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# Growth and Reproductive Biology of Bream, *Acanthobrama thisbeae* (Freyhof&Özuluğ, 2014) a New Endemic Species in Sır Reservoir, Kahramanmaraş, Turkey

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## ABSTRACT

In this study growth and reproductive biology of endemic and new species *Acanthobrama thisbeae* in Sır Reservoir were investigated. The population were composed of 80.6% female and 19.40 % male individuals. The individuals' total lengths (mm) and total weights (g) varied between 130.4 to 260.5 mm and 12.92 to 203.89 g, respectively. Age groups 2 to 8 were identified in the population and the majority of the sample was between 130 to 180 mm (80.22%). The length-weight relationship for all samples was $W= 0.0000003*TL^{3.7265}$ with *b* value was significantly ($p<0.001$). The mean condition factors were 1.011±0.17 (n:263) between females and males. In observations of monthly changes, the gonadosomatic index (GSI) and the monthly frequency distribution spawning period were determined between April and June. Mean fecundity was 3574 egg/fish on mature individuals in reproductive periods. In addition, *A. thisbeae* individuals in Sır Reservoir were observed to be under the pressure of exotic species such as *Liza abu* and *Carassius gibelio*.

**Keywords:** *Acanthobrama thisbeae*, growth, reproductive, Sır Reservoir, Kahramanmaraş.

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**Sır Baraj Gölü'nde Endemik ve Yeni Tür *Acanthobrama thisbeae* (Freyhof&Özuluğ, 2014)'nin Büyüme ve Üreme Özellikleri, Kahramanmaraş, Türkiye**

**Öz:** Bu çalışmada, Sır Baraj gölündeki endemik ve yeni tür *Acanthobrama thisbeae*'nin büyüme ve üreme özellikleri incelenmiştir. Populasyonun %80,6'sı dişi ve %19,40'ı ise erkek bireylerden oluşmuştur. İncelenen bireylerin total boyları 130,4-260,5 mm, total ağırlıkları ise 12,92-203,89 g arasında değişim göstermiştir. Populasyon 2 ile 8 yaş grubu arasında tespit edilmiş ve örneklerin çoğunluğu 130 ile 180 mm boy grubuna ait bireylerden (%80,22) oluşmuştur. Bütün örneklerde boy-ağırlık ilişkisi $W= 0,0000003*TL^{3,7265}$ bulunmuş ve "*b*" değeri istatistiki olarak önemlidir ($p<0,001$). Kondüsyon faktörü ortalama 1,011±0,17 (n:263)'dir. Gonadosomatik indeks (GSI) değerlerine göre üreme dönemi Nisan ve Haziran ayları arasındadır. *A. thisbeae* populasyona ait olgun bireylerde ortalama fekondite ise 3574 yumurta/balık olarak tespit edilmiştir. Ayrıca Sır baraj gölündeki *A. thisbeae* bireylerinin *Liza abu* ve *Carassius gibelio* gibi exotik türlerin baskısı altında olduğu gözlemlenmiştir.

**Anahtar kelimeler:** *Acanthobrama thisbeae*, büyüme, üreme, Sır Baraj Gölü, Kahramanmaraş.

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## Introduction

Freshwaters of Turkey have a remarkable diversity of habitats, with essential variations in altitude, rainfall, temperature, topography and zoogeographical history, which is reflected by its richness of freshwater fishes and relatively high levels of endemism (Çiçek et al. 2018). According to a recent review of the literature, more than 368 freshwater fish species belonging to 34 families have distribution in inland waters of Turkey (Kuru et al. 2014). A total of 368 fish species live in the inland waters of Turkey. Among these, 4 species are globally extinct, 5 are extinct in Turkey, 28 are non-native, and 194 are considered endemic to Turkey (Çiçek et al. 2018).

The Cyprinid fishes of the genus *Acanthobrama* has about 11 species and 5 of them are occurred in inland waters of Turkey; *Acanthobrama marmid* in Tigris-Euphrates, *Acanthobrama centisquama* in Orontes River Basin, *Alburnus orontis* in Seyhan River Basin, *Acanthalburnus microlepis* in Aras-Kura River Basin and *Acanthobrama thisbeae* in Ceyhan River Basin (Freyhof and Özuluğ. 2014; Küçük et al. 2014). In the study conducted on the distribution of fish fauna in the Ceyhan River Basin, 20 species belonging to 10 families, including *Acanthobrama* sp., were identified (Kara et al. 2010). In the following years, *A. thisbeae* was defined, considering the morphological data by Freyhof and Özuluğ (2014).

Reproductive biology investigation of fish species is vital to assess the commercial potentialities of its stock, culture practice and actual management of its fishery (Doha and Hye 1970; Soofiani et al. 2006; Dopeikar et al. 2015). It has three critical components including sexual maturity, reproductive period and fecundity, which are important demographic characteristics essential for understanding a species' life history. In addition, age data are used to assess the fish population dynamics including growth, mortality and recruitment and stock structure; also, this data is also an essential component of age-structured population models (Bagenal 1967).

*A. thisbeae* is one of the important species that is endemic to Turkey. The main object of this study was to consider the reproductive biology of the *A. thisbeae*, including the length-weight relationship, gonadosomatic index, fecundity, spawning season and condition factors necessary for conducting conservation and management programs of the species.

There are some studies on *A. thisbeae*. Çelik (2019) determined the phylogenetic position of *A. thisbeae* with molecular data. Ali (2015) identified some biological properties of *A. thisbeae* in Sır Reservoir. Kılıç (2016), on the other studies on the bioecological characteristics of *A. thisbeae* in lake Azaplı (Adıyaman). Apart from the studies as mentioned above, no comprehensive research has been found on this species. In this study, it was aimed to determine the growth and reproduction characteristics of *A. thisbeae* in Sır Reservoir.

## Materials and Methods

Sır Reservoir, constructed on the river Ceyhan in the East Mediterranean region of Turkey in 1987-1991, has a surface area of 47.50 km$^2$ at 600 m altitude and it is used for electrical energy production (Kara and Solak 2004). The fish fauna of the reservoir consists of *Acanthobrama* sp., *A. orontis*, *Silurus glanis*, *Cyprinus carpio*, *Capoeta angorae*, *Capoeta erhani*, *Barbus rajanorum*, *Squalius kottelati*, *Chondrostoma regium* and *Anguilla anguilla*. *A. anguilla* used to inhabit this area but it is now extinct, because 6 dam lake and reservoirs; Aslantaş, Berke, Kartalkaya, Kılavuzlu, Menzelet and Sır have been constructed on the river Ceyhan in succession and there is no fish passage or lifting systems on these dams (Kara et al. 2010; Alp et al. 2003, 2015).

The body of *A. thisbeae* individuals is silvery brown in the dorsal area, the abdomen is dirty white and the scales are small and the mouth is terminal. The head size of *A. thisbeae* is smaller than the body height. The last unbranched ray of the dorsal fin is not rigid and is clearly different from individuals of *A. marmid* with this feature. The body rises obliquely from the nape to the front of the dorsal fin. It has a concave structure between the head and nape area. The caudal fin has deep lobes and the tip of the lobes is sharp (Figure 1).


**Figure 1.** Sample of *A. thisbeae* from Sır Reservoir.

Samples of *A. thisbeae* were collected from December 2012 to September 2013 from commercial fishery catches. Fresh samples of *A. thisbeae* were brought to the laboratory after being placed on ice and the total length and weight were determined to the nearest 1 mm and 0.01 g, respectively. Gonads were weighed (Wg) with a precision of 0.01 g. Upon visual and microscopic examination of the gonads, sex and maturity stages were determined. The scale samples were removed from the left side of specimens, from the ventral to the dorsal fin for the age determination. Scales were removed from each fish and cleaned in a 5% sodium hydroxide solution for age analyses according to Chugunova (1959). The scales were scanned using a light microscope in order to determine the ages of the fish. All scales were read in triplicate.

The regression equation for the length–weight relationship was calculated using the least-squares method; the data were commonly used in this equation: $W = a \times TL^b$, where W is the total weight (g) and *TL* is the total length (mm). The hypothesis of isometric growth (Ricker 1975, Sparre and Venema 1998) was tested with Student's t-test.

The condition factor (*K*) was calculated monthly with the formula $K=(W/TL^3) \times 100.000$, where *W* and *TL* are the total weight and total length, respectively (Özdamar 1999).

The spawning period was estimated based on the monthly changes in gonads and monthly variations in oocyte sizes of samples. Gonadosomatic index (GSI) was calculated using the equation: $GSI = (Wg / W) \times 100$, where *Wg* and *W* are gonad weight and the total weight of fish in grams, respectively (Bagenal and Braun 1978).

All sampled fish were then dissected, gonads removed and weighed, and sex determined visually or by microscope. The gonads were preserved in 4% formalin solution. To calculate fecundities, the ovaries were weighed; three subsamples were taken from the front, mid-and rear-section of each ovary and weighed. The total number of eggs in each subsample ovary was determined. This value was proportional to the total ovary weight; the number of eggs (F1) for the subsample was estimated using the equation, F1= (Gonad weight x number of eggs in the subsample)/subsample weight (Yeldan and Avşar 2000). Later, by taking the mean number of three subsample fecundities (*F1*, *F2* and *F3*), the individual fecundity for each female fish was calculated *[F=(F1+F2+F3 )/3]* (Alp et al. 2003). Total length, fecundity and body weight and fecundity relationships were determined from the equations:

$$In\ F = a + b\ x\ In\ TL;\ F = q\ x\ TL^b$$

$$In\ F = a + b\ x\ In\ W_B;\ F = q\ x\ W_B^b$$

where *F* is the number of eggs (fecundity), *TL* and $W_B$ are the total length (mm) and body weight (g) respectively. 'a' and 'b' are constant parameters in linear regression analysis and $q=e^a$. Fecundity was estimated according to Bagenal and Braun (1978). The diameters of 10 ova (30 ova in each female fish) were measured by a digital micrometre. The egg shapes were round and slightly hard when diameters were being measured. The mean fecundities and mean egg diameters for individuals were recorded by age, length, and weight of each examined female fish.

## Results

### Length Frequency and Age Distribution

During the sampling period (from December 2012 to September 2013), a total of 263 individuals of *A. thisbeae* were examined, ranging in total length from 130.40 to 260.50 mm (Figure 2 a). Of these individuals, 212 were females (80,6%) and 51 were males (19,40%). The obtained results showed that the age of this species ranged from 2 to 8 years (Figure 2 b).

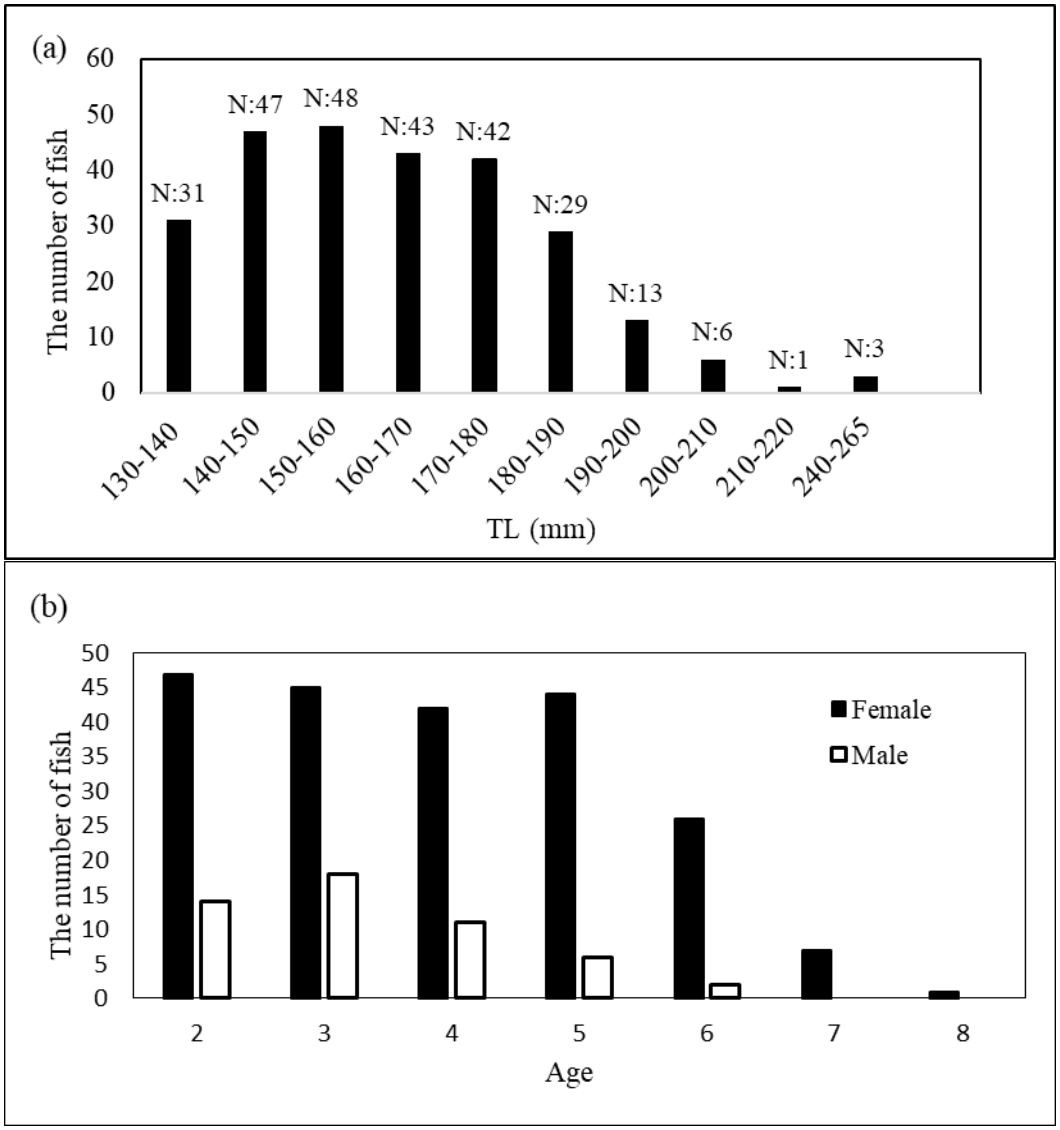


**Figure 2.** Total length (mm) (a) and age (b) distributions of *A. thisbeae*.

Most of the fish were 2 (27,4%), 3 (35,6%) and 4 (35,6%) years old and seven of them were 7 (4,9%) and only one of them was 8 (4,9%) years old (Table 1). According to the t-test results, the average total length and weights are significant, except for the two age groups (p> 0,05); the difference between other age groups is significant (p<0,05).

**Table 1.** The mean lengths (mm) and total weights (g) in the age groups of *A. thisbeae* from Sır Reservoir (N: Number of fish, W: Weigth, SD: Standart deviation).

| Age | Sex | N | Mean TL(mm) | Min-Max | SD | W(g) | Min-Max | SD | t-test |
|---|---|---|---|---|---|---|---|---|---|
| **2** | Female | 47 | 139.67 | 130.4-149.00 | 5.41 | 24.35 | 12.92-29.81 | 2.94 | p>0.05 |
| | Male | 14 | 141.53 | 132.78-148.72 | 5.52 | 26,28 | 20.15-34.8 | 3,81 | |
| **3** | Female | 45 | 150.49 | 140.00-165.29 | 5.88 | 31.17 | 24.4-42.7 | 4.75 | p<0.05 |
| | Male | 18 | 151.59 | 140.00-160.4 | 5.24 | 30.67 | 24.93-39.8 | 4.93 | |
| **4** | Female | 43 | 165.76 | 150.6-190.9 | 10.12 | 47.23 | 28.82-76.53 | 11.12 | p<0.05 |
| | Male | 11 | 159.49 | 140.5-170.8 | 10.53 | 42.13 | 31.36-55.08 | 7.84 | |
| **5** | Female | 43 | 174.14 | 160.0-200.3 | 10.71 | 62.88 | 38.30-95.3 | 12.67 | p<0.05 |
| | Male | 6 | 159.89 | 150.0-170.1 | 10.49 | 42.06 | 34.58-57.11 | 9.21 | |
| **6** | Female | 26 | 181.70 | 160.1-200.1 | 11.32 | 70.87 | 46.6-102.41 | 12.29 | - |
| | Male | 2 | 185.25 | 180.5-190.0 | 6.71 | 65.90 | 62.78-69.03 | 4.41 | |
| **7** | Female | 7 | 220.32 | 200.0-250.1 | 22.21 | 136.90 | 87.16-203.89 | 46.41 | - |
| | Male | 0 | | | | | | | |
| **8** | Female | 1 | 260.5 | | | 160.17 | | | |
| | Male | 0 | | | | | | | |

The length-weight relationship for *A. thisbeae* is shown in Figure 3. The relationship was determined as W= $0.0000003*TL^{3.7265}$. The *b* value was significantly bigger than 3.0 ($p<0.001$), which indicates positive allometric growth of *A. thisbeae.*

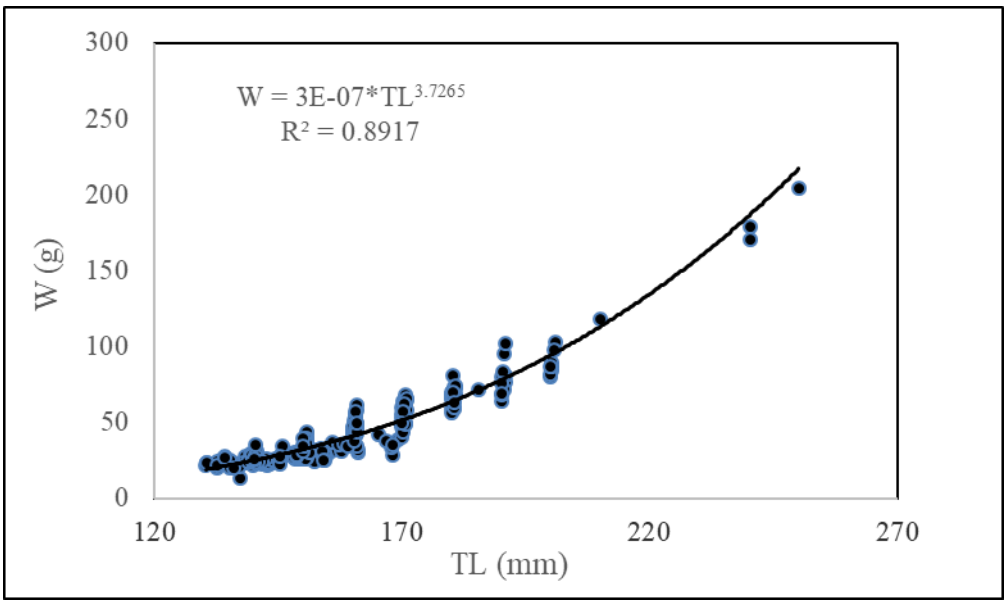


**Figure 3.** Length–weight relationship of *A. thisbeae*.

The condition factor of *A. thisbeae* population in Sır Reservoir was determined as 1.011 ± 0.17 on average. The condition factor variation of the *A. thisbeae* population by months is given in Table 2. The lowest condition value was seen in March while the highest condition value was seen in July.

**Table 2.** Mean condition factor values of *A. thisbeae* (n:263)

| | **Dec.** | **Jan.** | **Feb.** | **Mar.** | **Apr.** | **May** | **June** | **July** | **Sep.** |
|---|---|---|---|---|---|---|---|---|---|
| | **N:41** | **N:17** | **N:16** | **N:21** | **N:26** | **N:21** | **N:57** | **N:30** | **N:35** |
| **Mean** | 0.988 | 0.909 | 0.862 | 0.835 | 0.837 | 0.881 | 1.169 | 1.191 | 1.069 |
| **Min.** | 0.820 | 0.750 | 0.725 | 0.605 | 0.499 | 0.695 | 0.340 | 1.012 | 0.818 |
| **Max.** | 1.164 | 1.077 | 1.028 | 0.972 | 1.122 | 1.158 | 1.481 | 1.345 | 1.309 |
| **SD** | 0.067 | 0.105 | 0.092 | 0.084 | 0.114 | 0.110 | 0.166 | 0.083 | 0.096 |

**Seasonal Fluctuations in the Gonadosomatic Index (GSI)**

The breeding period of *A. thisbeae* individuals living in Sır Reservoir was determined by the monthly development of the gonadosomadic index (GSI). Accordingly, GSI varied between 0.18 and 15.27 in a total of 201 *A. thisbeae* female individuals. Gonadosomatic index value was the lowest in December (GSI = 0.18) and the highest in April (GSI = 15.27). According to the data, the spawning season of the *A. thisbeae* population in Sır Reservoir was determined between April and June (Figure 4).

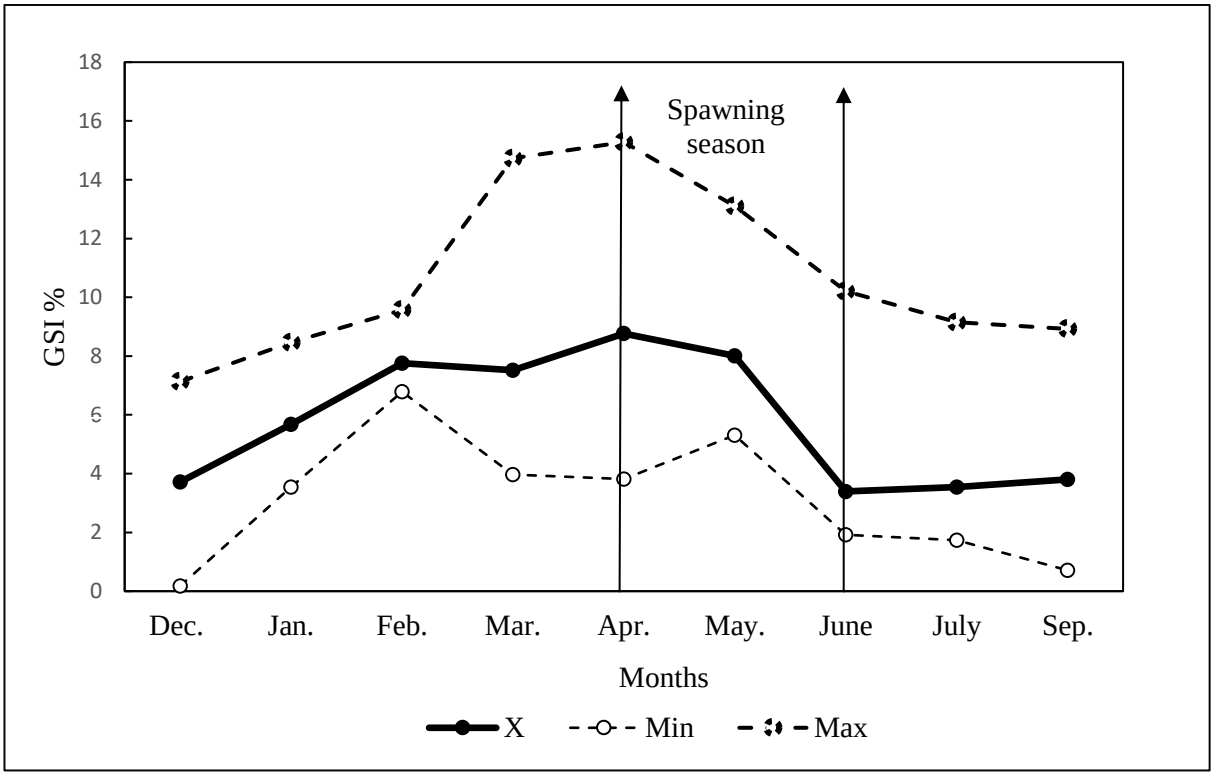


**Figure 4.** Monthly variation of gonadosomatic index (GSI) of female *A. thisbeae* individuals

The average fecundity of 67 female individuals belonging to *A. thisbeae* in Sır Reservoir was determined as 3574 eggs/fish. The average fecundity varied between 2767 (in February) and 5114 (in March) eggs/fish (Table 3).

**Table 3.** Monthly fecundity variation of *A. thisbeae* (NF: number of fish; Egg (N), MTL: mean total length (mm); $MW_B$: Mean body weight (g), MF: Mean fecundity, number of eggs (min-max.).

| Months | NF | Egg (N) | MTL (mm) | $MW_B$(g) | Mean Fecundity (Min-Max) |
|---|---|---|---|---|---|
| **January** | 12 | 360 | 145.59 | 28.33 | 3329(1950-5215) |
| **February** | 11 | 330 | 143.59 | 25.08 | 2767(1767-3947) |
| **March** | 17 | 510 | 150.52 | 28.73 | 5114(2862-10587) |
| **April** | 16 | 480 | 144.46 | 24.79 | 3323(2348-6082) |
| **May** | 12 | 360 | 150.70 | 29.58 | 3457(2246-5073) |

Linear relationship was found between fecundity and the total length, body weight (Figure 5). These positive correlations may be expressed by the following regression equations:

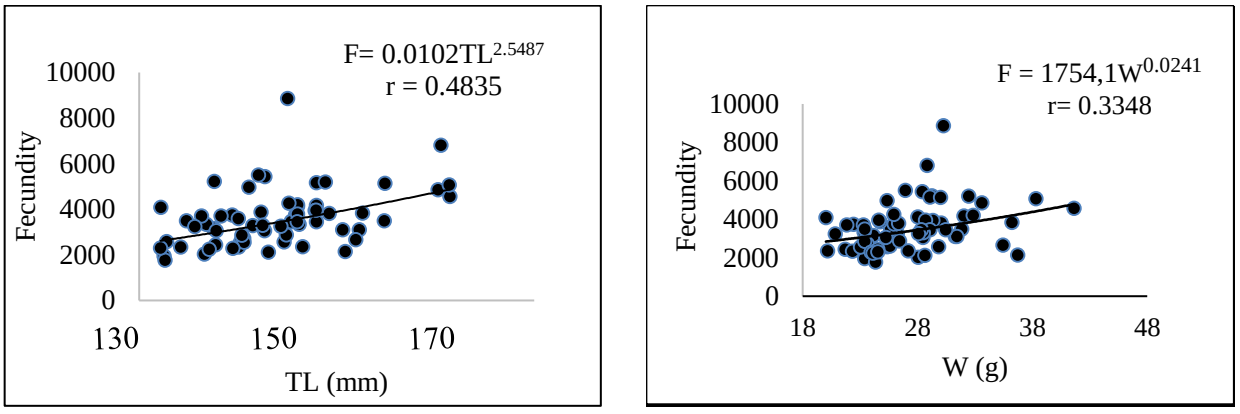


**Figure 5.** Relationships between fecundity and body weight and total length in 67 *A. thisbeae*.

## Discussion

*Acanthobrama* sp. was reported by Kara et.al (2010) from the Sır Reservoir, after that this species was defined as a new species *A. thisbeae* by Freyhof and Özuluğ (2014). There are few studies in the literature regarding for *A. thisbeae*. Freyhof and Özuluğ (2014) report that the standard length of *A. thisbeae* individuals in Sır Reservoir is between 154.9 and 173.8 mm. Kılıç (2016) states that the *A. thisbeae* population in Lake Azaplı (Gölbaşı, Adıyaman) varies between 1-5 age groups and the most dominant age group is 1 year old (62,85%), in that study, the average total length was 125.5 mm and the maximum length was 215.0 mm. Ali (2015) reported that in individuals of *A. thisbeae* in Sır Reservoir, fork lengths varied between 164.3 mm and 228.0 mm in females and between 158.7 and 177.5 mm in males. In this study, it was determined that *A. thisbeae* individuals in Sır Reservoir were between the ages of 2-8 and the majority of the population (80,22%) were between 130.0 and 180.0 mm in height. The total length of 260.5 mm detected in the Sır Reservoir was the new maximum length for this species.

The value of condition factor in fish varies depending on various factors such as fish size, sampling date, reproduction time, season, disease and parasite status of the fish (Bagenal and Tesch 1978; Welcomme 2001). Ali (2015) states that the average condition factor of *A. thisbeae* individuals in Sır Reservoir is between 1.50 and 2.03 in females and 1.41 and 1.89 in males. In this study, the condition factor was found to be 1.011±0.17 (n:263) in the *A. thisbeae* populations in Sır Reservoir.

Spawning seasons of *Achanthobrama* species were differed in different habitats. The spawning season of *A. marmid* individuals in the Tigris River was in May-June (Ünlü et al. 1994), *A. mirabilis* in the Kemer Reservoir was in April-June (Özcan and Balık 2009), and *Achanthobrama telaviensis* in the Yarqon stream was also in April-June (Elron et al. 2006). According to the gonadosomatic index (GSI) values, the spawning season of the *A. thisbeae* population in the Sır Reservoir was determined between April and June (Figure 4).

The mean fecundity of the population was 3574 eggs/fish. It was concluded that the fecundity value of Sır Reservoir *A. thisbeae* individuals was low according to the relations of total length-fecundity and weight-fecundity (Figure 5).

It is known that *A. thisbeae* is one of the most important species that are caught in the reservoir according to commercial fisheries and constitutes a dense stock in Sır Reservoir (Çelik 2019). However, in the studies conducted between 2014 and 2016 (Kara and Alp 2014), it was seen that the *A. thisbeae* populations, living only in Sır Reservoir in the middle and upper Ceyhan River Basin, were decreased significantly. While *L. abu* and *C. gibelio* species were not seen in the previous study (Kara et al. 2004) in the Sır Reservoir, in the field studies conducted in 2014-2016, *Liza abu* and *Carassius gibelio* individuals were found to be widespread in the Sır Reservoir. It has been determined that fishermen catch these fish species and *A. thisbeae* individuals are now less caught. It is thought that *L. abu* and *C. gibelio* individuals put pressure on *A. thisbeae* populations as the reason for the significant decrease in *A. thisbeae* populations in Sır Reservoir. In addition, the majority of *A. thisbeae* individuals caught from Sır Reservoir have lesions in different parts of their bodies. It is important to take the necessary measures to protect the endemic new species *A. thisbeae* population living in the Ceyhan river system.

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