.207-0.761)	6	0.070±0.055 (0.027-0.156)	15	0.272±0.217 (0.027-0.761)
October	16	0.689±0.313 (0.498-0.954)	12	0.079±0.082 (0.008-0.312)	28	0.428±0.326 (0.008-0.954)
November	2	0.716±0.086 (0.655-0.777)	1	0.091±0 (0.091-0.091)	3	0.508±0.365 (0.091-0.777)
December	-	-	-	-	-	-
Total	94	1.098±1.589 (0.033-11.80)	106	0.070±0.068 (0.008-0.451)	200	0.551±1.201 (0.008-11.80)

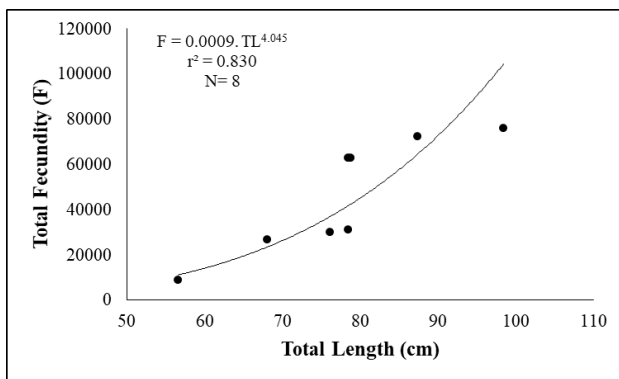
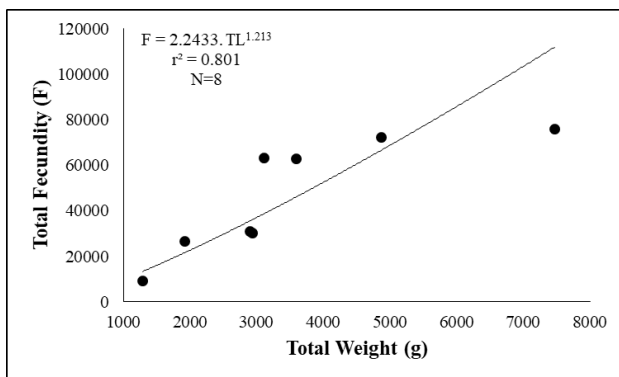
**Fecundity and Egg Diameter**

Total fecundity was estimated in 8 females. The minimum, maximum, mean length and weight of 8 females were given in Table 2. The number of eggs in female varied between 9018 and 75938 eggs/individual. The mean total fecundity was 46343eggs/individual. Egg diameters ranged from 1.091 mm to 2.465 mm and mean egg diameter was found as 1.758 mm (Table 2). Relative fecundity for each kilogram of female fish was ranged from 7020 to 17510 eggs and mean relative fecundity was calculated as 13000 eggs.

The relationships between total fecundity-length (Figure 4) and total fecundity-weight (Figure 5) were determined as  $F = 0.0009 \times TL^{4.045}$  and  $F = 2.2433 \times W^{1.213}$ , respectively. It was found that the number of eggs (total fecundity) increased in parallel with length and weight increase (Figure 4-5). Coefficients of correlation showed that there were strong relationships between total fecundity-length ( $r^2 = 0.830$ ) and total fecundity-weight ( $r^2 = 0.801$ ) of *S. glanis* inhabiting Siddıklı Reservoir.

**Table 2.** Fecundity and egg diameter of *S. glanis* inhabiting Sıddıklı Reservoir.

	N	Mean Total Length (Min-Max) (cm)	Mean Total Weight (Min-max) (g)	Minimum	Maximum	Mean±Sd
<b>Fecundity</b>	8	77.8	3509.46	9018	75938	46343±25012.429
<b>Egg Diameter</b>		(56.6-98.4)	(1283.6-7465.1)	1.091 mm	2.465 mm	1.758±0.604

**Figure 4.** The relationships between total fecundity and total length in *S. glanis*.**Figure 5.** The relationships between total fecundity and total weight in *S. glanis*.

## Discussion

In this study, the sex ratio was found not to be statistically different from the expected 1.00:1.00 ( $\chi^2 = 0.841$ ,  $P > 0.05$ ). Alp et al. (2004) found that sex ratio was 1.00:0.82 in Menzelet Reservoir and that this ratio was not different from expected 1.00:1.00. Sex ratios were reported as 50.62% male and 49.38% female in Hirfanlı Dam Lake (Doğan Bora and Gül 2004), 60.94% female, 26.56% male and 12.50% unsexed in Altınkaya Dam Lake (Yılmaz et al. 2007), 49.1% of female and 50.9% of male in İznik Lake (Uysal et al. 2009), 40.91% female, 59.09% male in Çelik Lake (Yüngül et al. 2014) and 42.86% female, 57.14% male in Altınkaya Dam Lake (Saylar 2014). In the literature, the numbers of male and female individuals are generally close to each other.

It has been determined that the reproduction period of *S. glanis* in the Sıddıklı Reservoir continued from April to June according to the monthly GSI changes of all individuals. As a matter of fact, Alp et

al. (2004) reported that hunting for *S. glanis* in Turkey has banned between 1 April and 1 August. It has been reported that this species was breeding from June to August in the Menzelet Reservoir (Alp et al. 2004) and from May to June in Karasu Stream (Akyurt 1988). In this study, the water temperature in reproduction period was measured as 14.9 °C in April 18.1 °C in May and 20.8 °C in June, respectively. Akyurt (1988) found that the water temperature in the prior of reproduction season in Karasu Stream was 16-18 °C. In other studies, the water temperature at the time of reproduction was noted as 15-18 °C (Slastenenko 1956) and 18-22 °C (Copp et al. 2009). The results of this study are quite compatible with other studies in terms of both reproduction time and water temperature. Also, the spawning season is dependent on the ecological conditions of the habitats and is closely related to the water temperature (Akyurt 1988). For this reason, reproduction time may vary depending on water temperature, latitude and climatic characteristics of habitats.

In this study, total fecundity ranged from 9018-75938 egg/individual and mean total fecundity was determined as 46343 egg/individual. Akyurt (1988) found that *S. glanis* had 12.700 eggs per kilogram in the Karasu Stream. The mean total fecundity of *S. glanis* was calculated as 87108 egg/individual (Alp et al. 2004). Copp et al. (2009) reported that the mean total fecundity was found to vary between 14.600-354.000 eggs/individual in *S. glanis* populations. The total fecundity value obtained in this study was lower than other studies. As a matter of fact, Jones (2009) reported that fecundity decreased because of the slowing of fish growth. The fact that the growth of *S. glanis* inhabiting in Sıddıklı Reservoir is very slow (Yazıcı 2018) confirms the results of this research. Although there are fishing at least twice each month during the reproductive period in this study, gonads were taken only from 8 fish. The lack of the number of fishes that reached reproduction maturation led to this situation. In this respect, although the value of total fecundity in this study suits the reference values reported by Copp et al. (2009), it is considered that an actual comparison cannot be made. However, relative fecundity for each kilogram of female fish was 13000 eggs in this study. The number of eggs per kilogram 12700 eggs in the Karasu Stream (Akyurt 1988). Alp et al. (1988) found that *S. glanis* had 8434

eggs per kilogram in the Menzelet Reservoir. Relative fecundity values of this study were higher than other studies. The weight and lengths of fish in the sample led to this situation.

In this study, it was determined that the egg diameter of *S. glanis* ranged from 1.091 mm to 2.465 mm and mean egg diameter was 1.758 mm. Akyurt (1988) reported that mean egg diameter of this species was 2.500 mm in Karasu Stream. The diameters of the egg of *S. glanis* inhabiting Menzelet Reservoir vary between 1.000 mm and 3.630 mm, and the mean egg diameter is 2.130 mm (Alp et al. 2004). According to the results of this study, egg diameters of the *S. glanis* were lower than the other studies. The lack of the number of fishes that reached reproduction maturation may have caused this situation.

The strong relationships which are exponential between fecundity and length and fecundity and weight were determined in this study. Also, fecundity increased with the weight and length increases. Alp et al. (2004) reported that there are strong correlations between fecundity and length and fecundity and weight in *S. glanis* inhabiting Menzelet Reservoir and noted that the number of eggs was closely related to the increase in length and weight ( $r^2 > 0.899$ ).

In conclusion, *S. glanis* inhabiting Sıddıklı Reservoir performed reproduction activities between April and June. The changing climate conditions due to global warming can be affect the reproduction season of fish. Therefore, constant updating of the reproduction times of the fish species in each habitat and the regulation of fishing bans according to the habitats will be beneficial for the future of fish populations.

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### References

- Akyurt İ. 1988. Iğdır Ovası Karasu Çayı'nda yaşayan yayın balıklarının (*Silurus glanis* L.) biyokolojisi ve ekonomik değer taşıyan verimleri üzerine bir araştırma. Atatürk Üniv. Ziraat Fak. Derg. 19(1-4): 175-188. [in Turkish]
- Alp A, Kara C, Büyükçapar HM. 2004. Reproductive biology in a native European catfish, *Silurus glanis* L., 1758, population in Menzelet Reservoir. Turk J Vet Anim Sci. 28(3): 613-622.
- Anonymous 2011. Kırşehir il çevre durum raporu. Kırşehir Valiliği 219 p. [in Turkish]
- Chakraborty BK, Mirza ZA, Miah MI, Habib MAB, Chakraborty A. 2007. Reproductive cycle of the endangered *Sarpunti*, *Puntius sarana* (Hamilton, 1822) in Bangladesh. Asian Fisheries Science 20(1/2): 145-164.
- Copp GH, Britton JR, Cucherousset J, García-Berthou E, Kirk R, Peeler E, Stakénas S. 2009. Voracious invader or benign feline? A review of the environmental biology of European catfish *Silurus glanis* in its native and introduced range. Fish Fish. 10(3): 252-282. doi: 10.1111/j.1467-2979.2008.00321.x
- Devlaming V, Grossman G, Chapman F. 1982. On the use of the gonadosomatic index. Comp Biochem Phys Part A. 73(1):31-39. doi: 10.1016/0300-9629(82)90088-3
- Doğan Bora N, Gül A. 2004. Feeding biology of *Silurus glanis* (L., 1758) living in Hirfanlı Dam Lake. Turk J Vet Anim Sci. 28(3): 471-479.
- Froese R. 2004. Keep it simple: three indicators to deal with overfishing. Fish Fish. 5(1):86-91. doi: 10.1111/j.1467-2979.2004.00144.x
- Geldiay R, Balık S. 2007. Türkiye tatlısu balıkları. İzmir: Ege Üniversitesi Su Ürünleri Fakültesi Yayınları 644 p. [in Turkish]
- Jones MC. 2009. Chapter 2: Age and growth. In: Fuiman LA, Werner RG, editors. Fishery science: the unique contributions of early life stages, New Jersey (USA): John Wiley & Sons. p.33-62.
- Kottelat M, Freyhof J. 2007. Handbook of European Freshwater Fishes, Germany: Kottelat, Cornol. 646 pp.
- Le Cren ED. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the Perch (*Perca fluviatilis*). J Anim Ecol. 20(2):201-219. doi: 10.2307/1540
- Linhart O, Stech L, Svarc J, Rodina M, Audebert JP, Grecu J, Billard R. 2002. The culture of the European Catfish, *Silurus glanis*, in the Czech Republic and in France. Aquat Living Resour. 15(2):139-144. doi: 10.1016/S0990-7440(02)01153-1
- Polat N, Uğurlu S. 2011. Samsun ili tatlısu balık faunası. Samsun: Ceylan Ofset. 272 p. [in Turkish]
- Priyadharsini S, Manoharan J, Varadharajan D, Subramaniyan A. 2013. Reproductive biology and histological study of Red Lionfish *Pterois Volitans* from Cuddalore, South East Coast of India. J Aquac Res Development. 4(6):1-9. doi: 10.4172/2155-9546.1000201
- Reddy PB. 1979. Maturity and spawning in the Murrel, *Channa punctata* (Bloch, 1973) (Pisces, Teleostei, Channidae) from Guntur. Proc Indian Natl Sci Acad B Biol Sci B. 45(6):543-553.
- Saylar Ö. 2014. Comparative age determination methods of *Silurus glanis* L., 1758 living in Altınkaya Dam Lake according to their bony structures. The Journal of Adyutayam. 2 (2):1-7. [in Turkish]
- Slastenenko E. 1956. Karadeniz Havzası balıkları. İstanbul. Et ve Balık Kurumu Umum Müdürlüğü Yayınları. 711 p. [in Turkish].
- Uysal R, Yağcı M, Yeğen V, Cesur M, Yağcı A, Çetinkaya S, Bostan H. 2009. İznik Gölü (Bursa-Türkiye)'ndeki Yayın Balığı (*Silurus glanis* L., 1758) populasyonunun büyüme özellikleri. Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü Dergisi 13(3): 221-228. [in Turkish]

- Yazıcı R. 2018. Biological properties of the Wels Catfish (*Silurus glanis* L., 1758) from Sıddıklı Küçükboğaz Dam Lake [PhD Thesis]. Ahi Evran University. 154 p. [in Turkish]
- Yılmaz S, Yılmaz M, Polat N. 2007. Altınkaya Baraj Gölü (Samsun)'ndeki *Silurus glanis* L., 1758 populasyonunda yaş-boy, yaş-ağırlık ve boy-ağırlık ilişkileri üzerine bir araştırma. SDÜ Fen Edebiyat Fakültesi Fen Dergisi 2(1):18-26. [in Turkish]
- Yüngül M, Karaman Z, Dörücü M. 2014. Çelik Gölü'nde yaşayan yayın balığı (*Silurus glanis* Linnaeus, 1758)'nın yaş ve bazı büyüme özellikleri. Yunus Araştırma Bülteni 2014(4): 73-84. [in Turkish] doi: [10.17693/yunus.19089](https://doi.org/10.17693/yunus.19089)
- Zar JH. 1999. Biostatistical analysis. New Jersey (USA): Prentice-Hall. 663 p.