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Age structure and growth pattern in an east Anatolian high altitude population of *Iranolacerta brandtii* (De Filippi, 1863)

(Squamata: Sauria: Lacertidae)

Altersstruktur und Wachstum in einer ostanatolischen Hochlandpopulation von *Iranolacerta brandtii* (De Filippi, 1863)

(Squamata: Sauria: Lacertidae)

Serkan Gül & Çetin Ilgaz & Yusuf Kumlutaş & Kamil Candan

KURZFASSUNG

Die Arbeit präsentiert skelettochronologische Daten zur Altersstruktur und zum Wachstum von *Iranolacerta brandtii* (De Filippi, 1863) einer ostanatolischen Gebirgspopulation (2363 m ü. M.) aus dem Gebiet des Dorfes Karadulda im Bezirk Çaldıran, Provinz Van (Türkei). Das Alter der dreiundzwanzig (19 Männchen, vier Weibchen) untersuchten Exemplare lag bei Männchen zwischen drei und sechs, bei Weibchen zwischen vier und fünf Jahren, wobei sich anhand der Stichprobe kein statistisch signifikanter Unterschied nachweisen ließ. Die Geschlechtsreife wurde von Männchen wie Weibchen im zweiten oder dritten Jahr erreicht. Die mittlere Kopf-Rumpf-Länge der Weibchen (64.27 ± 1.42 mm) übertraf die der Männchen (58.41 ± 1.17 mm) signifikant (p = 0,029).

ABSTRACT

Information on age structure and growth of *Iranolacerta brandtii* (De Filippi, 1863), is presented for a high altitude (2,363 m a.s.l.) population from Karadulda Village, District of Çaldıran, Province of Van, east Anatolia (Turkey). Twenty-three specimens (19 males and four females) were studied using skeletochronological methods. The age ranged from three to six years in males, and from four to five in females, this difference being not statistically significant in the sample studied. Age at sexual maturity was two to three years for both male and female individuals. The mean SVL was significantly (p = 0.029) greater in females (64.27 ± 1.42 mm) than males (58.41 ± 1.17 mm).

KEY WORDS

Reptilia: Squamata: Sauria: Lacertidae: *Iranolacerta brandtii*; age structure, age at sexual maturity, skeletochronology, growth, eastern Anatolia, Turkey

INTRODUCTION

Iranolacerta (Arnold et al., 2007) is a small genus with a fragmented distribution range (Ahmadzadeh et al. 2013). It includes the ground dwelling species *I. brandtii* (de Filippi, 1863), and the saxicolous *I. zagrosica* (Rastegar-Pouyani & Nilson, 1998). The Persian Lizard, *I. brandtii*, a small-sized lacertid of a total length of up to 20 cm is known from northwestern Iran (Provinces of Azerbaijan, Ardebil and Esfahan), Republic of Azerbaijan and eastern Turkey with a limited and scattered distribution (Arnold et al. 2007; Ahmadzadeh et al. 2008; Šmid et al. 2014; Avci et al. 2015; Yildiz & İğci 2015) at altitudes of 1,500 to 3,200 m (In den Bosch 1996; Nilson et al. 2003). In the IUCN Red List, *I. brandtii* is categorized as being Data Deficient (DD) due to the lack of information regarding threats, biology, ecology and distribution of the species (Tuniyev et al. 2009).

This study aimed to gain information on longevity and growth rates of *I. brandtii* from an east Turkish population living about 230 km from the nearest known Iranian records.

Table 1: Descriptive statistics in terms of snout-vent-length (SVL, mm) and age (years) of males and females in the studied sample of *Iranolacerta brandtii* (DE FILIPPI, 1863), from eastern Turkey. SD – Standard Deviation.

Tab. 1: Deskriptive Statistiken zu Kopf-Rumpf-Länge (KRL, mm) und Alter (Jahre) bei Männchen und Weibchen in der untersuchten Stichprobe von *Iranolacerta brandtii* (DE FILIPPI, 1863) aus der Osttürkei. SA – Standardabweichung.

	SVL (mm) / KRL (mm)		Age (years) / Alter (Jahre)	
Karadulda Population	Males Männchen	Females Weibchen	Males Männchen	Females Weibchen
N	19	4	19	4
Minimum-Maximum	52.1-67.9	60.1-66.1	3-6	4-5
Mean (±SD) / Mittel (±SA)	58.41 (±1.17)	64.27 (±1.42)	4.32 (±0.24)	4.5 (±0.29)
Mann-Whitney U	11		33	
P value	$p = 0.029$		$p = 0.725$	

MATERIALS AND METHODS

Twenty-three specimens of *I. brandtii* (19 males and four females) captured at Karadulda Village, District of Çaldıran in the Province of Van, east Anatolia, at altitudes of 2,363 m a.s.l. on July 27, 2015, entered the skeletochronological analysis. The presence or absence of hemipenes was used to determine the sex; snout-vent length (SVL) was measured with a digital caliper (accuracy 0.01 mm).

According to the skeletochronological protocol applied, the third toe of a hind leg was clipped including the second phalanx in all studied specimens, kept in water for 24 hrs and thereafter transferred into 5 % nitric acid for two hrs to decalcify the bones. After this, the phalanges were kept in water for 12 hrs again. Cross sections (18 μm) of the middle part of the diaphysis of the second phalanx were prepared using a freezing microtome and stained with Ehrlich's hematoxylin (Fig. 1). Cross sections were treated with glycerol for the study of lines of arrested growth (LAGs) under a light microscope.

A Shapiro-Wilk test was applied to test for normal distribution of age and SVL, and Mann-Whitney U tests to test for the presence or absence of significant differences in age and SVL between male and female individuals. Pearson's correlation coefficient (r) was used to indicate the strength and direction of the relationship between age and SVL, a quadratic regression analysis was applied to determine the model showing the best fit to the correlation between age and SVL. The analyses were carried out using SPSS v. 22 (IBM SPSS Statistics for Windows, Armonk, NY).

RESULTS

LAGs in subterminal phalangeal bones of the third toe were easily counted in all specimens. Descriptive statistics on age and SVL are given in Table 1. There was no statistically relevant difference in the distribution of the age between the male and female population studied (Mann-Whitney U test; $U = 33$, $z = -0.423$, $p = 0.725$) whereas, there was a significant difference between the sexes in terms of SVL (Mann-Whitney U test; $U = 11$, $z = -2.190$, $p < 0.05$). The age where a significant decrease in the growth took place was determined as age at sexual maturity (RYSER 1988). According to this definition, the individuals of the population reach sexual maturity at the age of four or five years. While the maximum age was six years in males, it was five in females, the corresponding maximum SVL values being 67.9 mm and 66.1 mm, respectively.

There was a strong correlation between age and SVL in males ($N = 19$; $r = 0.664$, $p = 0.029$) based on Pearson correlation coefficient, but this relationship was not significant in females ($N = 4$; $r = 0.484$; $p =$

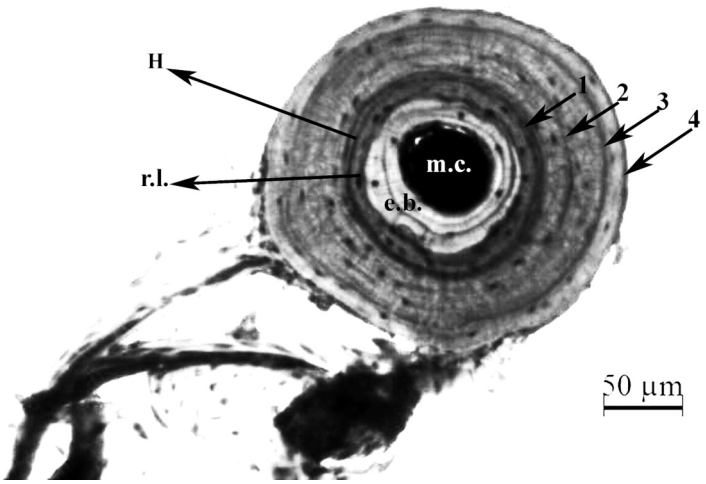

Fig. 1: Cross-section (18µ) of the diaphysal region of a distal phalanx of the third toe of a male of *Iranolacerta brandtii* (De Filippi, 1863), from eastern Turkey (SVL = 62.23 mm, age = four years). Arrows indicate LAG numbers 1 to 4 observed in the periosteal bone. e.b. – endosteal bone, m.c. – marrow cavity, r.l. – reversal line, H – hatching line.

Abb. 1: Querschnitt (18µ) der Diaphysenregion eines distalen Gliedes der dritten Zehe einer männlichen *Iranolacerta brandtii* (De Filippi, 1863) aus der Osttürkei (Kopf-Rumpf-Länge = 62.23 mm, Alter = vier Jahre). Die Pfeile markieren die Linien verminderten Wachstums Nr. 1 bis 4 im periostalen Knochen. e.b. – endostaler Knochen, m.c. – Markhöhle, r.l. – Umkehrlinie, H – Schlupflinie.

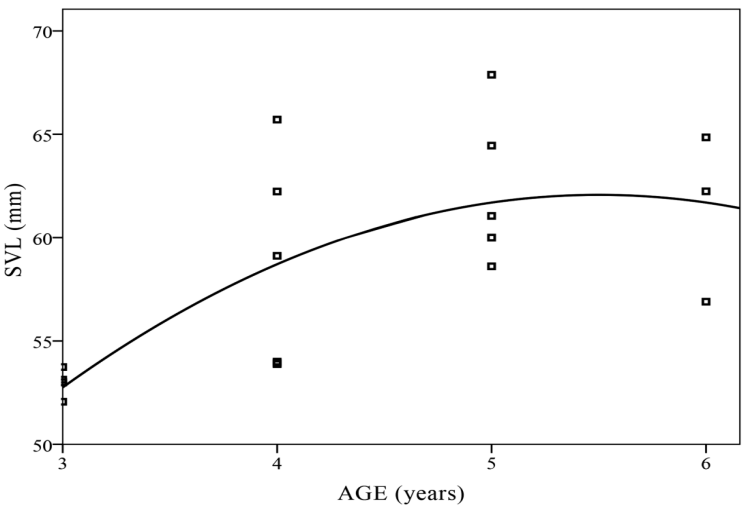

Fig. 2: Regression model showing the best fit to the correlation between age (years) and SVL (mm) in 19 males of *Iranolacerta brandtii* (De Filippi, 1863), from eastern Turkey ($y = 16.985 + 16.392 \text{ x} - 1.49 \text{ x}^2$; $R^2 = 0.525$).

Abb. 2: Regressionsmodell mit der besten Kurvenanpassung an die Korrelation zwischen Alter (AGE, Jahre) und Kopf-Rumpf-Länge (SVL, mm) von 19 Männchen von *Iranolacerta brandtii* (De Filippi, 1863) aus der Osttürkei ($y = 16.985 + 16.392 \text{ x} - 1.49 \text{ x}^2$; $R^2 = 0.525$).

0.516). The quadratic function showing the best fit to the correlation between age and SVL in males (y = 16.985 + 16.392x - 1.49x^2; R^2 = 0.525; p = 0.003) was selected for regression analysis (Fig. 2).

DISCUSSION

The present paper provides first data on age and growth parameters of *I. brandtii* from the eastern Anatolian region. As a general rule, ectotherms such as lizards have relatively short annual activity periods at high altitudes where temperature plays a key role in shaping life history traits such as age and size at sexual maturity, longevity and growth (Perry 2007). *Iranolacerta brandtii* phalangeal cross sections showed thick layers of spring-summer growth and thin layers (LAGs) occurring in winter (Fig. 1). The close vicinity of the hatching line to the first LAG (see Fig. 1) points to a hatching date late in the year. Generally, in cold areas, lizards reach sexual maturity at higher age. Maximum longevity in the *I. brandtii* sample studied was five and six years for females and males respectively. Although this difference was not significant in the materials studied, it is representative of many high altitude populations of small lizard species. For example, five years for males and six for females were reported in the Ardanuç population (2,137 m a.s.l.) of *Darevskia rudis* (Bedriaga, 1886) (Gül et al. 2014), nine years for male and 10 for female *Eremias suphani* Basoglu & Hellmich, 1968, at an altitude of 2,180 m a.s.l. (Üzüm et al. 2015). The opposite trend was found for a high altitude population of *Lacerta agilis* Linnaeus, 1758, in which males (three years) and females (four years) were short-lived as compared to their lowland conspecifics (Guarino et al. 2010). Although life history traits of male and female individuals can vary considerably between or within populations of a given species (Guarino et al. 2010), longevity, mean age and age at sexual maturity of female and male individuals were similar in the studied population of *I. brandtii*.

In lacertid lizards, SVL is widely used to verify whether or not sexual size dimorphism is present (Arribas 1996). In the studied sample of *I. brandtii*, the mean SVL of females was significantly larger than of males. Variation in body size of lizards can differ both between and within populations if individuals live in different habitat types (Simith 1998). The reasons for variation are manifold, e.g., differences in food availability, risk of predation, or climate conditions (Roitberg & Smirina 2006a, 2006b). Maybe the mean SVL of male and female lizards of the present study is affected by the arid climate conditions prevailing in the Province of Van, where the specimens were collected (average annual temperature 9.11 C° and rainfall 32.14 mm - information based on annual averages between 1950 and 2014; TSMS 2015). Similarly, Oufiero et al. (2011) reported that aridity can be a key determinant factor for body size and shape. Also, Gül et al. (2014) believed that the effect of aridity could have led to an increased difference in body size between male and female individuals of *D. rudis* from high altitudes.

Whether the observed significant difference between male and female SVL in *I. brandtii* is explained by genetics or external conditions (Roitberg & Smirina 2006a, 2006b; Borczyk & Pasko 2011) is still to be revealed.

REFERENCES

Ahmadzadeh, F. & Carretero, M. A. & Rödder, D. & Harris, D. J. & Freitas, S. N. & Perera, A. & Böhme, W. (2013): Inferring the effects of past climate fluctuations on the distribution pattern of *Iranolacerta* (Reptilia, Lacertidae): Evidence from mitochondrial DNA and species distribution models.- Zoologischer Anzeiger, Amsterdam, München etc.; 252: 141-148.

Ahmadzadeh, F. & Kiabi, B. H. & Kami, H. G. & Hojjati, V. (2008): A preliminary study of the lizard fauna and their habitats in Northwestern Iran.- Asiatic Herpetological Research, Berkeley; 11: 1-9.

Arnold, E. N. & Arribas, O. & Carranza, A. S. (2007): Systematics of the palaearctic and oriental lizard tribe Lacertini (Squamata: Lacertidae: Lacertinae), with description of eight new genera.- Zootaxa, Auckland; 1430: 1-86.

Arribas, O. J. (1996): Taxonomic revision of the Iberian 'Archaeolacertae' I: A new interpretation of the geographical variation of '*Lacerta*' *monticola* Boulenger, 1905 and '*Lacerta*' *cyreni* Müller & Hellmich, 1937.- Herpetozoa, Wien; 9: 31-56.

Avci, A. & Ilgaz, Ç. & Bozkurt, E. & Üzüm, N. & Olgun, K. (2015): A new record of *Iranolacerta brandtii* (de Filippi, 1863) (Sauria: Lacertidae) in eastern Anatolia, Turkey.- Russian Journal of Herpetology, Moskva; 22: 68-74.

Borczyk, B. & Pasko, L. (2011): How precise are size-based age estimations in the sand lizard (*Lacerta agilis*)?- Zoologica Poloniae, Wroclaw; 56: 11-17.

De Filippi, F. (1863): Nuove o poco note specie di animali vertebrati raccolte in un viaggio in Persia nall'estate dell'anno 1862 [New or little-known species of vertebrate animals gathered on a trip to Persia in the summer of 1862].- Archivio per la Zoologia, l'Anatomia e la Fisiologia, Genova etc; 2: 377-394.

Guarino, F. M. & Giá, I. D. & Sindaco, R. (2010): Age and growth of the sand lizards (*Lacerta agilis*) from a high Alpine population of northwestern Italy.- Acta Herpetologica, Firenze; 5: 23-29.

Gül, S. & Özdemir, N. & Kumlutaş, Y. & Ilgaz, Ç. (2014): Age structure and body size in three populations of *Darevskia rudis* (Bedriaga, 1886) from different altitudes.- Herpetozoa, Wien; 26: 151-158.

In den Bosch, H. A. J. (1996): Op zoek naar de Perzische Hagedis (*Lacerta brandtii*).- Lacerta, 's-Gravenhage; 54: 121–128.

Nilson, G. & Rastegar-Pouyani, N. & Rastegar-Pouyani, E. & Andrén, C. (2003): Lacertas of south and central Zagros Mountains, Iran, with description of two new taxa.- Russian Journal of Herpetology, Moskva; 10: 11-24.

Oufiero, C. E. & Gartner, G. E. A. & Adolph, S. C. & Gariand, T. Jr. (2011): Latitudinal and climatic variation in body size and scale rows in *Sceloporus* lizards: a phylogenetic perspective.- Evolution, Hoboken; 65: 3590-3607.

Perry, G. (2007): Movement patterns in lizards: measurement, modality, and behavioral correlates; pp. 13-48. In: Reilly, S. & McBrayer, L. & Miles, D. B. (Eds.): Lizard ecology: The evolutionary consequences of foraging mode. Cambridge (Cambridge University Press).

Roitberg, E. S. & Smirina, E. M. (2006a): Adult body length and sexual size dimorphism in *Lacerta agilis boemica* (Reptilia, Lacertidae): between year and interlocality variation; pp. 175-188. In: Corti, C. & lo Cascio, P. & Biaggini, M. (Eds.): Mainland and insular lizards. A mediterranean perspective. Firenze (Firenze University Press).

Roitberg, E. S. & Smirina, E. M. (2006b): Age, body size and growth of *Lacerta agilis boemica* and *L. strigata*: a comparative study of two closely related lizard species based on skeletochronology.- Herpetological Journal, London; 16: 133-148.

Ryser, J. (1988): Determination of growth and maturation in the common frog, *Rana temporaria*, by skeletochronology.- Journal of Zoology, London; 216: 673-685.

Šmíd, J. & Moravec, J. & Kodym, P. & Kratochvil, L. & Hosseinian Yousefkhani, S. S. & Rastegar-Pouyani, E. & Frytna, D. (2014): Annotated checklist and distribution of the lizards of Iran.- Zootaxa, Auckland; 3855: 1-97.

Smith, G. R. (1998): Habitat-associated life history variation within a population of the striped plateau lizard, *Sceloporus virgatus*.- Acta Oecologica, Paris; 19: 167-173.

Tuniyev, B. & Ananjeva, N. & Agasyan, A. & Orlov, N. & Tuniyev, S. & Anderson, S. (2009): *Iranolacerta brandtii*.- The IUCN Red List of Threatened Species 2009: e.T164697A5918527. WWW document available at < http://dx.doi.org/10.2305/IUCN.UK.2009.RLTS.T164697A5918527.en > [last downloaded on June 22, 2015].

Turkish State Meteorological Service (TSMS) (2015): Resmi İstatistikler (İllerimize Ait İstatistiki Veriler) - VAN.- WWW document available at < http://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=VAN > [last accessed on August 29, 2016].

Üzüm, N. & Avci, A. & Kumlutaş, Y. & Beşer, N. & Ilgaz, Ç. (2015). The first record of age structure and body size of the Suphan Racerunner, *Eremias suphani* Başoğlu & Hellmich, 1968.- Turkish Journal of Zoology, Ankara; 39: 513-518.

Yildiz, M. Z. & İğci, N. (2015): On the occurrence of the Persian Lizard, *Iranolacerta brandtii* (de Filippi, 1863) (Squamata: Sauria: Lacertidae) in Eastern Anatolia, Turkey.- Biharean Biologist, Oradea; 9: 66-71.

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