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Body size and age structure of the *Parvilacerta parva* (Boulenger, 1887) population from Sivas, Turkey

Tuğba ERGÜL KALAYCI[1], İbrahim UYSAL[2], Çiğdem GÜL[2], Nurhayat ÖZDEMIR[1*]

ABSTRACT: Longevity and age of sexual maturity are key life history trait factors directly linked to ecological and evolutionary aspects. In this study, we determined age structure of *Parvilacerta parva* individuals from Sivas (Turkey) using skeletochronology. The maximum age was found to be seven years for females and six years for males of *P. parva*. A significant relationship was found between age and body size in individuals whose head length, head width and body length were measured. Additionally, it was seen that there is a significant relationship among body length, head length and head width.

Keywords: *Parvilacerta parva*, Dwarf Lizard, Lacertidae, skeletochronology, life-history traits

Parvilacerta parva'nın Sivas, Türkiye'deki populasyonunun vücut büyüklüğü ve yaş yapısı

ÖZET: Yaşam tarihi özelliklerinden; ömür uzunluğu ve eşeysel olgunluk yaşı, bireyin ekolojik ve evrimsel safhaları ile direkt bağlantılı kilit faktörlerdir. Bu çalışmada Sivas'tan (Türkiye) toplanan *Parvilacerta parva* bireylerinin iskelet kronolojisi yöntemi ile yaş yapıları belirlenmiştir. Maksimum yaş *P. parva*'nın dişi bireylerinde 7 yıl, erkeklerinde 6 yıl olarak bulunmuştur. Baş uzunluğu, baş genişliği ve vücut uzunluğu belirlenen bireylerde, yaş ve vücut boyu arasında anlamlı bir ilişki tespit edilmiştir. Bununla birlikte, vücut uzunluğu, baş uzunluğu ve baş genişliği arasında da anlamlı bir ilişki mevcuttur.

Anahtar Kelimeler: *Parvilacerta parva*, Cüce kertenkele, Lacertidae, iskelet kronolojisi, yaşam öyküsü özellikleri.

[1] Tuğba ERGÜL KALAYCI (**Orcid ID:** 0000-0002-4790-0263), Nurhayat ÖZDEMİR (Orcid ID: 0000-0001-2345-6789), Recep Tayyip Erdoğan Üniversitesi, Fen Edebiyat Fakültesi, Biyoloji Bölümü, Rize, Türkiye
[2] İbrahim UYSAL (**Orcid ID:** 0000-0002-7507-3322), Çiğdem GÜL (Orcid ID: 0000-0003-4736-2677), Çanakkale Onsekiz Mart Üniversitesi, Fen Edebiyat Fakültesi, Biyoloji Bölümü, Çanakkale, Türkiye

*Sorumlu Yazar/Corresponding Author: Nurhayat ÖZDEMİR, e-mail: nurhayat.ozdemir@erdogan.edu.tr

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INTRODUCTION

Dwarf lizard, *Parvilacerta parva* (Boulenger, 1887), which a member of the genus *Lacerta* L., 1758, included into the genus *Parvilacerta* that has been recently established by Harris et al. (1998). Individuals of *P. parva* were recognized with their small size and called as a Dwarf Lizard. This species is endemic to the Anatolian peninsula and Transcaucasia (Bologna and Venchi, 1996) and is distributed in central and eastern Anatolia. It lives at an altitude between 800 and 2400 m above sea level (IUCN, 2019).

The main purpose of life-history studies of animals is to estimate variation in traits associated with longevity (age) of populations (Stearns, 1992). The age of animals is influenced by a wide variety of abiotic and biotic factors (like temperature, food availability, competition, predation, etc.). Different methods exist for age determination, such as body size correlation, mark and recapture, and skeletochronology. However, skeletochronology is the most trustworthy age determination method in reptiles and amphibians (Castanet, 1994; Smirina, 1994). This method appertaining to the number of lines of arrested growth (LAG) in the cross-sections of examined specimens has been used in amphibians and reptiles (Altunışık et al., 2018; Kurnaz et al., 2018).

Although there are studies about the hematology (Arıkan et al., 2009), phylogeny (Harris et al., 1998) and skull osteology of *P. parva* (Müller, 2002), only an age structure study from Konya, Turkey (Yakın et al., 2012) is present in literature. The ageing structure of natural populations can considerably vary among species, across populations of species, among individuals of the same population, and even among siblings of the same family (Toïgo et al., 2007; Lemaître and Gaillard, 2017). In addition to that, demographic population structures can vastly differ across latitudes and altitudes both within as well as among species (Gül et al., 2014; Bülbül et al., 2016; Kurnaz et al. 2018). Life-history research of *P. parva* is also needed according to IUCN Red List.

Here, we described longevity, age structure, age at sexual maturity and some morphological traits of *P. parva* from Sivas, central region of Turkey. Our goal is to find the relationship among these parameters and evaluate the feature which affects the age structure of the natural population of *P. parva*.

MATERIAL AND METHODS

Sampling

We used museum specimens of the Herpetological Collection of the Section of Zoology, Department of Biology, Çanakkale Onsekiz Mart University, Turkey (COMU-ZM, Baycan and Tosunoğlu, 2017) for the present study. A total of 24 preserved (21 ♀♀, 3 ♂♂) *P. parva* specimens from Sivas (1738 m a.s.l.), Turkey were evaluated.

Snout-vent length (SVL), head width (HW) and head length (HL) of each individual were measured with a digital caliper (nearest 0.01 mm) (Mitutoyo Corp., Kawasaki, Japan). Sex and description of subadult or adult were identified by the base of gonad condition. The longest toe of the hind limb of each sample was used for skeletochronological analysis.

Age Determination

The removed bone tissue of each specimen was left in 5% nitric acid for 1-2 h for decalcification and then was washed in tap water. Cross-sections at mid-diaphyseal level (approximately 17 μm) were gained using a freezing microtome (Shandon, Thermo) and after that each cross-section was stained with Hematoxylin. The phalanges having the smallest medullar cavity were selected and mounted in aqueous synthetic resin (Figure 1).

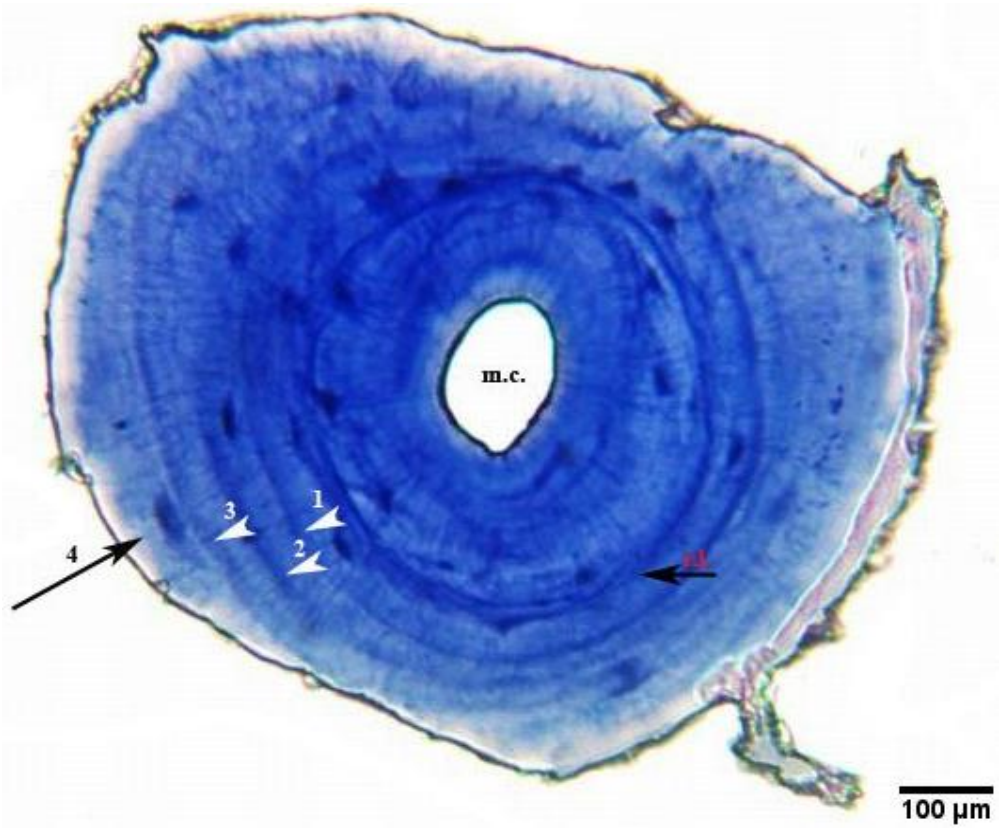

Figure 1. A cross-section (17 µm thick) at the diaphysis level of a phalanx of a *P. parva* indicates 4 LAGs (m.c. = marrow cavity, r.l. = resorbtion line).

The histological sections were examined with a light microscope (Olympus BX51) equipped with a camera. The sections were evaluated using a BAB Bs200 pro analyzer. Two observers evaluated the number of LAGs on each section independently (T. Ergül Kalaycı and N. Özdemir). The decrease in distance between adjacent two LAGs was accepted as the sign of sexual maturity age (Ryser, 1988).

Due to inadequate numbers of male individuals, the survival rate (*Sr*) and the adult life expectancy were estimated only for the females. The following formula formed by Robson and Chapman (1961) was used for the calculation of survival rate:

$Sr=T/(R+T-1)$, where $T=N1+2N2+3N3+\ldots$, $R=\Sigma N_i$, and N_i = the number of individuals in the age group i.

The adult life expectancy (ESP) was calculated via Seber's (1973) formula: $ESP=0.5+1/(1-S)$.

Statistical Analysis

Normality was calculated by the Kolmogorov-Smirnov test. SVL and age were normally distributed ($P>0.05$). Because of inadequate numbers of male individuals, differentiation between sexes in terms of morphological measurements and age was not determined, only descriptive value was exhibited. Only statistical differences were calculated between studied female population and literature (Yakın et al., 2012) and these were exhibited by Student's t-test.

Pearson's correlation was performed to test the relationship between the variables. All statistical analysis were tested via SPSS 21 (IBM SPSS Statistics for Windows).

RESULT AND DISCUSSION

The oldest individuals were found to be 7 years (range from 2 years to 7 years) for females and 6 years (range from 4 years to 6 years) for males (Figure 2). The mean age was determined as 4.33±1.20 years for female and 5.00±1.00 years for male individuals. Individuals reached sexual maturity at the age of 2 or 3 years. There was a false lines among sections, but we did not consider them as a LAGs. In addition to this, we detected double line 57.14% of individuals.

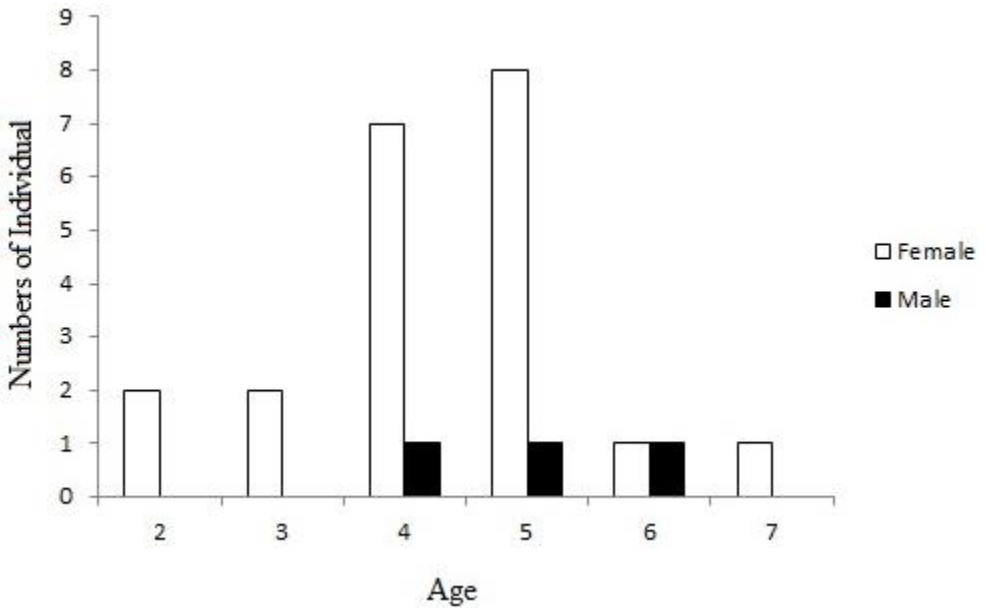

Figure 2. Age frequency of *P. parva* from Sivas population.

The survival rate and adult life expectancy (ESP) were calculated for only females of *P. parva* and they were found as 0.71 and 3.94, respectively.

The mean body size (SVL) was detected as 45.64±6.66 mm in females and 51.09±2.93 mm for males (Table 1). Descriptive statistics of head length and head width of the individuals were also given in Table 1.

Significant correlation was found in body size and age of females ($r=0.96$ $P<0.05$). In addition, SVL-HL, SVL-HW, and HL-HW were significantly correlated ($r_{SVL-HL}=0.88$, $r_{SVL-HW}=0.67$ and $r_{HL-HW}=0.80$ $P<0.01$).

Table 1. Descriptive statistic of *P. parva* from Sivas

Sex	Number of individuals (years)	Mean SVL±S.D. (mm)	Range SVL (mm)	Mean Head Width±S.D. (mm)	Range Head Width (mm)	Mean Head Length±S.D. (mm)	Range Head Length (mm)
Female	21	45.64±6.66	31.18-58.76	6.84±0.62	5.70-7.83	11.00±1.21	8.32-12.67
Male	3	51.09±2.93	47.70-52.82	7.19±0.19	6.98-7.35	11.78±0.69	11.20-12.55

The one and only study in the literature about the age structure of *P. parva* is the study of Yakın et al. (2012) from Akşehir, Konya (c. 1050 m a.s.l.), Turkey. In that study, the highest age was found to be 8 years in female and 7 years for the male individual in *P. parva* from Konya. We found that maximum age was 7 years for female and 6 years for male in Sivas population. Additionally, significant differences in age were found between females of Konya and Sivas population ($df=28$, $t=3.663$, $P<0.05$). Generally, activity seasons of reptile are shorter at high altitudes and it is probably linked to slower growth and increased longevity (Piantoni et al., 2006; Kubisch et al., 2012). The altitude of Sivas locality is higher and the climate here is colder than Konya province (according to Turkish state meteorological service, the mean annual temperature is 9°C in Sivas and 11.6°C in Konya). Despite that, longevity of *P. parva* population is significantly higher in Konya. Researchers also found results in accordance with ours. Gül et al. (2014, 2015) estimated that individuals from lower altitudes exhibited higher mean ages than those from higher altitudes in *Darevskia rudis* and *Apathya cappadocica*, respectively. According to Boretto et al. (2018), differences in environmental condition, diet, and reproductive plasticity affect physiological and metabolic processes of the species resulting in the different longevities observed. Also, Tarkhnishvili and Gokhelashvili (1996) indicated that longevity is mostly related to the type of locality rather than other factors. As a result, physiological differences between two habitats of *P. parva* could lead to life history tradeoffs.

We found the age of sexual maturity as 2 and 3 years, although IUCN Red List database declared that sexual maturity comes after second hibernation (IUCN, 2019).

High survival rate was detected in females of *P. parva* (found as 0.71). Concordantly, the risk factor of this species is categorized in IUCN Red List as a LC (Least Concern).

Kumlutaş et al. (2004) reported that the body length was higher in females than males in *P. parva*. In addition, Yakın et al. (2012) observed that females were larger in average SVL than males. In spite of that, we found higher values of the mean body length in males than the females. But it is a common fact that sexual dimorphism is almost absent in *P. parva* and we have inadequate numbers of males.

Yakın et al. (2012) found the mean SVL as 53.11 mm in females and 50.81 mm in males from lower (c. 1050 m a.s.l.) altitude than studied locality (1738 m). Mean SVL value of females was smaller in our study (Table 1). In most other reptiles, larger body size is characterized by high altitudes (Cabezas-Cartes et al., 2015; Bülbül et al., 2016). The selection towards more rapid heating abilities could be the reason for small body size in lizards which inhabit at colder climates (Pianka and Vitt, 2003). In additon, the body size of females is linked to fecundity and this pattern generally shows geographic variation (Horvathova et al., 2013). Climate has little effect on this variation (Bleu et al., 2011).

We found closer values in both sexes for head length. Similarly, in the absence of sexual dimorphism in *P. parva*, observing similarity in two sexes of *P. parva* is not surprising (Müller, 2002).

In this study, the significant correlation was detected between age and SVL. Correspondingly, Yakın et al. (2012) indicated a positive correlation between age and SVL in *P. parva* population from Konya. It appears that indeterminate growth is generally seen in lizards (Bauwens, 1999).

CONCLUSION

The field application of skeletochronology include conservation biology (habitat management of species) (de Buffrénil and Castanet, 2000) or it determines the effects of comparative climatic features on population age structure and longevity (Wapstra et al., 2001). Findings of this study extend the knowledge of life-history traits of *P. parva*. Studies on different regions of Anatolia populations of *P. parva* are needed to understand the effects of local conditions on age structure and life histories of *P. parva*.

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