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## On Specimens of *Darevskia armeniaca* (Sauria: Lacertidae: Darevskia) Collected from Ardahan\*

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**Abstract:** Forty-seven *Darevskia armeniaca* specimens collected from 2 different localities in Ardahan were examined in terms of pholidosis characters, morphometric measurements and colour-pattern features. The 2 populations were differentiated from one another in terms of the number of supraciliar plates (left-right) (SCP<sub>a</sub>-SCP<sub>b</sub>), supralabial plates (left-right) (SRL<sub>a</sub>-SRL<sub>b</sub>) and transversal series of ventral plates (TVP) according to the results of the Mann-Whitney U test. An independent t-test based on morphometric measurements revealed significant differences in terms of the head index (HI) between the 2 populations. Regarding pholidosis characters, morphometric measurements and colour-pattern features, specimens collected from the 2 localities showed a similarity to *Darevskia armeniaca* specimens from Georgia, Armenia, Azerbaijan and Zigana.

**Key Words:** Sauria, Lacertidae, *Darevskia armeniaca*, morphology, Ardahan

### Ardahan'dan Toplanan *Darevskia armeniaca* (Sauria: Lacertidae: Darevskia) Örnekleri Hakkında

**Özet:** Ardahan'daki iki farklı lokaliteden toplanan kırk yedi *Darevskia armeniaca* örneği pholidosis karakterleri, morfometrik ölçümler ve renk-desen özellikleri bakımından incelenmiştir. İki popülasyonun supraciliar plak sayısı (sol-sağ) (SCP<sub>a</sub>-SCP<sub>b</sub>), supralabial plak sayısı (sol-sağ) (SRL<sub>a</sub>-SRL<sub>b</sub>) ve ventral plakların enine sayısı (TVP) bakımından Mann-Whitney U testi sonuçlarına göre farklılık gösterdiği saptanmıştır. Morfometrik ölçümlere dayanan independent t-testi, iki popülasyon arasında baş indeksi (HI) bakımından farklılık olduğunu göstermektedir. İki lokaliteden toplanan örnekler, pholidosis karakterleri, morfometrik ölçümler ve renk-desen özellikleri bakımından Gürcistan, Ermenistan Azerbaycan ve Zigana *Darevskia armeniaca* örneklerine benzerlik göstermektedir.

**Anahtar Sözcükler:** Sauria, Lacertidae, *Darevskia armeniaca*, morfoloji, Ardahan

### Introduction

*Darevskia armeniaca* was first described as *Lacerta armeniaca* from Sevan, Armenia (Mehely, 1909). Now it is known from north-eastern Turkey, northern and north-western Armenia, southern Georgia and western Azerbaijan (Darevsky, 1967; Daresky, 1972). The distribution range of *Darevskia armeniaca* in Turkey includes the vilayets Trabzon, Ardahan and Kars (Baran and Atatür, 1998; Sindaco et al., 2000). Lantz and Cyren (1936) were the first scientists to draw attention to the absence of males in this lizard species. They reported that of the 4 male specimens noted by Boulenger (1920), despite belonging to *Lacerta saxicola armeniaca*, 2 were in fact females and the remainder were different subspecies. In exactly the same manner, the data reported by

Chernov (1939) also proved erroneous, in that there were 7 male specimens among the 180 specimens that he examined (Darevsky, 1957). Darevsky (1966) reported that male specimens rarely completed their embryological development in *Lacerta armeniaca* and *Lacerta dahli*. Darevsky (1967) found no significant differences among 5 populations of *Lacerta armeniaca* from Georgia, Armenia and Azerbaijan in terms of pholidosis and stated that no prominent variational cline was exhibited among the populations of this parthenogenetic species. He also (1967) noted that the fairly distinct differences in morphometric measurements observed in different populations could be correlated with the elevation of their habitat. Darevsky (1972) examined 4 specimens (2 females and 2 males) of *Lacerta armeniaca* from Zigana

\* This study is a part of the PhD thesis supervised by Prof. Dr. Abidin BUDAK.

(Trabzon) and reported that geographical parthenogenesis was possible for *Lacerta armeniaca*. Darevsky et al. (1978) stated that the external appearance of the 2 male specimens examined in their study did not differ from that of female specimens of *Lacerta armeniaca* except for the body size and head. They also found that 1 male specimen had 2 well-developed testes, the other appeared to be bisexual, with a testis to the left and an ovotestis to the right. The number of chromosomes was the same for *Lacerta armeniaca* (Darevsky et al., 1978). Darevsky and Kupriyanova (1982) recorded no differences between male and female specimens in terms of morphological or karyological features. Arribas (1999) stated that rock lizard species were different from other species of the genus *Lacerta*, with respect to some morphological (pholidosis characters and colour-pattern features), osteological, karyological and behavioural features. He, therefore, assigned rock lizard species to a newly erected genus: *Darevskia*.

In this study, *Darevskia armeniaca* specimens collected from 2 different localities in Ardahan were evaluated morphologically and compared with specimens from Zigana (Turkey), Armenia, Georgia and Azerbaijan.

## Materials and Methods

Specimens were collected from 2 different localities in Ardahan (Figure 1) in 2001 and 2003. Colour slides of the specimens were taken and then the specimens were fixed with 5% formaldehyde in 70% ethanol and then preserved in 70% ethanol according to the method described by Başoğlu and Baran (1977). The specimens

were incorporated into the collection of ZDEU (Zoology Department Ege University) and kept in the Zoology Lab. of the Department of Biology at Buca Education Faculty.

**Material:** ZDEU. 132/2001. 1-18♀♀, 19-20juv., between Ardahan and Göle, 03.07.2001, leg. Y. Kumlutaş, K. Olgun, Ç. Ilgaz, A. Avcı, F. İret;

ZDEU. 48/2003. 1-22♀♀, 23-27juv., Ardahan, 09.07.2003, leg. İ. Baran, C.V. Tok, Y. Kumlutaş, Ç. Ilgaz, F. İret.

The following morphometric measurements were taken using dial calipers with an accuracy of 0.02 mm: Snout-vent length (SVL): Tip of snout to anal cleft. Tail length (TL): Anal cleft to the tip of tail. Pileus width (PW): At widest point between parietal plates. Pileus length (PL): Tip of the snout to the posterior margins of parietals. Head width (HW): At widest point of head. Head length (HL): Tip of snout to posterior margin of ear opening. Total body length (TBL): Tip of snout to the tip of tail. Furthermore, some morphometric indexes and ratios were calculated: Pileus index (PI) [(PW / PL) X 100], head index (HI) [(HW / HL) X 100], SVL / TL and TL / TBL.

Pholidosis characters considered here consisted of the following counts: Supraciliar granules (left-right) (SCGa-SCGb), supraciliar plates (left-right) (SCPa-SCPb), supralabial plates (left-right) (SRLa-SRLb), sublabial plates (left-right) (SLa-SLb), transversal series of gular scales between inframaxillary symphysis and collar (MG), collar plates (C), temporals 1 (temporals between masseteric and tympanic plates) (left-right) (TMP1a-TMP1b), supratemporal plates (without 1<sup>st</sup> supratemporal) (left-right) (STPa-STPb), ventral plates

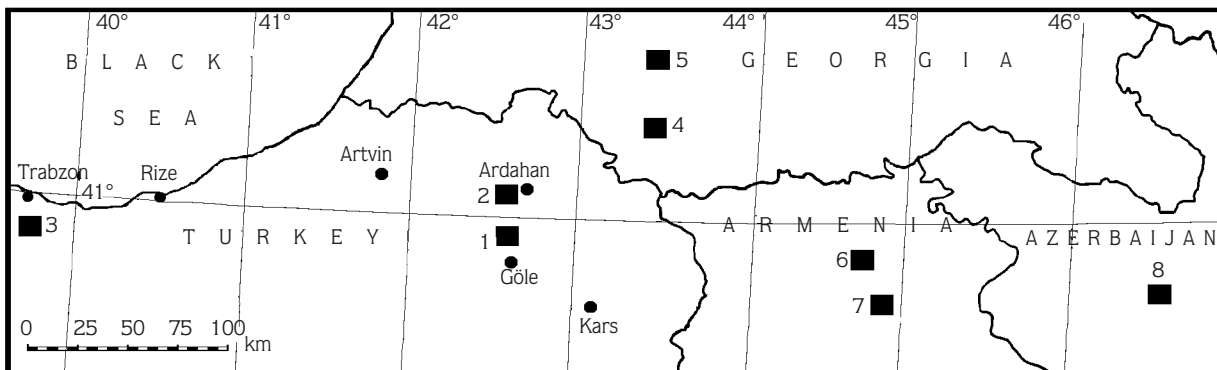


Figure 1. The map showing the localities in which *Darevskia armeniaca* specimens were compared (1: between Ardahan and Göle, 2: Ardahan, 3: Zigana, 4: Akhalkalaki, 5: Bakuriani, 6: Semenov, 7: Sevan, 8: Geygel).

(transversal and longitudinal) (TVP and LVP), preanals 1 (number of preanals located anterior of the anals) (PA1), preanals 2 (number of preanals surrounding anals) (PA2), femoral pores (left-right) (FPa-FPb), longitudinal rows of scales on the ventral surface of the thigh between the femoral pores and the outer row of enlarged scales (left-right) (LSa-LSb), subdigital lamellae in the 4<sup>th</sup> toe (left-right) (SDLa-SDLb), temporals 2 (temporals in the shortest row between 1<sup>st</sup> supratemporal and masseteric plates) (left-right), (TMP2a-TMP2b), tibial scales (scales lying on the dorsal surface of the ankle between the large scales (TS) and transversal series of dorsal scales at the midtrunk (DS).

In order to compare similarities and differences, an independent t-test was applied to the morphometrics of the 2 populations. In addition, the distribution functions of the pholidosis characters of the 2 populations were tested with the Mann-Whitney U test.

## Results

**Pholidosis characters:** The rostral is usually separated from the internasal (95.7%) or rarely is in contact (4.3%) as a suture or point. Postorbital is usually separated from parietal (95.7%) or is rarely in contact (4.3%). A parietal foramen exists on the interparietal except for in a single specimen. SRL are usually 4-4 (89.4%), rarely 4-5 (2.1%), 5-4 (2.1%), 3-3 (2.1%), 4-3 (2.1%) and 6-6 (2.1%). SL are 6-5 (29.8%), 6-6

(27.7%), 5-5 (23.4%), 5-6 (17.0%) and 4-4 (2.1%). 1<sup>st</sup> supratemporal is large, more or less rectangular. Masseteric is very large and indistinct in all specimens but is doubled in 4 specimens (8.5%) on the right side and in 2 specimens (4.3%) on the left side. Masseteric is separated from tympanic in 37 specimens (78.7%) but is in contact in 10 specimens (21.3%). Masseteric is in contact with 1<sup>st</sup> supratemporal in 28 specimens (59.65%) but is separated in 19 specimens (40.4%). Other pholidosis features of the specimens are given in Table 1.

The Mann-Whitney U test based on pholidosis characters confirmed differences in SCPa, SCPb, SRLa, SRLb and TVP ( $P < 0.05$ ), which can distinguish between the 2 populations (Table 2). The box and whisker plots of SCPa, SCPb, SRLa, SRLb and TVP of the 2 populations are given in Figure 2A, B, C, D and E. According to these plots, the mean numbers of SRLa, SRLb and TVP are higher in the Ardahan and Göle populations than in Ardahan one, while the mean number of SCPa and SCPb is lower.

**Morphometric measurements:** The morphometric measurements taken from the specimens are given in Table 3. The independent t-test performed between the 2 populations verified a statistically significant difference in only HI ( $P < 0.05$ ) (Table 4). In other words, of the 11 morphometric measurements taken from the specimens 9.1% discriminated statistically between the 2 populations. The box and whisker plot of HI of the 2 populations is given in Figure 3. According to this plot,

Table 1. Pholidosis characters of *Darevskia armeniaca* specimens collected from 2 different localities in Ardahan. For abbreviations, see text (N: Number of specimens, Range: Extreme values, SD: Standard deviation, SE: Standard error of the mean).

Characters	N	Mean	Range	SD	SE	Characters	N	Mean	Range	SD	SE
SCGa	47	4.57	2.0-7.0	1.19	0.17	PA1	47	1.53	1.0-3.0	0.69	0.10
SCGb	47	4.79	1.0-8.0	1.43	0.21	PA2	47	8.47	7.0-11.0	1.02	0.15
SCPa	47	4.57	3.0-6.0	0.77	0.11	FPa	47	15.60	14.0-18.0	0.97	0.14
SCPb	47	4.62	3.0-6.0	0.82	0.12	FPb	47	15.38	14.0-17.0	0.95	0.14
MG	47	22.77	20.0-25.0	1.11	0.16	LSa	47	4.00	4.0-4.0	0.00	0.00
C	47	8.91	7.0-10.0	0.72	0.10	LSb	47	4.00	4.0-4.0	0.00	0.00
TMP1a	41	1.00	1.0-1.0	0.00	0.00	SDLa	47	27.04	26.0-29.0	0.86	0.13
TMP1b	42	1.00	1.0-1.0	0.00	0.00	SDLb	47	26.96	25.0-29.0	0.95	0.14
STPa	47	2.30	2.0-3.0	0.46	0.07	TMP2a	33	1.00	1.0-1.0	0.00	0.00
STPb	47	2.30	2.0-3.0	0.46	0.07	TMP2b	31	1.00	1.0-1.0	0.00	0.00
LVP	47	6.00	6.0-6.0	0.00	0.00	TS	47	16.53	15.0-18.0	0.65	0.10
TVP	47	26.40	25.0-28.0	0.65	0.09	DS	47	44.64	42.0-48.0	1.19	0.17

Table 2. Comparison of pholidosis characters of the 2 populations according to the Mann-Whitney U test (U: Mann-Whitney U value).

Characters	U	P	Characters	U	p
SCGa	224.00	0.305	TVP	146.50	0.002
SCGb	232.00	0.403	LVP	270.00	1.000
SCPa	6.500	0.000	PA1	217.00	0.196
SCPb	5.500	0.000	PA2	237.50	0.463
SRLa	35.50	0.000	FPa	264.00	0.891
SRLb	34.00	0.000	FPb	193.50	0.080
SLa	230.00	0.319	LSa	270.00	1.000
SLb	264.00	0.882	LSb	270.00	1.000
MG	268.50	0.973	SDLa	213.50	0.199
C	243.00	0.519	SDLb	270.00	1.000
TMP1a	209.00	1.000	TMP2a	135.00	1.000
TMP1b	218.50	1.000	TMP2b	117.00	1.000
STPa	245.50	0.506	TS	202.50	0.106
STPb	269.00	0.978	DS	243.50	0.552

the mean of HI is higher in the Ardahan and Göle populations than in the Ardahan one.

**Colour and pattern:** The ground colour of the head is yellowish brown with different sized dark blotches. This ground colour extends to the supralabial plates at the flanks of the head. The lower side of the head is dirty white. The ground colour of the dorsum is usually green, rarely yellow or greenish brown with dark maculations running from the parietal plates to the 2/3 part of the tail; the green colouration is usually more prominent on the anterior third of the trunk. Supraciliar stripes consisting of interrupted white points run from the posterior of the head to the tail tip. The broad temporal stripes consist of a number of irregular dark ocelli. These ocelli are distinct and have white centres, while one or two are bluish at the level of the forelimbs. White smaller ocelli are seen on the fore and hindlimbs. The underside of the head is white. The venter is yellow or light yellow. The outer ventral plates are blue with small dark points.

The specimens from Ardahan and Göle were captured under small stones in a stony open field with grassland along a small river. The temperature was 28 °C when the specimens were captured. The altitude where the sampling was carried out was 1825 m a.s.l. The sympatric reptile and amphibian species were *Darevskia valentini valentini*, *Coronella austriaca* and *Rana camerani*.

The Ardahan specimens were collected from rocky slopes near a small river at an elevation of 1750 m. Specimens found in this region were hiding in burrows at the roots of small weeds, especially *Urtica* sp. *Darevskia armeniaca* specimens were sympatric with *Rana camerani*. In both localities, the specimens were collected during cloudy environmental conditions.

### Discussion

Although *Darevskia armeniaca* is one of the parthenogenetic rock lizard species (Darevsky, 1967; Darevsky, 1972; Baran and Atatür, 1998; Sindaco et al., 2000), some rare male specimens were found in Turkey (Zigana) (Darevsky, 1972) and Armenia (Stepanavan) (Darevsky, 1966; Darevsky et al., 1978; Darevsky and Kupriyanova, 1982). No male specimens were found in the 2 localities in Ardahan.

The comparisons of the pholidosis characters and morphometric measurements with those of Armenia, Georgia, Azerbaijan and Zigana specimens are given in Table 5.

The pholidosis features of the *Darevskia armeniaca* specimens collected from Ardahan are quite similar to those in the Armenia, Georgia, Azerbaijan and Zigana specimens (Darevsky, 1967; Darevsky, 1972).

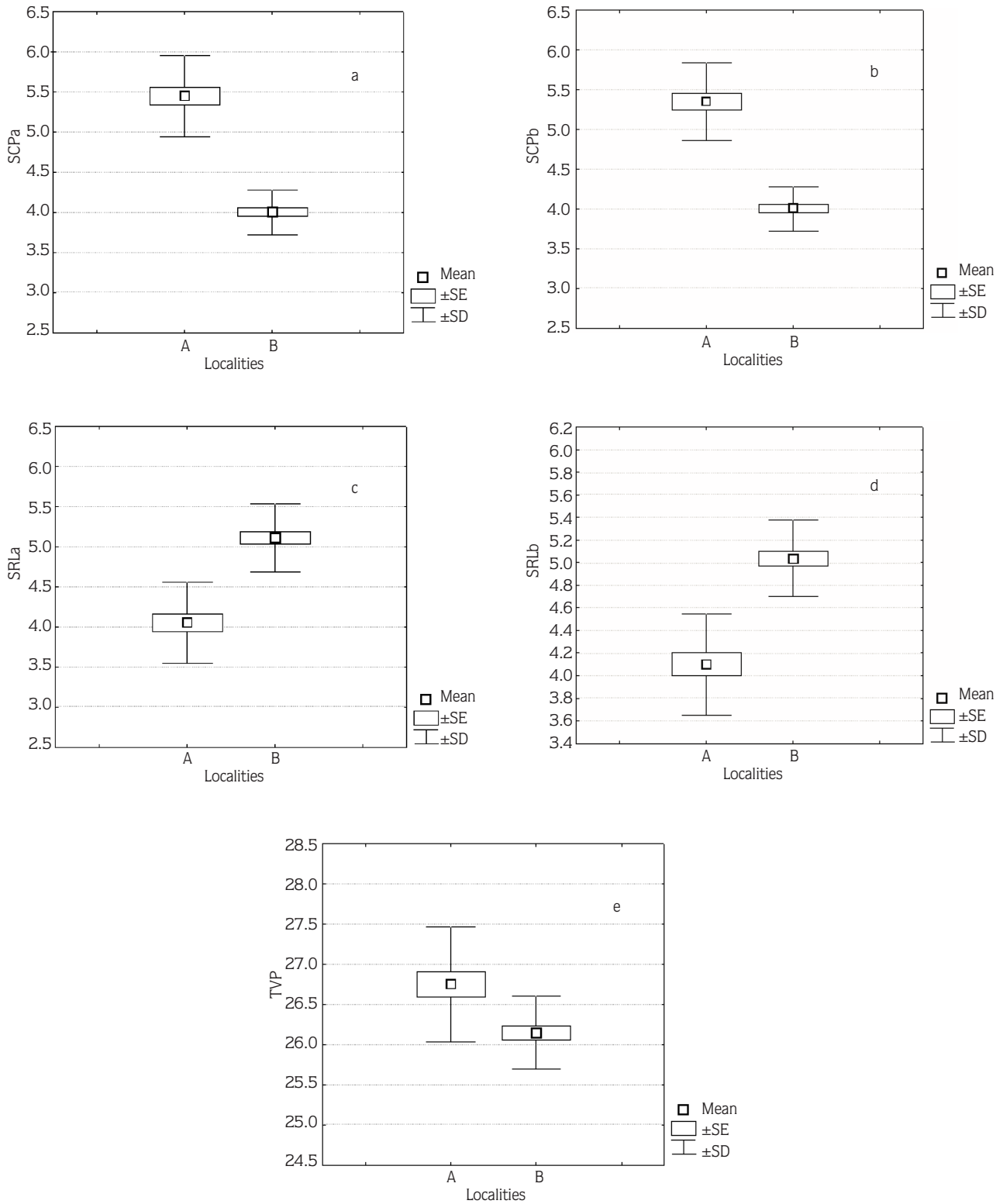


Figure 2. Box and whisker plots of the pholidosis characters showed significant differences between the 2 populations according to the Mann-Whitney U test (A: between Ardahan and Göle, B: Ardahan).

Table 3. Some morphometric measurements of *Darevskia armeniaca* specimens collected from 2 different localities in Ardahan (N: Number of specimens, Range: Extreme values, SD: Standard deviation, SE: Standard error of the mean).

Characters	N	Mean	Range	SD	SE
PL	39	13.31	10.84-14.46	0.80	0.13
PW	39	6.75	5.82-7.72	0.41	0.07
HL	39	14.28	11.78-15.42	0.82	0.13
HW	39	7.71	6.42-8.80	0.48	0.06
SVL	39	62.36	48.30-71.92	4.87	0.78
TL	12	99.42	85.00-111.00	7.06	2.04
TBL	12	159.95	133.30-175.20	12.17	3.51
PI	39	50.74	47.99-55.14	1.88	0.30
HI	39	54.01	49.80-58.11	2.08	0.33
SVL / TL	12	0.61	0.57-0.65	0.03	0.01
TL / TBL	12	0.62	0.60-0.65	0.01	0.01

Table 4. Comparison of morphometric measurements of the 2 populations according to the independent t-test.

Characters	t value	df	p
PL	-0.402	37	0.690
PW	0.507	37	0.615
HL	-0.712	37	0.481
HW	0.747	37	0.460
SVL	-1.406	36	0.168
TL	0.569	10	0.582
TBL	0.695	10	0.503
PI	1.464	37	0.152
HI	2.645	37	0.012
SVL / TL	0.899	10	0.390
TL / TBL	-1.037	8.631	0.328

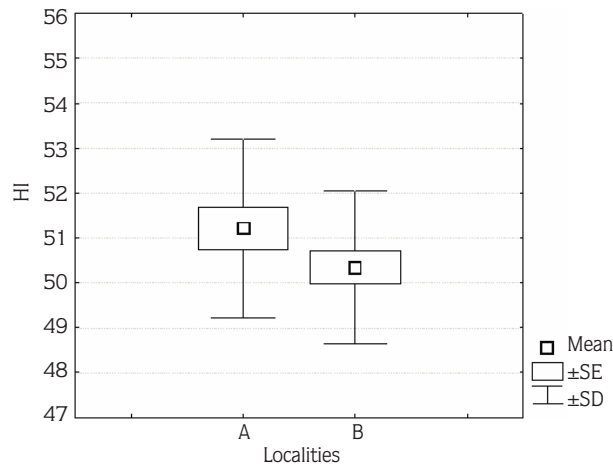


Figure 3. Box and whisker plot of the head index showed significant differences between the 2 populations according to the independent t-test (A: between Ardahan and Göle, B: Ardahan).

DS counts in the Ardahan specimens are similar to those in the Armenia, Georgia, Azerbaijan and Zigana specimens (Table 5). According to MG counts, the Ardahan specimens had values similar to those in the Armenia, Georgia and Azerbaijan specimens but had absolutely lower values than the Zigana specimens. FPa counts in the present study were similar with those in the Armenia, Georgia and Azerbaijan specimens but lower than those in the Zigana specimens (Table 5). Baran and

Atatür (1998) reported that the number of femoral pores ranged from 14.0 to 19.0 for *Darevskia armeniaca*.

According to SVL, the Ardahan specimens were slightly shorter than previously measured specimens from Armenia, Georgia and Azerbaijan but longer than the Zigana specimens. TL value in present study was higher than that in the Zigana specimens but lower than those in the Armenia, Georgia and Azerbaijan specimens. The SVL / TL ratio of the Ardahan specimens was similar to those of the Armenia, Georgia and Azerbaijan specimens (Table 5).

*Darevskia armeniaca* was sympatric with *Darevskia valentini valentini*, *Coronella austriaca* and *Rana camerani* in the 2 different localities in Ardahan. Darevsky (1967) noted that *Coronella austriaca* was one of the main predators of the rock lizard species. Darevsky (1967) also stated that *Darevskia armeniaca* was to a large extent, sympatric with other parthenogenetic rock lizard species, *Darevskia dahli* and *Darevskia rostombekovi*, and in places with *Darevskia valentini*, *Darevskia nairensis* and *Darevskia portschinskii* in central Armenia. It was also determined that there were zones of sympatry with *Darevskia rudis macromaculata*, *Darevskia rudis obscura* and *Darevskia mixta* in the vicinity of Bakuriani (Georgia) (Darevsky, 1967).

Statistical analyses performed between the pholidosis characters and morphometric measurements of the 2

Table 5. Comparison of some pholidosis characters among specimens from Ardahan (Turkey), Armenia, Georgia, Azerbaijan and Zigana (Turkey).

Characters	Darevsky (1967)			Darevsky (1972)			This study			
	N	Mean	Range	N	Mean	Range	N	Mean	Range	
DS	♀	95	44.26	42-47	2	40.00	38-42	47	44.64	42-48
	♂	---	---	---	2	44.50	42-47	---	---	---
MG	♀	95	22.36	19-26	2	28.00	28-28	47	22.77	20-25
	♂	---	---	---	2	28.50	28-29	---	---	---
FP	♀	95	15.66	14-19	2	17	17-17	47	15.38	14-17
	♂	---	---	---	2	19	19-19	---	---	---
SCG	♀	95	4.85	1-8	---	----	----	47	4.79	1-8
TMP1	♀	95	1.00	0-2	---	----	----	47	1.00	1-1
LS	♀	95	4.01	4-5	---	----	----	47	4.00	4-4
TVP	♀	95	26.75	25-29	---	----	----	47	26.40	25-28
PA1	♀	95	1.50	1-3	---	----	----	47	1.53	1-3
STP	♀	95	2.47	2-4	---	----	----	47	2.30	2-3
TS	♀	95	16.53	15-19	---	----	----	47	16.53	15-18
SVL	♀	95	99.42	51-73	2	59.50	57.62	39	62.36	48.30-71.92
	♂	---	---	---	2	44.00	37-51	---	---	---
TL	♀	95	104.90	90-120	---	---	---	12	99.42	85.0-111.0
	♂	---	---	---	1	97.00	---	---	---	---
SVL / TL	♀	95	0.61	0.55-0.72	---	---	---	12	0.61	0.57-0.65
	♂	---	---	---	1	0.53	0.53-0.53	---	---	---

populations verified statistically significant differences in 6 characters. In other words, of the 39 characters examined 15.4% discriminated statistically between the 2 populations. More specimens from north-eastern Turkey, northern and north-western Armenia, southern Georgia and western Azerbaijan should be examined, and with different techniques such as morphological and molecular studies in order to clarify the taxonomic status of this species. Darevsky (1967) noted that the fairly distinct differences in morphometric measurements observed in different populations from Armenia, Georgia and Azerbaijan could be correlated with the elevation of their habitat. By studying other populations, it can be determined whether the morphological differences found here change vertically, and whether they correspond to other ecological conditions.

In conclusion, regarding pholidosis characters, morphometric measurements and colour-pattern features, specimens collected from 2 different localities in Ardahan were found to be similar to *Darevskia armeniaca* specimens from Georgia, Armenia, Azerbaijan and Zigana.

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