



Length-Weight Relationships for an Endemic Species *Aphanius transgrediens* from Lake Acıgöl (Afyonkarahisar-Turkey)

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ABSTRACT

In this study, it is aimed to investigate length-weight relationships (LWRs) of Acıgöl toothcarp (*Aphanius transgrediens* Ermin, 1946) population from Lake Acıgöl, Afyonkarahisar in Turkey. For this purpose, 144 females and 16 males were examined, totally. The total lengths of female, male and total specimens were measured 2.0-4.7 cm, 2.3-4.0 cm, 2.0-4.7 cm. Also, their weights were found 0.15-1.94 g, 0.32-0.82 g, 0.15-1.94 g, respectively. LWRs parameters have been calculated: intercept (a) was found 0.0262, 0.0145, 0.0237; slope (b) was found 2.661, 3.056, 2.732 for females, males and for all specimens, respectively. While growth type was determined negative allometric for females and for all specimens, it was detected isometric for males.

Keywords: *Aphanius transgrediens*, killifish, endemic fish, length-weight relationship, Lake Acıgöl

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Acıgöl (Afyonkarahisar-Türkiye) Endemiği *Aphanius transgrediens*'in Boy-Ağırlık İlişkisi

Öz: Bu çalışmada, Türkiye Acıgöl'de dağılım gösteren Acıgöl dişli sazancık (*Aphanius transgrediens* Ermin, 1946) populasyonunun boy-ağırlık ilişkisinin (BAİ) belirlenmesi amaçlanmıştır. Bu amaçla, 144 dişli ve 16 erkek birey incelenmiştir. Total boy değerleri dişiler, erkekler ve tüm bireyler için 2,0-4,7 cm, 2,3-3,4 cm ve 2,0-4,7 cm olarak ölçülmüştür. Total ağırlık sırasıyla 0,15-1,94 g, 0,32-0,82 g, 0,15-1,94 g olarak bulunmuştur. BAİ parametreleri hesaplanmış; keşişim noktası " a " dişli, erkek ve tüm bireyler için sırasıyla, 0,0262, 0,0145 ve 0,0237; eğim " b " değeri ise 2,661, 3,056 ve 2,732 olarak hesaplanmıştır. Büyüme tipi, dişiler ve tüm bireyler için negatif allometrik olarak bulunurken, erkek bireyler için isometrik olarak belirlenmiştir.

Anahtar kelimeler: *Aphanius transgrediens*, dişli sazancık, endemik balık, boy-ağırlık ilişkisi, Acıgöl

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Introduction

In terms of fisheries management length and weight data of fish are very useful and they are always used in fish population estimate programs (Özaydın and Taşkavak 2006). In addition, LWR is very significant parameter to estimate condition factor of fish populations; to find growth rates; to guess stock biomass from limited sample size; to comparison the populations morphologies and their life cycles in different habitats (Petraakis and Stergiou 1995; Tarkan et al. 2006). LWR analysis reveals the level and direction of relationships between the environmental variables and the species.

Cyprinodontidae very large family is represented in every continent, except Australia, also their

preference is bounded by warm temperate and tropical climates (Sterba 1973). *Aphanius* one of the genus of the family are widely distributed from south Europe, east Mediterranean, to north and east Africa (Hrbek and Meyer 2003). They are euryhaline fishes (Geldiay and Balık 2007) and as it is claimed by Kosswig (1967) that *Aphanius* has distributed Tethys Sea and they are Tethyan relicts.

Aphanius member's lengths are generally changes in 4-8 cm (Wildekamp 1993). Their color widely changes according to females, males and species. They are omnivore fishes, they generally feed on algae, insects, mollusks (Geldiay and Balık 2007) and also they frequently prefer mosquito larvae for nutrition (Yıldırım and Karaçuha 2007).

Because of these nutrition preferences they are used in biological control against to mosquitos, in some countries (WHO 2003). Although the genus members generally don't have an important commercial value, they are very significant for ecosystems because of their role in the food chain and number of endemic species in the genus (Leonardos 1996; Sarı et al. 2007). Genus members' reproduction time start at the beginning of spring to the end of summer (Leonardos and Sinis 1998).

Acıgöl toothcarp, *Aphanius transgrediens* is one of the Turkey's endemic fish which is inhabited in Lake Acıgöl (Freyhof et al. 2014). Since endemic species are substantial for biodiversity, it is necessary to follow up the characteristics of the type of growth of these fishes. In addition to this, conservation status of *A. transgrediens* is Critically Endangered (CR) in the IUCN (1996) Red List of Threatened Species, it has estimated that its population in danger since at the beginning of the 21th century (Yoğurtçuoğlu and Ekmekçi 2014a). Nonetheless introduced species such as *Gambusia* sp. in Lake Acıgöl should be regarded as a serious threat to the populations of the species, too (Wildekamp and Valkenburg 1994). For all that, habitat destruction, climate changes and especially industrial pollution threat the future of species. Because of the reasons mentioned it has become more important for studying on *A. transgrediens*.

Several aspects of the genus *Aphanius* were studied by different authors in Turkey. For instance, its biogeography was determined by Hrbek et al. (2002), genetic properties were searched by Bardakçı et al. (2004) and Gaffaroğlu et al. (2014), population dynamics were studied by Güçlü and Küçük (2008), morphometric features were defined by Ergüden (2015), feeding regime were investigated by Yıldırım and Karaçuha (2007) and their parasitic fauna were appointed by Öztürk and Özer (2008). Although it is limited, there are some studies about *A. transgrediens* as their general features, conservation, length-weight relationship (Yoğurtçuoğlu and Ekmekçi 2014a, 2014b, 2015).

Material and Methods

Lake Acıgöl is also known as Lake Çardak which is an example of such basins with its tectonic sedimentary development as a prominent shallow-perennial playa-lake or endorheic lake (Helvacı et al. 2012). It is located in Afyonkarahisar and Denizli provinces. Lake Acıgöl is a significant wetland area and also an important location to extracting natural sodium that Turkey's sodium sulfate extracted from it (Gündoğan et al. 1995).

The lake has an area of 50 km² and is 836 meters altitude maximum (Özdemir and Bahadır 2009). Although the lake fed from the groundwater, it is surrounding with the Gemiş springs, also some mountain brooks which are pouring out to the lake their waters, from the south part. The study area has showed with warm temperate in main climates, summer dry in precipitation and has semi-arid climate conditions in the Köppen Climate Classification study (Kottek et al. 2006). The water of lake is reduced in summer and dry in some places, frequently.

The fish fauna of the lake especially prefer to live in south part, because permanent hardness is more appropriate. All samples were collected from this part of Lake Acıgöl by seine net in October 2012. Throughout the study, 160 of *A. transgrediens* specimens were chosen randomly from the samples (other specimens were released).

All of the specimens were measured to nearby 0.05 mm in total length with a vernier caliper and weighed to nearby 0.001 g in total weight with digital scales. These total length measures of all specimens were used to calculate LWR with

$$W = aL^b$$

equation (Ricker 1975).

W is the total weight (g), L is the total length (cm), a (intercept) and b (slope) are regression constants in this equation (Zar 1984). Subsequently, the student t-test was used for determination of growth types. Before determined LWR equality, correlation coefficient significance test was calculated (Zar 1984; Sümbüloğlu and Sümbüloğlu 2005).

Results

In this study, it has been determined that lengths were between 2.0-4.7 cm, 2.3-3.4 cm; weights were between 0.15-1.94 g, 0.32-0.82 g for females and males. The slope of length-weight relationships were determined 2.661, 3.056 and 2.732 for females, males, for all specimens respectively. The values for correlation coefficient (r) for all the LWR parameters of females, males and entire specimens and were highly significant ($P < 0.05$; Table 1). As a result of correlation coefficient significance tests for female, for male and for all specimens' results were significant. (Correlation coefficient significance tests results for females $t_{cal}=33.5$, $P < 0.05$; for males $t_{cal}=10.422$, $P < 0.05$; for all specimens $t_{cal}=46.8$, $P < 0.05$). Considering the results, growth type were found negative allometric for females, isometric for males and negative allometric for all specimens. Estimated parameters and statistics analysis results for the species are given (Table 1).

Table 1. Total length, total weight and LWR parameters of *A. transgrediens*.

Sex	n	Length Avg±SE	Weight Avg±SE	r	a	b	SE(b)	t _{cal}	Growth type
♀♀	144	2.0-4.7 3.34±0.445	0.15-1.94 0.68±0.244	0.939	0.0262	2.661	0.082	-4.127	Allometric (-)
♂♂	16	2.3-3.4 3.09±0.271	0.32-0.82 0.51±0.116	0.939	0.0145	3.056	0.301	0.186	Isometric
♀♀ + ♂♂	160	2.0-4.7 3.32±0.034	0.15-1.94 0.66±0.019	0.936	0.0237	2.732	0.081	-3.279	Allometric (-)

Discussion

According to Froese and Pauly (2006) LWR parameter suggests (If *b* constant is found 2.5-3.5 and *a* constant is in approach to 0.01, it is an expected result for fusiform fishes) in these studies' results are in normal range. Considering the previous studies, it has seen that there is only one data on *A. transgrediens* LWR, which was given in 2015. In the study, it has been determined female and male's length ranges were 1.78-5.41 cm, 2.16-4.44 cm; weight ranges were 0.06-2.44 g, 0.11-1.14 g. Also they have been found slope as 3.29 and 3.26 females and males, respectively (Yoğurtçuoğlu and Ekmekçi 2015).

Also some other endemic *Aphanius* species results are given from Turkey. Because of *A. anatolia* (Baltain Creek, Ankara) and *A. saldae* (Salda Lake, Burdur) habitats are closer *A. transgrediens* habitat, to discussing the values of the two species are suitable with them. For *A. anatolia* it has been found female and male length ranges were 2.68-5.57 cm, 2.03-4.58 cm; weight ranges were 0.21-3.30 g, 0.12-1.25 g; slope has been found as 3.23 and 3.39; one of the other species for *A. saldae*, it has been found female and male length ranges were 3.87-6.01 cm, 4.02-5.47 cm; weight ranges were 0.62-2.06 g, 0.61-1.60 g; slope has been found as 2.94 and 2.90 females and males, respectively (Yoğurtçuoğlu and Ekmekçi 2015).

It is seen that LWR parameters of Yoğurtçuoğlu and Ekmekçi (2015) studies' results are higher (except *A. saldae*'s males' slope result) than this studies' results. Consequently, dissimilarities may have caused LWRs values because of the differences on sampling times and locations, sample sizes and fishing gears. All of these other, introduction of exotic species as *Gambusia holbrooki* in 1992 may have a negative impact to *A. transgrediens* populations (Wildekamp et al. 1999). Therefore, in order to protect the existence of freshwater resources of the lake must be precious; also it is necessary to increase and expansion of coverage this kind of studies.

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