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On the occurrence of the Persian Lizard, *Iranolacerta brandtii* (De Filippi, 1863) (Squamata: Sauria: Lacertidae) in Eastern Anatolia, Turkey

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Abstract. This is the first report of the occurrence of *Iranolacerta brandtii* in Eastern Anatolia. The distribution of *I. brandtii* is extended approximately 230 km eastwards into Van province, Turkey, showing that this species is not endemic to Iran as previously stated in the literature. Seven specimens were collected from four different localities between May and September 2014. Specimens were evaluated with respect to their morphological characters and some ecological features and their taxonomical status is also discussed.

Keywords: *Iranolacerta brandtii*, new record, systematics, Van, Turkey.

Introduction

Anatolia is located in an important transitional zoogeographical region, which includes a very species rich biodiversity (Göçmen et al. 2007). Herpetological research has recently been accelerated in Turkey (Yildiz 2010, Akman and Göçmen 2014, Göçmen et al. 2014a,b,c). As a result of these studies, the number of new species or locality records has increased, showing that the herpetofaunal diversity of Anatolia deserves more studies (Uğurtaş et al. 2001, Ilgaz et al. 2005, Yildiz et al. 2009, Göçmen et al. 2011, Göçmen and Akman 2012, Göçmen et al. 2014b). De Filippi (1863) described *Iranolacerta brandtii* (The Persian Lizard) from Basmenj (near Tabriz), Iran in 1863 as *Lacerta brandtii*. Arnold et al. (2007) described the genus *Iranolacerta* and *I. brandtii* and *I. zagrosica* (formerly *Lacerta* sp.) were included in this genus nova. Subsequent researchers have studied the morphology (Nilson et al. 2003, Rezazadeh et al. 2010), hemipenial microornamentation (Böhme 1993), general biology (In den Bosch 1996), karyology (Olmo et al. 2001), distribution (Nilson et al. 2003, Ahmadzadeh et al. 2008, Rajabizadeh et al. 2010, Hosseinian Yousefkhani et al. 2012), ecology (Rezazaeh et al. 2010), and molecular phylogeography (Ahmadzadeh et al. 2013) of this genus.

The Persian Lizard, *I. brandtii* is distributed in northwestern Iran, in Iranian Azerbaijan provinces and discontinuously in Esfahan province, Iran, according to the previous literature (Nilson et al. 2003, Ahmadzadeh et al. 2008, Rajabizadeh et al. 2010, Hosseinian Yousefkhani et al. 2012, Ahmadzadeh et al. 2013). However, Caucasian records are considered suspicious (In den Bosch 1996, Anderson 1999, Nilson et al. 2003, Rezazadeh et al. 2010). *Iranolacerta brandtii* has two subspecies: nominotypical subspecies firstly described from Basmenj and *I. b. esfahanica* from Zagros Mountains in Isfahan province, Iran (Nilson et al. 2003). Based on the literature, the known localities of the Persian Lizard specimens include Tabriz (In den Bosch 1996), the Maragheh palaeontological site (Anderson 1999), Shalilvand, Chalivan, 25 km east of Sharab, Ardabil, Kuh Rang, Fereydun shahr (Nilson et al. 2003), Semian (Ahmadzadeh et al. 2008), Sahand (Pavlicev and Mayer 2009), 30 km north of Tekab city (Rajabizadeh et al. 2010), Ardabil, Namin, Sabalan Mountain (Rezazadeh et al. 2010), and 40 km north of Varzeghan province (Hosseinian Yousefkhani et al. 2012). There is no previous record of this species outside Iran.

The main objective of this study is to present a description of the new *I. brandtii* specimens collected from Eastern Anatolia with a discussion on the systematic position of the specimens, to extend its distribution range, and to explain some ecological observations.

Material and methods

Material List:

Iranolacerta brandtii (De Filippi, 1863)

ZMADYU 2014/85: 1-2, 1 ♂, 1 ♀, Karakoç village (Fig. 2A), Gürpınar, province Van, Turkey, 23.06.2014, Leg. M. Z. Yıldız, N. İğci - ZMADYU 2014/86: 1-2, 1 ♂, 1 ♀, Bağrıaçık village (Fig. 2B, 2C), Özalp, province Van, Turkey, 23.06.2014, Leg. M. Z. Yıldız, N. İğci - ZMADYU 2014/87: 1♀, Sarıköy village, Özalp, province Van, Turkey, 23.06.2014, Leg. M. Z. Yıldız, N. İğci - ZMADYU 2014/88: 1-2, 2 juveniles, Karadulda village (Fig. 2D), Çaldıran, province Van, Turkey, 15.09.2014, Leg. M. Z. Yıldız, N. İğci, E. Bulum.

The Ministry of Forestry and Water Affairs, General Directorate of Nature Conservation and National Parks has begun to inventory the biodiversity of the 30 provinces in Turkey in July 2013. These first of the 30 provinces' biodiversity projects, including Van province, were carried out through the end of 2014. The authors of this paper carried out the herpetological part of the biodiversity inventory for the Van province. For this project, four excursions were conducted in Van province between May and September for 20 days. 283 different localities were explored in Van province for this study. Specimens of *I. brandtii* were collected from four localities (Fig. 1). The geographical coordinates of the localities were determined with the GPS, model Garmin Nuvi 235i. Weather temperature was measured with a mercury thermometer.

The color photos of all specimens were taken by Nikon D300s digital camera while specimens were alive. After color pattern characteristics were recorded, all specimens were anaesthetized with ether and fixed by 96% ethanol injection into the stomach cavity and deposited in 96% ethanol. This method was selected to conserve DNA samples for future genetical studies (Yildiz et al. 2012). All specimens were recorded and deposited in the Zoology Museum of Adıyaman University (ZMADYU), Turkey. Pholidolial and the other morphological characters were measured according to Nilson et al. (2003) and Rajabizadeh et al. (2010). All measurements were taken under an Olympus SZX 16 stereomicroscope, except snout-vent length and tail length, which were measured using digital calipers (Mitutuyo 500-181 U) with an accuracy of 0.02 mm. Macro photographs

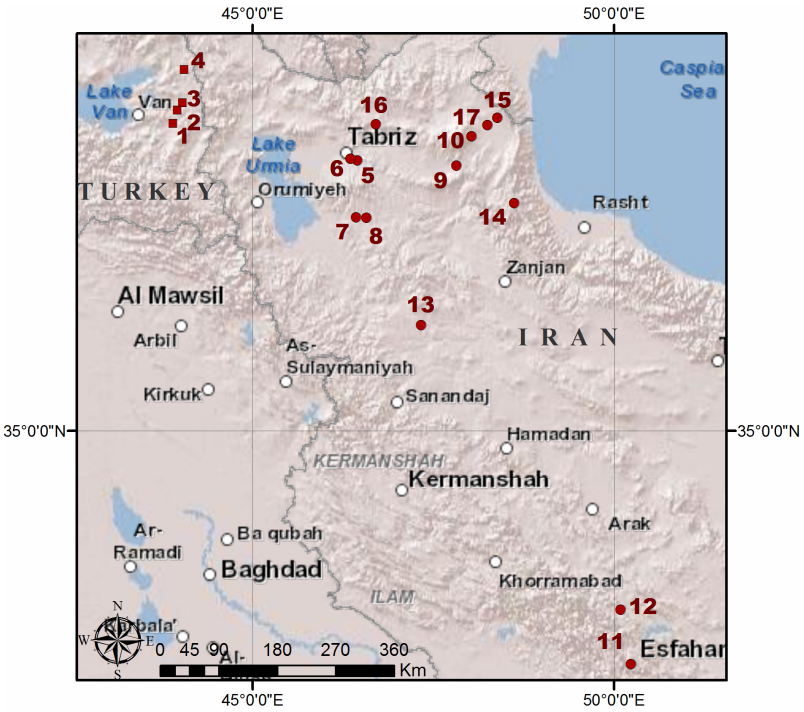

Figure 1. The localities of *Iranolacerta brandtii*. Squares refer to the new localities and filled circles refer to the previous localities from the literature. [1:Karakoç village, Gürpınar; 2: Bağrıaçık village, Özalp; 3: Sarıköy village, Özalp; 4: Karadulda village, Çaldıran; 5: Basmanj (Anderson, 1999); 6: Sahand (Pavlicev and Mayer, 2009); 7: Shalilvand; 8: Chalivan; 9: 25 km east of Sharab; 10: Ardabil; 11: Kuh rang; 12: Fereydun shahr (Nilson et al., 2003); 13: 30 km north of Tekab city (Rajabizadeh et al., 2010); 14: Hillsides around Ardabil; 15: Steppe of Namin; 16: 40 km north of Varzeghan (Hosseinian Yousefkhani et al. 2012); 17: Semian (Ahmadzadeh et al. 2008).]

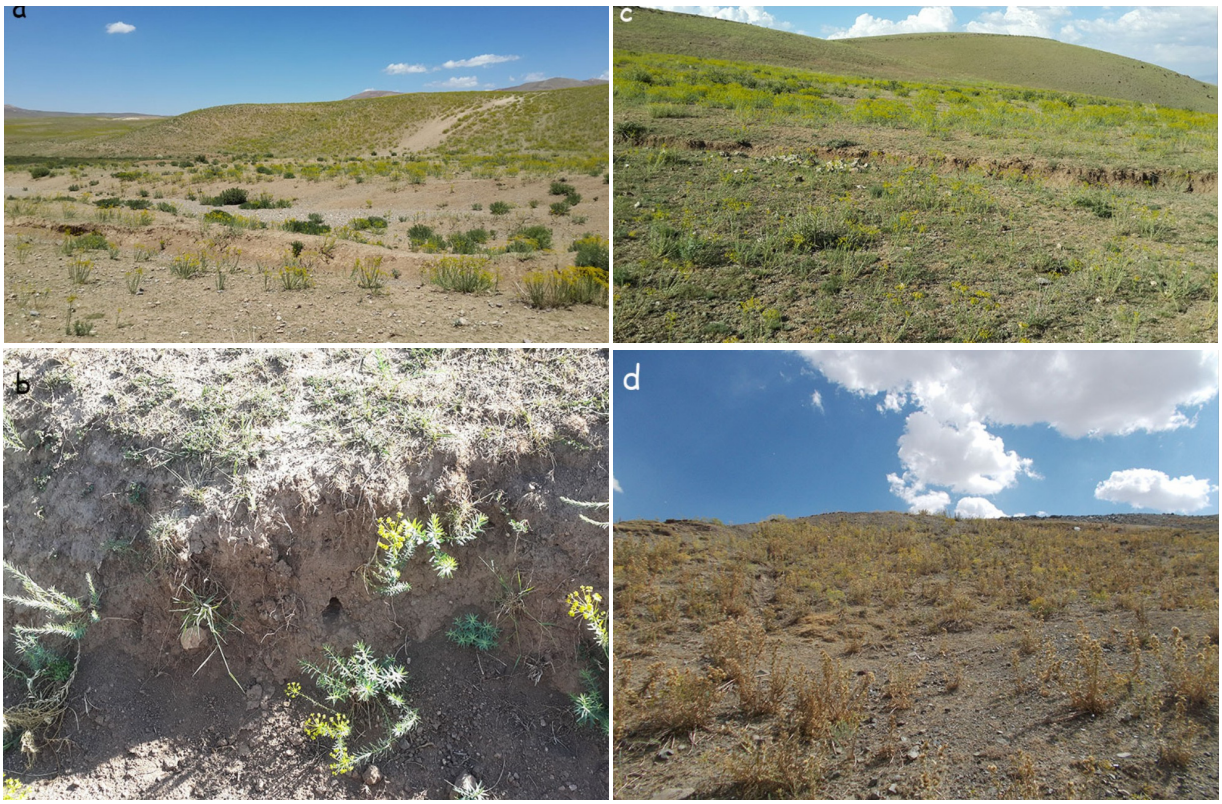

Figure 2. General aspects of the habitats of *Iranolacerta brandtii*. A: 1.6 km east of Karakoç village, province Van, B: Nest hole of *I. brandtii* at Bağrıaçık village, province Van, C: 2.7 km north of Bağrıaçık village, province Van, D: 1.5 km north-east of Karadulda village, province Van (Photographs by Naşit İĞCİ)

of some specific parts of the body were taken and some characters were counted on photo by the computer. Data were summarized using SPSS 15 for Windows statistical software. Metric data of juveniles were not added to the descriptive statistics.

Results

Specimens were collected from both plains and hills. Vegetation in all habitats was alpine steppe with *Cirsium* spp. and *Euphorbia* spp. as dominant plant species. The habitat of Karakoç village (2129 m a.s.l.) was a dry stream gully, which

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Figure 3. General aspects of *Iranolacerta brandtii* specimens from new localities. A-B: A male specimen, ZMADYU 2014/86-1, C-D: A female specimen, ZMADYU 2014/85-1 (Photographs by Bayram GÖÇMEN), E-F: A juvenile specimen, ZMADYU 2014/88-1 (Photographs by Mehmet Zülfü YILDIZ).

had sandy and soft soil (Fig. 2A). Specimens were observed hiding under the leaves and roots of *Cirsium* spp. and run swiftly amongst plants. The weather was clear and the air temperature in shade was 35° C. The habitat of Bağrıaçık village (2300 m a.s.l.) was hilly with a small dry stream gully (Fig. 2B, 2C). The air temperature in shade was measured as 26° C. The habitat of Sarıköy (2055 m a.s.l.) was plain and surrounded by cultivated areas. The air tempaarture was 25° C. The habitat of Karadulda had the same conditions as the Karakoç habitat. The Karadulda village survey was carried out in September; therefore, vegetation was dry and only juvenile individuals were observed (Fig. 2D). *Eremias suphani* Başoğlu & Hellmich, 1968 and *Ablepharus bivittatus* (Ménétriés, 1832) were observed in a habitat 4.4 km northeast of Karadulda locality but not syntopic with *I. brandtii*. This situation indicates that the Persian lizard and the Suphan lizard might have similar ecological niches. *Ablepharus bivittatus* was observed at Bağrıaçık village in sympatry with *I. brandtii*. No other reptile species were observed at other habitats.

Sexual dichromatism was determined between sexes in spring (breeding) season. Adult specimens could not be

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Table 1. Meristic characters of the investigated specimens.

	Male						Female					
	N	Mean	SE	SD	Min	Max	N	Mean	SE	SD	Min	Max
Dorsals	2	56.0	0.0	0.0	56.0	56.0	3	55.7	3.5	2.0	52.0	59.0
Ventral plates rows	2	8.0	0.0	0.0	8.0	8.0	3	8.0	0.0	0.0	8.0	8.0
Ventral plates series	2	28.0	1.4	1.0	27.0	29.0	3	26.3	2.3	1.3	25.0	29.0
Submaxillary pairs	2	5.0	0.0	0.0	5.0	5.0	3	5.0	0.0	0.0	5.0	5.0
Gulars	2	27.0	0.0	0.0	27.0	27.0	3	26.3	0.6	0.3	26.0	27.0
Collar	2	9.0	0.0	0.0	9.0	9.0	3	10.0	0.0	0.0	10.0	10.0
Supralabials	4	8.8	0.5	0.3	8.0	9.0	6	8.8	0.4	0.2	8.0	9.0
Infralabials	4	6.0	0.0	0.0	6.0	6.0	6	6.3	0.5	0.2	6.0	7.0
Supracilliars	4	6.3	0.5	0.3	6.0	7.0	6	7.0	0.0	0.0	7.0	7.0
Supracilliar granuls	4	9.0	0.0	0.0	9.0	9.0	6	7.0	2.3	0.9	4.0	9.0
postnasals	4	1.8	0.5	0.3	1.0	2.0	6	1.7	0.5	0.2	1.0	2.0
pre-preanal plates	2	6.5	0.7	0.5	6.0	7.0	3	6.7	0.6	0.3	6.0	7.0
Temporals	4	59.5	2.1	1.0	57.0	62.0	6	62.3	3.3	1.4	57.0	67.0
Femoral pores	4	18.8	1.5	0.8	17.0	20.0	6	17.0	0.9	0.4	16.0	18.0
Subdigital lamellae	4	26.5	1.3	0.6	25.0	28.0	6	28.2	1.0	0.4	27.0	29.0
Scales in 9th segment of tail	2	28.5	0.7	0.5	28.0	29.0	3	26.3	2.5	1.5	24.0	29.0

	Juveniles						Total					
	N	Mean	SE	SD	Min	Max	N	Mean	SE	SD	Min	Max
Dorsals	2	56.0	1.4	1.0	55.0	57.0	7	55.9	2.1	0.8	52.0	59.0
Ventral plates rows	2	8.0	0.0	0.0	8.0	8.0	7	8.0	0.0	0.0	8.0	8.0
Ventral plates series	2	27.0	1.4	1.0	26.0	28.0	7	27.0	1.7	0.7	25.0	29.0
Submaxillary pairs	2	5.0	0.0	0.0	5.0	5.0	7	5.0	0.0	0.0	5.0	5.0
Gulars	2	27.0	0.0	0.0	27.0	27.0	7	26.7	0.5	0.2	26.0	27.0
Collar	2	10.0	0.0	0.0	10.0	10.0	7	9.7	0.5	0.2	9.0	10.0
Supralabials	4	9.0	0.0	0.0	9.0	9.0	14	8.9	0.4	0.1	8.0	9.0
Infralabials	4	6.0	0.0	0.0	6.0	6.0	14	6.1	0.4	0.1	6.0	7.0
Supracilliars	4	7.0	0.0	0.0	7.0	7.0	14	6.8	0.4	0.1	6.0	7.0
Supracilliar granuls	4	8.5	0.6	0.3	8.0	9.0	14	8.0	1.7	0.5	4.0	9.0
postnasals	4	2.0	0.0	0.0	2.0	2.0	14	1.8	0.4	0.1	1.0	2.0
pre-preanal plates	2	8.0	0.0	0.0	8.0	8.0	7	7.0	0.8	0.3	6.0	8.0
Temporals	4	56.8	4.3	2.2	53.0	61.0	14	59.9	3.9	1.1	53.0	67.0
Femoral pores	4	16.5	0.6	0.3	16.0	17.0	14	17.4	1.3	0.4	16.0	20.0
Subdigital lamellae	3	26.0	1.0	0.6	25.0	27.0	13	27.2	1.4	0.4	25.0	29.0
Scales in 9th segment of tail	2	28.0	1.4	1.0	27.0	29.0	7	27.4	1.9	0.7	24.0	29.0

observed outside of spring season; therefore, sexual dichromatism was not assessed for the other seasons. Head color of male specimens (Fig. 3A) is substantially green on the dorsum, while the anterior is uniformly brown in females (Fig. 3C), but olive-green that changes brown beyond the middle of the body in males (Fig. 3A). Throat is light blue in males (Fig. 3B) and greenish light blue in females (Fig. 3D). Abdomen color changes from blue to greenish-light brown from anterior to posterior in males while it changes in from blue to light brown in females. The tail is uniformly brown dorsally, and brownish-orange ventrally in both sexes (Fig. 3A, 3C). Coloration of juveniles is similar to that of females except the tail which is green in juveniles (Fig. 3E, 3F). Descriptive statistics of meristic and metric characters of specimens are given in Table 1 and Table 2, respectively.

Discussion

The Persian lizard was previously considered as an endemic species to Iran. Ahmadzadeh et al. (2013) studied mitochondrial DNA (cytochrome *b*, 16S and 12S ribosomal RNA) to clarify the distribution pattern of *Iranolacerta* spp. by phylogeography and species distribution modeling approaches. The results of the species distribution modeling showed that Persian Lizards might be distributed in Alborz Mountain range in Iran, Karabak in the Southern Caucasus, and Khoy-Chaldoran mountain ranges in the administrative borders of Iran and Turkey. New distribution sites in Turkey extend about 50 km parallel of the Khoy-Chaldoran mountain ranges, Iran. Therefore, our study supports the distribution model result given by Ahmadzadeh et al. (2013). However, our finding shows that this mountain range is not a barrier, supporting the fragmented distribution model of the species, indicating that the area might have been a glacial refugia for this species. Additionally, the results by Ahmadzadeh et al. (2013) indicated high phylogenetic divergence between *I. brandtii* and *I. zagrosica*. However, they suggested that subspecies of *I. brandtii* should be revised because of a low uncorrected genetic distance based on cytochrome *b* between populations of *I. brandtii*, which was found to be maximum 3.5%. Ahmadzadeh et al. (2013) suggested some scenarios to explain why the distribution of Persian lizard is discontinuous and limited. One of them was competitive interaction

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Table 2. Metric characters (mm) of the investigated specimens.

	Male						Female					
Characters	N	Mean	SE	SD	Min	Max	N	Mean	SE	SD	Min	Max
Snout-vent length	2	55.36	14.29	10.11	45.25	65.46	3	60.67	1.21	0.70	59.30	61.60
Tail length							3	95.26	9.90	5.72	84.07	102.91
Length of widest part of tail base	2	6.76	2.23	1.58	5.18	8.33	3	6.41	0.15	0.09	6.30	6.58
Length of cloaca	2	5.00	1.91	1.35	3.65	6.35	3	4.97	0.43	0.25	4.55	5.41
Snout length	2	4.97	1.72	1.22	3.75	6.18	3	4.56	0.37	0.21	4.14	4.82
Head length	2	13.64	3.22	2.28	11.36	15.91	3	12.42	0.70	0.40	11.62	12.90
Head height	2	7.51	2.37	1.68	5.83	9.18	3	6.84	0.21	0.12	6.64	7.06
Head width	2	8.96	2.56	1.81	7.15	10.77	3	7.96	0.68	0.40	7.19	8.50
Eye length	4	3.69	0.28	0.14	3.39	3.94	6	3.40	0.20	0.08	3.06	3.61
Max diameter of ear opening	4	3.26	1.46	0.73	1.98	4.59	6	2.42	0.23	0.09	2.13	2.70
Axilla-groin	4	14.55	11.10	5.55	3.70	27.04	6	18.01	14.76	6.02	4.39	32.86
Distance of orbit ear left	2	5.39	2.24	1.59	3.80	6.97	3	4.57	0.14	0.08	4.43	4.70
Length of forearm	4	4.68	1.21	0.61	3.34	5.74	6	5.22	0.97	0.40	4.30	6.71
Length of arm	4	4.36	1.33	0.67	3.05	5.73	6	4.51	0.68	0.28	3.96	5.62
Length of foreleg	4	5.99	0.76	0.38	5.23	6.75	6	7.16	1.92	0.79	5.18	9.77
Length of thigh	4	10.54	2.13	1.07	8.66	12.56	6	9.09	1.52	0.62	7.21	10.70
Length of fourth toe	4	10.82	1.15	0.58	9.10	11.56	6	9.97	0.65	0.27	9.14	10.90

	Total					
Characters	N	Mean	SE	SD	Min	Max
Snout-vent length	5	58.55	7.76	3.47	45.25	65.46
Tail length	3	95.26	9.90	5.72	84.07	102.91
Length of widest part of tail base	5	6.55	1.13	0.51	5.18	8.33
Length of cloaca	5	4.98	1.00	0.45	3.65	6.35
Snout length	5	4.72	0.92	0.41	3.75	6.18
Head length	5	12.91	1.81	0.81	11.36	15.91
Head height	5	7.10	1.25	0.56	5.83	9.18
Head width	5	8.36	1.47	0.66	7.15	10.77
Eye length	10	3.51	0.27	0.09	3.06	3.94
Max diameter of ear opening	10	2.76	0.96	0.30	1.98	4.59
Axilla-groin	10	16.63	12.85	4.06	3.70	32.86
Distance of orbit ear left	5	4.90	1.21	0.54	3.80	6.97
Length of forearm	10	5.00	1.05	0.33	3.34	6.71
Length of arm	10	4.45	0.93	0.29	3.05	5.73
Length of foreleg	10	6.69	1.62	0.51	5.18	9.77
Length of thigh	10	9.67	1.83	0.58	7.21	12.56
Length of fourth toe	10	10.31	0.93	0.30	9.10	11.56

with other ground-dwelling lacertids. Our results support this idea, because 283 different localities were explored in Van province and the other ground-dwelling lacertid species, *Eremias suphani, Parvilacerta parva, Lacerta media* and *Ophisops elegans* were found 4, 6, 21 and 36 different localities respectively but never observed as syntopic with *I. brandtii*.

Regarding to the morphology, Nilson et al. (2003) reported that *I. b. esfahanica* specimens had grayish-green body, browner posteriorly, and head was green on dorsal side. Abdomen was yellowish green to yellowish brown posteriorly and throat was light blue in both sexes. Nilson et al. (2003) also reported that in the dorsal pattern of *I. b. brandtii* male specimens, the vertebral region was uniformly brownish-olive-green, the ventral color pattern was uniformly bluish-white, throat was uniformly greenish-white, tail was uniformly greenish dorsally and greenish-cream ventrally in *I. b. brandtii* males. Moreover, Anderson (1999) reported that throat and abdomen was light bluish, head greenish during breeding season for females and whitish yellow throat and abdomen for male. The pattern of our new specimens is in concordance with the data given in the literature but the coloration of new specimens is not exactly compatible with the literature data (Anderson 1999, Nilson et al. 2003, Arnold et al. 2007).

Nilson et al. (2003) indicated that nominotypic subspecies of *I. brandtii* differs from *I. b. esfahanica* by having large masseteric shield and fewer temporal scales, fewer longitudinal ventral plate rows, and fewer gular and collar scale numbers. One of our specimens has a small masseteric shield (ZMADYU 86/2014-1, ♂) and one has no masseteric shield on the left side (ZMADYU 86/2014-2, ♀). The other specimens have large masseteric shields on each side. According to Nilson et al. (2003), *I. b. brandtii* has 40.33 (SD: 5.7) and *I. b. esfahanica* has 63.2 (SD: 4.8) temporal scales. Rejabizadeh et al. (2010) reported 52 and 56 temporal scales for two specimens of *I. b. brandtii* from north of Tekab city. In this study, number of temporal scales averaged as 59.93 (SD:1.05). The number of gular and collar scales of our specimens is compatible with the data given for nominotypic subspecies by Nilson et al. (2003). However, the other meristic (Table 1) and

metric (Table 2) data of our specimens are generally in accordance with the data given by different researchers for *I. b. brandtii* (Nilson et al. 2003, Ahmadzadeh et al. 2008, Rajabizadeh et al. 2010, Hosseinian Yousefkhani et al. 2012). The coloration of our new specimens is similar to *I. b. esfahanica* whereas pholidolial characters fit the data given by Nilson et al. (2003) for *I. b. branditii*.

The coloration and some pholidolial features (eg. temporal scales) of the our new specimens presented in this study show some differentiation from the previously published data (Anderson 1999, Nilson et al. 2003, Ahmadzadeh et al. 2008, Rajabizadeh et al. 2010, Hosseinian Yousefkhani et al. 2012). Molecular results of Ahmadzadeh et al. (2013) proved a need for a revision of subspecies of the Persian lizard. Therefore, specimens were not evaluated at the subspecies level. This paper presents the first record of *I. brandtii* from 4 localities in Turkey. The new distribution boundary of the species is extended 230 km eastwards to Turkey.

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