

## Preliminary data on the age structure of *Asaccus barani* (Baran's leaf-toed gecko) from southeastern Anatolia, Turkey

Tuğba ERGÜL KALAYCI<sup>1\*</sup>, Abdullah ALTUNIŞIK<sup>1</sup>, Çiğdem GÜL<sup>2</sup>, Nurhayat ÖZDEMİR<sup>1</sup>, Murat TOSUNOĞLU<sup>2</sup>

<sup>1</sup>Department of Biology, Faculty of Arts and Sciences, Recep Tayyip Erdoğan University, Rize, Turkey

<sup>2</sup>Department of Biology, Faculty of Arts and Sciences, Çanakkale Onsekiz Mart University, Çanakkale, Turkey

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**Abstract:** In this study, the age structure of an *Asaccus barani* sample from Şanlıurfa (southeastern Anatolia, Turkey) was determined by skeletochronology for the first time. A total of 17 preserved adults (7♂♂, 10♀♀) were evaluated, and the maximum observed lifespan was recorded as 6 years in males and 5 years in females. The first line of arrested growth was partially eroded by endosteal resorption in 29% of individuals and completely eroded in 18%. The mean age was  $3.85 \pm 0.50$  years in males and  $3.80 \pm 0.32$  years in females; the mean snout-vent length (SVL) was  $46.99 \pm 2.64$  mm (range: 37.78–54.13) in males and  $46.89 \pm 1.51$  mm (range: 40.33–53.19) in females. There was no significant difference between sexes in terms of age and SVL. However, there was a positive correlation between age and SVL in both males and females.

**Key words:** Southeastern Anatolia, age structure, *Asaccus barani*, skeletochronology

### 1. Introduction

*Asaccus barani* (Baran's leaf-toed gecko) is distributed in and endemic to southeastern Anatolia. This species differs from other *Asaccus* species due to a special morphological pattern: only Anatolian *Asaccus* has maximum variation in tuberculation (type, size, and distribution) on the dorsal body (Torki et al., 2011). The species, which has a very restricted range in Turkey and was previously evaluated as *A. elisae* in Anatolia (Baran and Gruber, 1982; Tok et al., 1997, 2002; Franzen et al., 2002; Baran et al., 2003), is now recorded as *A. barani* (Torki et al., 2011; Baran et al., 2013).

Morphological, distribution, and systematic studies on *Asaccus* genera from southwestern Asia have been performed by many researchers (Rastegar-Pouyani, 1996; Anderson, 1999; Rastegar-Pouyani et al., 2006; Torki and Sharifi, 2007; Torki et al., 2008; Afrasiab and Mohamad, 2009; Torki, 2009). Recently, in the Iranian plateau, the systematics and distribution of the genus *Asaccus* have been described by Parsa et al. (2009), and a few studies on distribution and morphological features have appeared in the literature on *A. barani* (Tok et al., 1997, 2002; Baran et al., 2003; Torki et al., 2011).

Age plays a crucial role in life history and population dynamics studies of amphibians and reptiles (Castanet and Smirina, 1990). Life history traits (e.g., longevity, age of sexual maturity, or body size) are generally associated with

changes in environmental factors such as temperature, precipitation, and food availability, along with geographical features. Skeletochronology is the most reliable method for age estimation; this method is based on histological analyses of growth marks on the skeleton and counting the lines of arrested growth (LAGs) (Castanet and Smirina, 1990). This method has been successfully applied in various lizard species (Arakelyan, 2002; Roitberg and Smirina, 2006; Guarino et al., 2010; Altunışık et al., 2013; Parlak and Tok, 2013; Tok et al., 2013; Yakın and Tok, 2015), particularly in geckos (Pancharatna and Kumbar, 2005; Piantoni et al., 2006; Kanat and Tok, 2015). However, a skeletochronological study has not yet been conducted on the *Asaccus* genera, nor in *A. barani* in particular.

The main goal of the present study is to reveal the longevity and age at maturity of *A. barani* through the skeletochronological method and to analyze whether there is any correlation between these parameters and body measurements. Because information about *A. barani* is very limited and no data are available on its life history characteristics, this study provides preliminary data for future studies on this species.

### 2. Materials and methods

Seventeen preserved specimens (7♂♂, 10♀♀) of *A. barani* from ZDÇOMÜ (Zoology Department, Çanakkale

\* Correspondence: [tugba.ergul@erdogan.edu.tr](mailto:tugba.ergul@erdogan.edu.tr)

Onsekiz Mart University; collection number: 91/2008) were analyzed in this study. Specimens were collected on 2 July 2008 from the village of Çiçekalan in Birecik (vicinity of Şanlıurfa, 36°52'52.13"N, 38°03'26.22"E, 380 m a.s.l.) by M Tosunoğlu and Ç Gül. Birecik was the first known locality for *Asaccus* in Turkey (Böhme, 1973). The climate classification for this area is Mediterranean pluviseasonal-continental (Rivas-Martinez et al., 2003), characterized by a long, dry summer period and low annual precipitation largely dependent on altitude. Air temperature in daytime in July can reach 46 °C in Şanlıurfa. The average total monthly rainfall reaches its maximum in January (86 kg/m<sup>2</sup>; this rate decreases 0.7 and 0.9 kg/m<sup>2</sup> in July and August, respectively) (<http://www.dmi.gov.tr>).

Measurements of snout-vent length (SVL), head length, head width, forelimb length, and hind limb length of the specimens were taken by a digital caliper with 0.01-mm sensitivity. We evaluated the sexual dimorphism index (SDI) with respect to a formula introduced by Lovich and Gibbons (1992): SDI = (mean length of the larger sex / mean length of the smaller sex) ± 1 (size, SDI > 0 when females are larger than males, SDI < 0 when males are larger than females).

For the skeletochronological analysis, the femur was selected due to clearer growth marks compared with the phalanges. To examine the age structure of the population, we used a standard skeletochronology procedure (Castanet and Smirina, 1990). After each femur was dissected, the bone was washed in distilled water, decalcified in 5% nitric acid solution for a time varying between 1 and 2 h, and then washed in tap water. It was then cross-sectioned with a freezing microtome (16–18 µm thick) and stained with Ehrlich hematoxylin. All the LAGs were independently

interpreted by two of the authors (T Ergül Kalaycı and A Altunışık) under a light microscope, and they were well defined for providing precise age estimation. Endosteal resorption was evaluated by comparing the diameters of eroded marrow cavities with the diameters of noneroded marrow cavities in sections from the youngest specimens.

Kolmogorov–Smirnov and Levene tests were performed for testing normality and variance homogeneity assumptions, respectively. We used Student's t-test to differentiate between the means of the two sexes, and Pearson's correlation was used to test the relationship between the variables. We used SPSS 21.0 for all the analyses.

### 3. Results

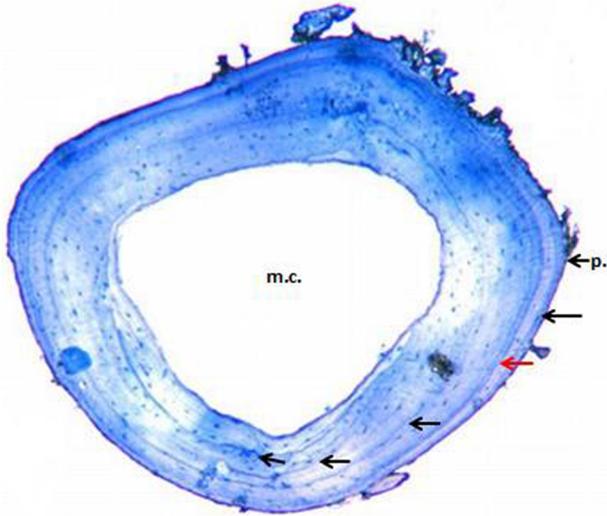
Descriptive statistics of age, body length, head length, head width, length of forelimb, and length of hind limb are summarized in the Table. The average SVL was 46.99 ± 2.64 mm (range: 37.78–54.13) in males and 46.89 ± 1.51 mm (range: 40.33–53.19) in females.

LAGs were clearly marked and relatively easy to count in all cross-sections, as can be seen in Figure 1. The first LAG was partially eroded in 29% of the individuals and completely eroded in 18% due to endosteal resorption. The ages of males ranged from 2 to 6 years (mean: 3.85 ± 0.50, n = 7), whereas those of females ranged from 3 to 5 years (mean: 3.80 ± 0.32, n = 10, Figure 2). Age of sexual maturity was ascertained using the distance between LAGs. After sexual maturity, the distances decreased rapidly toward the periphery. In this population, the youngest breeding females were 2 years old, whereas two males became sexually active at the age of 1 year. There were no significant differences in mean age (t = 0.01, df =

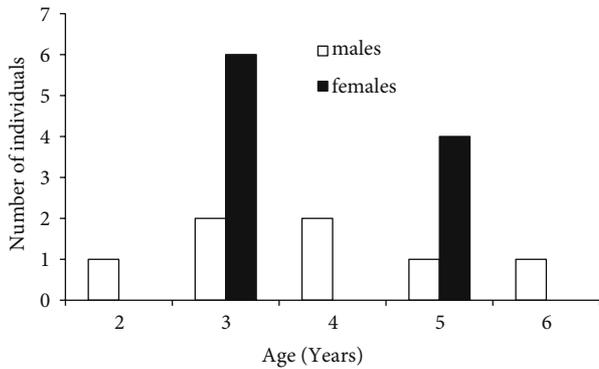
**Table.** Descriptive statistics of an *Asaccus barani* sample.

Sex	Number of individuals (years)	Age (years)	Mean SVL (mm)	Mean head length (mm)	Mean head width (mm)	Mean hind limb length(mm)	Mean forelimb length(mm)
Males	7 (2–6)	3.85 ± 0.5	46.99 ± 2.64	13.87 ± 0.62	9.03 ± 0.48	26.25 ± 3.74	18.53 ± 2.81
	1 (2)		39.99	11.88	8.02	21.33	16.15
	2 (3)		39.60 ± 2.58	12.35 ± 0.94	7.47 ± 0.02	23.42 ± 2.96	15.99 ± 1.38
	2 (4)		51.13 ± 1.58	14.77 ± 0.12	9.43 ± 0.55	27.62 ± 0.14	19.02 ± 2.21
	1 (5)		53.37	15.35	10.26	30.62	22.31
	1 (6)		54.13	15.66	10.73	29.73	21.24
Females	10 (3–5)	3.80 ± 0.32	46.89 ± 1.51	13.87 ± 0.4	8.61 ± 0.22	24.45 ± 2.48	18.07 ± 1.70
	6 (3)		43.68 ± 3.11	13.04 ± 0.92	8.28 ± 0.75	23.65 ± 1.90	17.07 ± 1.32
	4 (5)		51.71 ± 1.01	15.12 ± 0.17	9.12 ± 0.10	25.65 ± 3.04	19.58 ± 0.83

Data are expressed as means ± standard errors.  
SVL: Snout-vent length.



**Figure 1.** A cross-section (17 µm thick) of the femur bone of a 5-year-old *Asaccus barani* individual (m.c. = marrow cavity, p. = periosteal bone). The 5 LAGs are indicated by black arrows. A double LAG is highlighted by red arrow.



**Figure 2.** Age frequency distributions of the *Asaccus barani* sample.

15,  $P > 0.05$ ), SVL ( $t = 0.04$ ,  $df = 16$ ,  $P > 0.05$ ), head length ( $t = 0.005$ ,  $df = 15$ ,  $P > 0.05$ ), head width ( $t = 0.86$ ,  $df = 15$ ,  $P > 0.05$ ), or length of forelimb ( $t = 0.42$ ,  $df = 15$ ,  $P > 0.05$ ) and hind limb ( $t = 1.20$ ,  $df = 15$ ,  $P > 0.05$ ) between females and males. Meanwhile, mean values of head length, head width, and length of forelimb and hind limb in males were bigger than in females (Table); according to correlation analysis, head proportions and limbs increased with increasing SVL in both sexes. The SDI was calculated as  $-0.002$  male-biased; this was not statistically significant.

A significant positive correlation was found and cubic and linear regression was fitted between age and SVL in both males ( $n = 7$ ,  $r = 0.88$ ,  $P < 0.01$ ,  $y = 88.11 - 49.73x + 15.34x^2 - 1.34x^3$ ) and females ( $n = 10$ ,  $r = 0.87$ ,  $P < 0.01$ ,  $y = 31.62 + 4.02x$ ).

#### 4. Discussion

This study provides the first data on the age structure of *A. barani*. We found that maximum age could be reached at 6 years in males and 5 years in females in the Çiçekalan population. A wide range of age variation has been seen in geckos: short-lived species, such as *Rhynchoedura ornata* (Günther, 1867), may live as long as 2 years (Read, 1999), while lifespan ranged between 0 and 4 years in *Hemidactylus brooki* (Gray, 1845) (Gekkonidae) (Pancharatna and Kumbar, 2005). In Ryukyu ground gecko (*Goniurosaurus kuroiwae*) (Namiye, 1912), potential longevity was revealed to reach at least 7 years (Kurita and Toda, 2013). Additionally, the maximum age of Turkish gecko (*Hemidactylus turcicus*) has been determined as 9 years (Kanat and Tok, 2015), but some other gecko species live much longer, such as *Hoplodactylus stephensi* (Robb, 1980) (16 years; Hare and Cree, 2005), *Homonota darwini* (Boulenger, 1885) (17 years; Piantoni et al., 2006), and *Hoplodactylus maculatus* (Boulenger, 1885) (36 years; Bannock et al., 1999).

According to our study, the youngest breeding female was 2 years old and the youngest breeding male was 1 year old. Age of sexual maturity is fairly varied. In the study by Kubish et al. (2012), *Homonota darwini* individuals at a warmer site reached maturity in 3 years, but at a colder site, they reached maturity in the fourth year of their life. Temperate-region organisms, which are generally active for a long period during the year, reach sexual maturity faster than cold-temperate organisms, which have a shorter active period (Adolph and Porter, 1996). In our study, the relatively high daily air temperature and long dry summer in Şanlıurfa may be the cause of early sexual maturity in *A. barani*.

In Anatolian *Asaccus*, the body size is positively correlated with age, which appears to be a common characteristic in lizards showing indeterminate growth (Bauwens, 1999). Similar to our results, age and SVL were positively correlated in other geckos (*Hemidactylus brooki*, Pancharatna and Kumbar, 2005; *Homonota darwini*, Piantoni et al., 2006; *Hemidactylus turcicus*, Kanat and Tok, 2015).

In this study, we did not find any differences between sexes in terms of age. In Ryukyu ground gecko (*Goniurosaurus kuroiwae*), the difference in age structure between the sexes was not statistically significant in the Motobu Peninsula (Kurita and Toda, 2013). We also did not see any significant differences between sexes in terms of body length. This phenomenon has been confirmed in other *Asaccus* species. Torki (2009) declared that no significant difference was seen in the body sizes of males and females of *Asaccus kurdistanensis* (Rastegar-Pouyani, Nilson & Faizi, 2006), although the males of the samples

were on the average slightly longer (59.0 mm) than the females (58.3 mm). Additionally, males and females of *Hemidactylus turcicus* (Linnaeus, 1758) did not differ significantly in terms of SVL (Saenz and Corner, 1996).

The current study found that the head length, head width, and forelimb and hindlimb lengths of *A. barani* did not vary between sexes. In species that display limb size dimorphism, males generally have longer forelimbs and hind limbs (Irschick et al., 2005; Schwarzkopf, 2005). In *A. barani*, the mean values of forelimbs and hind limbs are longer in males, but this is not confirmed statistically.

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- In *A. barani*, the sexes have relatively similar head proportions and sizes (Table). Indeed, adult male and female geckos with similar body sizes do not differ in head measurements (Zuffi et al., 2011).
- This paper has given preliminary data for the life history traits of *A. barani*. However, with a small sample size, caution must be applied, as the findings might not reflect the whole population. More research is needed for a better understanding of the life history strategy of the Anatolian endemic *A. barani*. This research will serve as a base for future studies.
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