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Lyciasalamandra arikani n. sp. & *L. yehudahi* n. sp. (Amphibia: Salamandridae), two new Lycian salamanders from Southwestern Anatolia

Bayram GÖÇMEN* and Bahadır AKMAN

Ege University, Faculty of Science, Department of Biology, Zoology Section, 35100 Bornova, Izmir, Turkey
*Corresponding Author: B. Göçmen, E-mail: cypriensis@yahoo.com
Tel: +90 (232) 311 17 95, Fax: +90 (232) 388 10 36

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Abstract. Two new species of Lycian salamanders, *Lyciasalamandra arikani* n. sp. and *L. yehudahi* n.sp. are described and their relationships with similar and neighbouring taxa are discussed. Both taxa originate from areas new for the genus, with the former from around Erentepe Mt. (Kumluca, Antalya) and the latter from Tahtalı Mt. (Kemer, Antalya) in the southern parts of Beydağları Mountain range in southwestern Anatolia. Some information about their habitats and behaviour are reported.

Key words: Lycian salamanders, *Lyciasalamandra arikani* n.sp., *Lyciasalamandra yehudahi* n.sp , serology, taxonomy, Turkey.

Introduction

The Lycian salamanders (genus *Lyciasalamandra*) are one of the most popular and, at the same time, least known animals around Muğla and Antalya provinces (SW Anatolia), since their cryptic lifestyle in karstic areas mainly depends on suitable climatic conditions. The genus *Lyciasalamandra* contains ten allopatric species and subspecies from an area stretching for approximately 420 km along the Mediterranean coast of Turkey between Kaplanhanı Plataeu (Alanya, Antalya) and Marmaris (Muğla) and some adjacent islands (Pieper 1963, Başoğlu 1967, Başoğlu & Atatür 1974, 1975, Başoğlu & Baran 1976, Baran & Atatür 1980, Franzen & Klewen 1987, Başoğlu et al. 1994, Mutz & Steinfartz 1995, Veith et al. 2001, Budak & Göçmen 2005, Öz et al. 2004, Franzen et al. 2008, Akman et al. 2011, Göçmen et al. 2011). In earlier articles (Akman et al. 2011, Göçmen et al. 2011) it was reported that a new Lycian salamander from Göynük Canyon, Antalya, *Lyciasalamandra irfani* Göçmen, Arıkan & Yalçınkaya 2011 was threatened with extinction, and a new and somewhat different population of *L. atifi* (Başoğlu, 1967) was also found, representing a considerable range extension for both species and genus, around 35 km air distance to the south-east. During additional field work, we scanned the southern parts of the Göynük Canyon, on the way to Finike, which is inhabited by *L. luschani finikensis* (Başoğlu & Atatür, 1975), and detected two new and isolated populations of salamanders belonging to the genus *Lyciasalamandra*.

The new salamander populations were discovered during field trips conducted to SW Anatolia in the midst of the rainy season (April 2011). The two new populations, differing from previously known ones and between each other, were discovered at sites between Kemer and Kumlucayazı, separated by the snow covered Tahtalı Mountain topping at 2366 m a.s.l. The first new salamander species inhabits the southern mountainous parts of Tahtalı Mt. between Beycik and Kumlucayazı, and across the elevations (slopes and plains) of "Ulupınar" (425-782 m a.s.l.) constituting an inland locality. The second new species was found in and around Kemer, including Gedelme (an inland locality) between the Kemer stream at the north and Tekirova at the south, and within the coastal strip (altitudes 87-646 m a.s.l.). At that time, we thought that the population around Ulupınar was closely related to the *L. luschani* (Steindachner 1891) group as is shown by its light colouration on the head, especially on the upper eyelids and parotoid glands, whereas the Kemer population was presumed to associate to Bille's salamander [*L. billae* (Franzen & Klewen, 1987)] due to its proximity to that species and its rather dark coloured head. In the same rainy season, we also scanned for salamanders the area between the Göynük stream, the southernmost part of the known distribution range of *L. billae*, and Kemer stream, including Değirmendere. Although we made some repeated trips to this area, we were unable to find any additional Lycian salamanders. Apparently there is a gap between the distribution areas of *L. billae* and the new populations.

As a result of our survey, we concluded that the new Lycian salamander populations represents two new species.

Material and Methods

Material examined of the new populations is deposited at ZMHRU (The Zoology Museum of Harran University, Şanlıurfa, Turkey) (Table 1 & 2). The comparative material for the other taxa equals that in a previous paper (Göçmen et al. 2011), therefore it will not be listed.

The localities where the specimens were collected and the distribution areas of the known neighbouring Lycian salamander taxa are shown on the map (Fig. 1). The geographical coordinates of the sampled specimens were computed with a Magellan model XL GPS (Table 1 & 2). The specimens were kept alive for 3-30 days in terraria for colouration analyses and photography. Some adult specimens (at least one pair) from each population or taxon were used to facilitate interpopulation comparisons regarding blood-serum proteins, observed by using, the polyacrylamide gel electrophoresis (PAGE) and densitometric analyses. Within three days of collection, blood samples were taken from specimen in the laboratory after anaesthetizing them with ether, through ventral abdominal vein puncture using heparinized hematocrit capillaries.

The separations of blood-serum proteins followed the polyacrylamid "disc" electrophoresis method of Davis (1964), slightly modified by Özeti & Atatür (1979). Finally all specimens were etherized, then injected with 96% ethanol and stored in glass jars with 70% ethanol (Göçmen et al. 2007) to facilitate future DNA studies.

We tested for sexual dimorphism in each sample, although some of characteritics is well known for all *Lyciasalamandra* taxa (swollen cloacal region and hedonic protuberance above the tail base in males). For mensural ("metric") characters we used only the adults, to avoid the effects of allometry.

Measurements of body proportions and their ratios follow previously published methods on salamanders (e.g., Başoğlu & Atatür 1974, Öz & Arıkan 1990, Mutz & Steinfartz 1995, Öz et al. 2004, Çiçek et al. 2010). They are

Table 1. Geographic and some climatic information of the localities of *L. arikani* n.sp., as well as their museum numbers of the specimens. The numbers in brackets correspond to the localities shown in Fig. 1b.

Museum numbers (ZMHRU)	Localities	Altitude (m)	Latitude (DMS)	Longitude (DMS)	Collection date, number of specimens	Temp. (°C)
2011/137	Erentepe village [1]	609	36° 25' 24" N	30° 23' 10" E	23.04.2011 3 specimens (2♀♀, 1 juv.)	17
2011/130	İncircik village [2]	620	36° 26' 37" N	30° 22' 05" E	23.04.2011 2 specimens (1♂, 1♀)	19
2011/131	Ovacık plataeu [3]	782	36° 26' 32" N	30° 24' 23" E	23.04.2011 6 specimens (4♀♀, 2 juv.)	17
2011/122	Erentepe Mountain [4]	610	36° 24' 43" N	30° 25' 08" E	03.04.2011 15 specimens (3♂♂, 7♀♀, 5 juv.)	16
2011/120	Ulupınar [5]	425	36° 26' 01" N	30° 25' 40" E	03.04.2011 4 specimens (4♀♀)	16
2011/126	Dağdibi Mevki [6]	560	36° 28' 33" N	30° 25' 02" E	16.04.2011 7 specimens (1♂, 4♀♀, 2 juv.)	15
2011/132	Başören village [7]	748	36° 29' 52" N	30° 25' 52" E	24.04.2011 4 specimens (1♂, 3♀♀)	18

Table 2. Geographic and some climatic information of the localities of *L. yehudahi* n.sp, as well as their museum numbers of the specimens. The numbers in brackets correspond to the localities shown in Fig. 1b.

Museum numbers (ZMHRU)	Localities	Altitude (m)	Latitude (DMS)	Longitude (DMS)	Collection date, number of specimens	Temp. (°C)
2011/133	Tekirova [8]	99	36° 30' 34" N	30° 30' 04" E	24.04.2011 2 specimens (1♂, 1♀)	18
2011/134	Tahtalı Mt. Teleferic road 4th Km [9]	238	36° 32' 26" N	30° 31' 38" E	24.04.2011 7 specimens (1♂, 4♀♀, 2 juv.)	18
2011/135	Tahtalı Mt. Teleferic road 8th Km [10]	646	36° 32′ 22″ N	30° 29′ 09″ E	24.04.2011 3 specimens (3♀♀)	18
2011/124	Servelçukuru [11]	87	36° 34' 94" N	30° 31' 07" E	04.04.2011 2 specimens (1♂, 1♀)	16
2011/125	Kuzdere [12]	100	36° 35' 28" N	30° 30' 34" E	04.04.2011 7 specimens (2♂♂, 3♀♀, 2 juv.)	16
2011/123	Gedelme [13]	196	36° 36' 00" N	30° 29' 11" E	04.04.2011 6 specimens (3♂♂, 3♀♀)	16

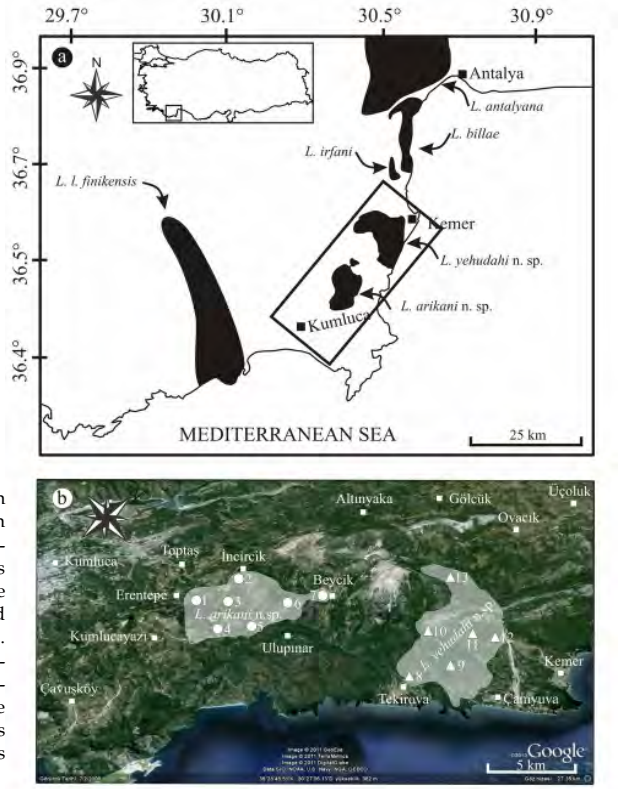

Figure 1. Maps showing (**a**) the distribution of the known neighbouring taxa based on the data of the recent comprehensive studies and our collections; (**b**) the localities where the specimens were collected of the new populations. The numbers correspond to the ones in the material list (Table 1 & 2). The watermarked areas exhibit the distribution of the two new species superimposed on a Google topographic map. White filled circles (*L. arikani* n.sp.) and triangles (*L. yehudahi* n.sp.) indicate the exact places of the new species.

as follows: Total Body Length –the length of the whole body including the tail (TBL), Rostrum-Anus Length – length from the snout to the posterior end of the cloacal opening (RA), Length of Trunk –length from gular fold to the anterior edge of cloacal opening (LT), Tail Length (TL), Nostril-Eye Distance (NED), Distance Between Nostrils (DBN), Eye Diameter (ED), Head Length –distance from the snout to the gular fold (HL), Head Width (HW), Parotoid Length (PL), Parotoid Width (PW), Fore Limb Length (FLL), Hind Limb Length (HLL), Distance between Fore- and Hind Limbs (DFHL), ratios of HW/HL, TL/TBL, PW/PL, NED/HL. Metric characters were measured with Mitutuyo digital calipers of 0.02 mm sensitivity, except RA, TL and TBL, which were measured with a millimetric ruler. Summarized statistics of the metric values of the populations and inter-population (taxa) comparison analyses were conducted with "SPSS 15.0 for Windows". In comparing the metric characters, Student's T-test were used. Furthermore, to control the test results of raw data, data on raw metric characters were again exposed to Student's T-test, taking index values of PERCRA (percents of rostrum-anus length; [each metric character/ RA] × 100), according to Werner (1971). So, the evaluations on similarities or differences between the populations/taxa were strengthened. The evaluations of all statistical analyses were based on the statistical significance level of "P≤0.05".

Results and Discussion

1) *Lyciasalamandra arikani* n. sp.

(Figs. 1-5, Table 1 & 3)

Differential Diagnosis: This is a species of *Lyciasalamandra* distinguished by colouration. The ground colour of the dorsum in both sexes is honey yellowish, with yellowish-whitish green upper eyelids and yellowish white flecks on the flanks, not forming a distinct line. The ground colour of the parotoid glands and the front side of the eyes, around the snout is typically lighter and unspotted than the other parts of the dorsum, being more orange in colour. Over the ground colour of dorsum, scattered and indistinct, especially in adults, small whitish spots are present. The juveniles are a bit darker.

In the light parotoid glands and upper eyelids, the new species resembles more to the *L. luschani* subspecies [*L .l. luschani* (Steindachner 1891), *L. l. basoglui* (Baran & Atatür 1980) & *L. l. finikensis* (Başoğlu & Atatür 1975)], but it differs by its honey yellowish ground colour, and its lack of dorsal

Figure 2. *Lyciaslamandra arikani* n. sp. (**a**) Typical adult female (Holotype, ZMHRU 2011/124:4); (**b**) Adult male showing a dark colouration; (**c**) Semiadult female; (**d**) Semiadult male; (**e**) Typical juvenile; (**f**) Juveniles showing some colour variations.

dark blotches. Also the upper eyelids in the new species are yellowish-whitish green, not pure whitish. It also differs from most other known Lycian salamanders [viz. *helverseni* (Pieper, 1963), *fazilae* (Başoğlu & Atatür, 1974), *antalyana* (Başoğlu & Baran, 1976, *billae* (Franzen & Klewen, 1987), *flavimembris* (Mutz & Steinfartz, 1995) and *irfani* Göçmen Arıkan & Yalçınkaya, 2011], in lacking yellow or red flecks on the dorsum. Like all other known taxa mentioned above, the new species is also small in size compared with *atifi*, which has an almost uniform dark dorsum and is evidently the largest taxon described up to now, reaching a total length of over 170 mm. It is also different from all other neighbouring taxa (*L. irfani, L. billae, L. luschani*) in having no complete lateral line on its flanks, similar to *L. flavimembris,* which however, has a dark brown dorsum with very few, small silvery yellowish blotches.

The new species differs from *L. irfani* and *L. billae* in having no whitish flecks or spots on their dorsal background colour in adults. Whitish flecks are seen only in young and juvenile specimens and not ordered regularly, forming two light dorsolateral bands as is in *L. billae*, which has salmon to black ground colour on the dorsum. Also the dorsum colour of *L. irfani* is aubergine reddish brown, whereas in *L. arikani* n.sp. it is honey yellowish, although it can be a bit dark (brownish) in both young and juvenile individuals. Beside these differences, *L. arikani* n.sp. is also distinctly different from both previously known neighbouring species (*L. irfani* and *L. billae*) and also the next described new species, in having no dark (blackish) face and upper eyelids.

Holotype and Terra Typica. (Fig. 2a) Adult female. ZMHRU 2011/122:4. the eastern slope of Tahtalı Mt., 4th Km Kumluca, Antalya – Turkey. 610 m. a.s.l.

Derivatio nominis. The name of the newly described species here is derived from the surname of the Turkish herpetologist Hüseyin ARIKAN, who made valuable contributions to the knowledge of the herpetofauna of Turkey.

Description of the holotype. Its body form is like all other species of *Lyciasalamandra*. Rostrum-anus length (RA) and tail length (TL) are 74.00 and 56.00 mm, respectively. Head flat, longer than

broad (HW/HL 0.66). Snout more or less rounded. Parotoid glands long and narrow (PW/PL 0.36), with a slight inner curvature towards the anterior end which is narrower than the posterior part. Gular fold distinctly visible. The cloacal region shows a very slight swelling.

Living specimen show honey yellowish ground colour of dorsum including head, tail and extremities, except upper eyelids. On this ground colour there are numerous tiny, indistinct, irregularly scattered brownish dots that are visible with a magnifying glass. The upper eyelids are yellowish white/green with some tiny, indistinct dark (brownish or blackish) dots; and the front side of the eyes, around the snout and parotoid glands is lighter than the other parts of dorsum with some orange tinge. The openings of the dorsal (vertebral), caudal and parotoid glands are visible as black dots.

The lower parts of the body is pale yellowish, especially on the ventral and lateral sides of the legs and the tail including the cloacal region. The throat is somewhat translucent without any spots, showing the internal organs. Towards the sides, there are many irregularly ordered, and sometimes joining with each other, white flecks dotted with the ground colour. These flecks do not form a continuous white lateral stripe, extending anteriorly to below the eyes.

The other measurements of the holotype are (in mm): total body length (TBL) 130.00; length of trunk (LT) 49.87; head length (HL) 16.88; head width (HW) 11.13; nostril-eye distance (NED) 3.27; the distance between nostrils (DBN) 4.94; eye diameter (ED) 4.57; parotoid length (PL) 8.31; parotoid width (PW) 3.02; forelimb length (FLL) 22.54; hind limb length (HLL) 27.29; distance between fore- and hind limbs (DFHL) 41.75.

Paratypes and Variations. Specimens collected from the area in the southern mountainous parts of Tahtalı Mt. between Beycik and Kumlucayazı (except the holotype) (N=40) were accepted as paratypes (Fig. 2b, c, d, e & f) (Table 1).

Variations observed in some mensural characters and ratios including those of holotype were summarized separately for adults and juveniles in Tables 3. Sexual dimorphism was observed within the population (P≤0.05) regarding the head length (HL), the parotoid length (PL) and the parotoid width (PW) in both raw data and PERCRA values. In addition, the projection at the base of the tail in six male specimens was ranging between 1.90 and 2.49 mm with an average of 2.15. Both females and juveniles lack any protuberance at their tail bases and have smooth or less swollen cloacal regions.

In colour pattern, the description given for the holotype would largely apply to the other adult females, including many females observed in the field but not collected. Adult males are a little darker than the females as shown in Fig. 2b. Semi-adults of both sexes exhibit a more brownish dorsum background colour with irregularly scattered whitish flecks (Fig. 2 c & d), which is absent in adults. As an important point, the semi-adult females from all locations (Fig. 2c) and also adults around the Başören village (Beycik) show some blackish blotches near the flanks, especially on the anterior half of the trunk, indicating some affinities in pattern to the neighbouring new taxon described below (Fig. 3).

Regarding the juveniles, although all have whitish flecks and dots on their dorsum similar to those of semi-adults and bulky bodies as is in females, we may note first that they shows considerable variations in colour of the dorsal background (Fig. 2 e & f). Some juveniles, especially those observed around the eastern slope of Erentepe Mt. (from locations labeled as 4, 5, 6 in Fig. 1b) have dorsal coloration quite similar to that of the holotype, i.e. they have honey yellowish dorsum colour. However, the other juveniles observed from the remaining locations have darker ground colour, being more brownish and prominent white flecks and spots on their dorsum (Fig. 2e). As an extreme case, in one juvenile with dark dorsal pattern from Ovacık plateau, the posterior third of the parotoid glands is distinctly yellow coloured (Fig. 2e, upper one) in contrast with the common parotoid gland colouration that is lighter than the other parts of dorsum with some orange tinge. Along with the only observed specimens in the field; apparently the pattern, especially that regarding the presence or absence of the whitish flecks and spots as well as the dorsal background colour, can change with growth depending on age and sex, respectively.

Habitat and Range. The specimens were collected from under variably sized stones of the more humid and rocky slopes covered with *Pinus brutia* (Brutian pine), *Quercus ilex* (Holly oak), *Arbuthus andrachne* (Greek strawberry trees) and Mediterranean frigana-garrique elements, such as *Phyllaria latifolia, Quercus cocciferae, Aristolochia stenosiphon, Cistus salviifolius* (Sage Leaf Rock Rose), *Cytinus hypocistis* ssp. *clusii* (Red Cytinus),

Table 3. Some mensural characters (in mm) and ratios of the *Lyciasalamandra arikani* n.sp. specimens. 1: Values in raw data; 2: Values in PERCRA; N: number of specimens; SD: Standard deviation; the abbreviations of characters were given in Material and Methods.

		Adults				Juveniles			
		N	Mean	Range	SD	N	Mean	Range	SD
TBL	1	31	121,84	94,00-146,00	13,12	10	85,20	82,00-91,00	3,26
	2	31	174,23	156,25-187,27	5,75	10	170,45	167,35-173,47	2,73
RA	1	31	69,94	55,00-82,00	7,21	10	50,00	48,00-54,00	2,16
LT	1	31	47,20	36,67-59,58	4,97	10	33,03	30,18-37,46	2,15
	2	31	67,56	61,84-80,51	3,52	10	66,05	61,59-69,37	2,78
TL	1	31	51,90	36,00-64,00	6,54	10	35,20	33,00-37,00	1,48
	2	31	74,23	56,25-87,27	5,75	10	70,45	67,35-73,47	2,73
NED	1	31	2,68	2,10-3,71	0,33	10	2,12	1,92-2,42	0,16
	2	31	3,84	3,29-4,76	0,35	10	4,25	3,56-4,94	0,42
DBN	1	31	4,75	3,81-5,58	0,48	10	3,56	3,20-3,95	0,24
	2	31	6,80	6,16-7,72	0,40	10	7,12	6,56-7,86	0,42
ED	1	31	4,09	3,37-5,15	0,43	10	3,34	3,11-3,52	0,14
	2	31	5,87	5,00-7,45	0,52	10	6,69	6,13-7,04	0,34
HL	1	31	16,30	13,75-18,69	1,31	10	13,00	12,33-13,47	0,41
	2	31	23,41	21,46-28,16	1,46	10	26,01	24,91-27,04	0,79
HW	1	31	10,84	8,41-12,53	0,97	10	8,44	7,80-9,77	0,55
	2	31	15,55	13,62-17,22	0,89	10	16,87	15,63-18,09	0,77
PL	1	31	7,69	5,63-9,70	0,95	10	5,97	5,29-6,29	0,31
	2	31	11,00	9,13-12,59	0,78	10	11,95	10,80-12,84	0,69
PW	1	31	2,40	1,69-3,27	0,46	10	2,13	1,70-2,47	0,25
	2	31	3,46	2,33-4,71	0,69	10	4,25	3,54-5,04	0,47
FL	1	31	21,05	16,92-23,90	1,89	10	15,76	14,23-17,64	0,93
	2	31	30,18	26,23-34,64	1,58	10	31,53	29,04-34,81	1,56
HLL	1	31	25,20	20,66-29,45	2,33	10	18,90	17,89-20,16	0,70
	2	31	36,12	33,51-40,71	1,77	10	37,82	36,51-39,10	0,87
DFHL	1	31	38,68	30,09-44,83	4,05	10	27,26	25,09-30,46	1,79
	2	31	55,35	49,23-59,96	2,39	10	54,51	51,20-58,33	2,54
HW/HL	1	31	0,67	0,58-0,71	0,03	10	0,65	0,59-0,73	0,04
TL/TBL	1	31	0,43	0,36-0,47	0,02	10	0,41	0,40-0,42	0,01
PW/PL	1	31	0,31	0,23-0,42	0,06	10	0,36	0,30-0,42	0,03
NED/HL	1	31	0,16	0,14-0,21	0,02	10	0,16	0,14-0,19	0,02

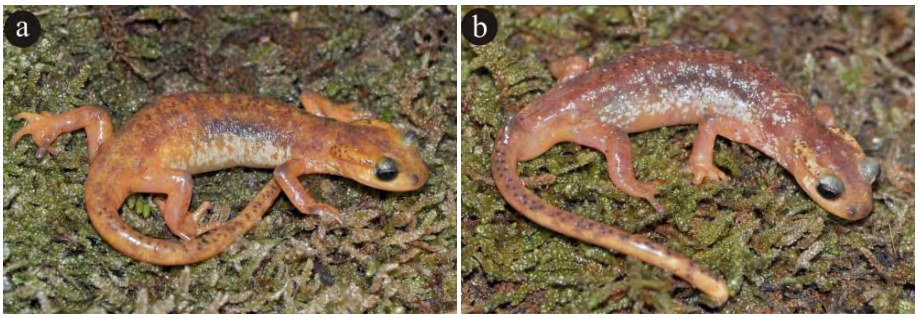

Figure 3. Some pattern variations of *Lyciaslamandra arikani* n. sp. found around Başören village (Beycik). (**a**) Adult female; (**b**) Semi-adult male (see the text for details).

Fritillaria acmopetala, Orchis anatolica, Ophrys lyciensis, Ophrys phryganae, Cyclamen sp., *Salvia viridis, Muscari weissii* and *Onopordon* sp. A typical habitat is shown in Fig. 4. All the specimens were detected in the mountainous parts between Beycik and Kumlucayazı, above the altitudes (slopes and

plains) of "Ulupınar", at altitudes between 425 and 782 m a.s.l..

Figure 4. A typical habitat of *Lyciasalamandra arikani* n. sp. where the pine and holly oak trees and some Mediterranean frigana-garrique elements are observed abundantly (from Ovacik plateau).

Figure 5. Defensive behaviour of a semi-adult male of *Lyciasalamandra arikani* n.sp. from Ovacık plateau.

It seems that the range of *L. arikani* n. sp. is strictly restricted to an area of 25-30 km² around Erentepe Mt.. According to the criteria of IUCN Red list Annex-2 (IUCN 2001) *L. arikani* n.sp. can be defined as "critically endangered" since the estimated area of occupancy is less than 100 km² (B1a). The Erentepe Mt. is not a Special Protected Area, and open to forestry and urbanization activities especially around Ovacık plateau and Dağdibi mevkii. This situation indicates that the species needs strict protection measures. All specimens were seen both in the open and under stones during April when the air temperatures varied between 15 and 19 °C at around 11 a.m. in different localities (Table 1). During our field work we also observed some individuals of other herptile species: *Pseudoepidelea variabilis, Ablepharus budaki anatolicus, Anatololacerta oertzeni ibrahimi, Blanus strauchi, Eirenis modestus, Platyceps collaris* and *Typhlops vermicularis*. During our studies on Ovacık plateau we encountered a semi-adult male salamander displaying some kind of defensive behaviour (Fig. 5): the body in arched posture by standing high on its legs without any audible distress call.

2) *Lyciasalamandra yehudahi* n. sp.
(Figs. 1, 6-7 & 8F, Table 2, 4 &5)

Differential Diagnosis: A species of *Lyciasalamandra* (Fig. 6) distinguished by the following characters: The ground colour of the dorsum of both sexes and of juveniles (being darker) is brown with irregularly scattered yellowish white flecks or spots of varying sizes, having tiny brown dots inside the light flecks. Typically, especially prominent in adults, the colouration of the dorsal side of the anterior part of the body, including the head, is more blackish than the other parts. The ground colour of the upper eyelids is black surrounding a narrow whitish zone at free margins and the front side of the eyes, around the snout is typically darker than the other parts of dorsum, with blackish tinge. The parotoid glands in both adults and juveniles are a little lighter. In some juveniles, the parotoid glands are lighter orange, especially obvious in the posterior half. The sides of the head, tail, legs and the upper parts of the posterior body flanks are light orange. In the flanks, there is an incomplete yellowish-whitish line, consisting of irregularly scattered yellowish to whitish flecks joining with each others. The venter is somewhat translucent and flesh coloured without any spots, showing the internal organs (Fig. 6e).

The new species differs from all *L. luschani* subspecies (*L.l. luschani, L. l. basoglui* & *L. l. finikensis*), *L. arikani* n.sp and *L. antalyana* in having almost completely black upper eyelids in addition to the differences in dorsum background colours and patterns (Fig. 6). In all *L. luschani* subspecies and also the neighbouring *L. arikani* n.sp. the upper eyelids are whitish or yellowish white, respectively, and in *L. antalyana* they are yellow coloured with a thin black stripe. It is unlike *L. fazilae*, in which the ground colour is typically red, bearing

Figure 6. *Lyciaslamandra yehudahi* n. sp. (**a**) Adult male (Holotype, ZMHRU 2011/134:5); (**b**) Adult female; (**c**) typical juvenile; (**d**) juvenile showing yellowish orange colouration on the posterior third of parotids and yellowish orange blotches on dorsum; (**e**) ventral aspect showing the colouration of the venter; (**f**) A pair (male in front side) displaying defensive behaviours in body-arched posture.

brown to black blotches, that can flow together near the white lateral line. *L. yehudahi* n.sp. is distinguished from both *L. helverseni* of Carpatos island and *L. flavimembris* of Marmaris which, on a dark brown color, have numerous yellowish spots mainly concentrated middorsally (in *L. helverseni*) or very few, small silvery-white and yellow spots (in *L. flavimembris*). In *L. yehudahi* n. sp. these yellowish flecks or dots do not show any order, as they are irregularly scattered. The new species is neither like *L. atifi* nor *L. billae*. The dorsum colour of *L. atifi* is black or blackish brown having a violent tinge, sometimes uniformly black and sometimes with tiny white spots. Furthermore, it is also distinctly larger than any other species described up to now, reaching a total length of over 170 mm. *L. billae* has some white spots distributed across the back and ordered regularly, forming two light dorsolateral bands; whereas in the new species the yellowish white spots or flecks are irregularly scattered on the dorsum. Moreover, the ground colour of the dorsum in *L. billae* can vary from salmon to black in contrast to the almost stable brown ground colour of *L. yehudahi* n.sp. It is also different from both, *L. billae* and *L. irfani,* in having incomplete, i.e. fragmented, lateral lines on the flanks. Both *L. billae* and *L. irfani* typically have almost complete lateral line on their flanks, but resemble *L. yehudahi* by having blackish faces and blackish upper eyelids. Moreover, the colour of the flecks forming the lateral line is more yellowish in *L. yehudahi* n. sp. instead of the whitish flecks of both *L. billae* and *L. irfani*.

Holotype and Terra Typica. (Fig. 6a & e) Adult male. ZMHRU 2011/134:5. The eastern slope of Tahtalı Mt., Teleferic road 4th km, Kemer, Antalya – Turkey. 238 m. a.s.l.

Derivatio nominis. The name of the species is derived from the first name of the senior author's second herpetological father and also close friend Yehudah Leopold WERNER (Department of Ecology, Evolution and Behavior, The Hebrew University of Jerusalem, Israel), who made valuable contributions to the knowledge of the herpetology of the Middle East.

Description of the holotype. The general body form resembles that of all other species of *Lyciasalamandra*. Rostrum-anus length (RA) and tail length (TL) are 66.00 and 50.00 mm, respectively. Head flat, longer than broad (HW/HL 0.61). Snout more or less rounded. Parotoid glands long and narrow (PW/PL 0.32), with a slight inner curvature towards the anterior end which is narrower than the posterior part. Gular fold distinct. The protuberance above the base of the tail is 1.59 mm and towards the free end it is curved forwards. The cloacal region is swollen.

In living specimen, the ground colour of dorsum including head and tail, except upper eyelids and extremities, is brown. Over this colouration, there are numerous yellowish white flecks or spots of varying sizes, having many brown dots that are visible with a magnifying glass. The upper eyelids are almost black with some tiny, indistinct whitish dots forming a narrow whitish zone at the margin of the eyelids. The front side of the eyes, around the snout and the anterior half of trunk is darker than the other parts of the dorsum with blackish tinge. The extremities and the parotoid glands a bit lighter (light orange). The extremities also sparsely covered with smaller yellowish white spots similarly to the dorsal ones. The openings of the dorsal, caudal and parotoid glands are visible as black dots.

The lower parts of the body, including extremities, is flesh coloured. This colouration grades into light orange towards the lateral sides of the legs, the tail and cloacal region. The throat is somewhat translucent without bearing any spots, showing the internal organs. Towards the sides, the colour changes to light orange with yellowish white flecks similar in form to those of the dorsum and forming an incomplete, i.e. fragmented, yellowish white lateral stripe that separates the dorsal and the ventral sides, extending anteriorly to under the eyes.

The other measurements of the holotype are (in mm): total body length (TBL) 116.00; length of trunk (LT) 41.98; head length (HL)15.62; head width (HW)9.56; nostril-eye distance (NED) 2.68; the distance between nostrils (DBN) 4.14; eye diameter (ED) 3.88; parotoid length (PL) 7.28; parotoid width (PW) 2.31; forelimb length (FLL) 20.50; hind limb length (HLL) 24.56; distance between fore- and hind-limbs (DFHL) 35.25.

Paratypes and Variations. All the specimens investigated from the eastern slope of Tahtalı Mt. around Kemer and Gedelme (as an inland locality) which is situated in Kemer Canyon (except the holotype) (N=26) were accepted as paratypes (Fig. 6b-e) (Table 2). Variations in some mensural characters and ratios including those of holotype were summarized separately for adults and juveniles in Table 4. Based on the Student's T-test results, there is sexual dimorphism within the population ($P \leq 0.05$) regarding the TBL, LT, HL, HW, PL, PW, FLL, HLL and DFHL (Table 5). In that way, we can say that males are smaller than the females when we take into consideration the raw data of the total body length (TBL) and the length of trunk (LT). This situation is clearly seen in Fig. 6e. Similar differences can apply for the distance between fore- and hind-limbs (DFHL), as well as the lengths and widths of head and parotoid glands (Table 5). In addition, the projection at the base of the tail in the other seven male specimens ranges between 1.64 and 2.04 mm with an average of 1.86 mm.

The colour pattern description given for the holotype would largely apply also to all other males and females, however the females can show more yellowish colouration at the posterior parts of the flanks since they have large yellow ovaria and they can be seen through the skin (Fig. 6b & e). They also have generally bulky bodies like juveniles. Beyond this structural difference, juveniles have darker ground colour, being more blackish on their dorsum than the adults (Fig. 6c). In some juveniles from Gedelme (Fig. 6d) exists a lighter dorsum colour similar to adults, although some irregularly arranged yellowish orange blotches near to vertebral zone can be seen on their dorsum. Apparently the colour pattern, especially on the colouration of the dorsum, changes a little during growth. Also both females and juveniles lack any prominent protuberance at their tail bases and have smooth or less swollen cloacal regions.

Habitat and Range. The specimens belonging to *L. yehudahi* n.sp. were collected from under calcareous stones of the rocky areas covered with *Platanus orientalis* (Oriental plane), *Pinus brutia* (Brutian pine) and *Arbuthus andrachne* (Greek strawberry trees) in rainy days of April. As subforestal elements, we detected some shrubs (such as *Phillyrea latifolia* and *Quercus coccifera*) and also some herbs belonging to *Cyclamen hederafolium, Elytrigia divaricata, Euphorbia kotschyana, Bromus tomentellus, Silene aegyptiaca* and *Orchis anatolica*. Some habitats are shown in Fig. 7.

Th e air temperatures were measured between

Table 4. Some mensural characters (in mm) and ratios of the *Lyciasalamandra yehudahi* n.sp. specimens. 1: Values in raw data; 2: Values in PERCRA; N: number of specimens; SD: Standard deviation; the other abbreviations of characters were given in Material and Methods.

		Adults				Juveniles			
		N	Mean	Range	SD	N	Mean	Range	SD
TBL	1	23	123,74	111,00-137,00	6,75	4	81,50	77,00-88,00	4,80
	2	23	176,62	170,27-182,81	2,82	4	174,53	167,39-183,72	6,82
RA	1	23	70,09	63,00-78,00	4,16	4	46,75	43,00-51,00	3,30
LT	1	23	46,01	41,58-51,04	2,82	4	30,74	28,71-32,34	1,65
	2	23	65,70	61,05-70,98	2,71	4	65,83	63,41-69,11	2,62
TL	1	23	53,65	47,00-59,00	2,95	4	34,75	31,00-37,00	2,63
	2	23	76,62	70,27-82,81	2,82	4	74,53	67,39-83,72	6,82
NED	1	23	2,79	2,22-3,43	0,30	4	1,99	1,72-2,24	0,22
	2	23	3,98	3,29-4,91	0,41	4	4,24	4,00-4,39	0,19
DBN	1	23	4,77	4,14-5,36	0,34	4	3,33	3,05-3,76	0,31
	2	23	6,80	6,09-7,60	0,37	4	7,17	6,53-8,74	1,05
ED	1	23	4,27	3,78-4,91	0,29	4	3,26	3,00-3,50	0,21
	2	23	6,10	5,48-6,98	0,42	4	7,01	6,38-7,65	0,72
HL	1	23	16,83	15,09-18,70	1,04	4	12,61	11,71-13,18	0,64
	2	23	24,03	22,07-25,78	1,01	4	27,00	25,84-28,13	0,95
HW	1	23	10,89	9,52-12,49	0,73	4	7,78	7,55-8,22	0,30
	2	23	15,55	13,90-16,88	0,75	4	16,72	14,80-18,02	1,41
PL	1	23	8,26	6,22-9,22	0,75	4	5,76	4,80-6,17	0,65
	2	23	11,78	9,72-13,19	0,90	4	12,31	11,16-13,13	0,95
PW	1	23	2,76	1,95-3,88	0,49	4	2,04	1,40-2,44	0,49
	2	23	3,92	2,96-5,11	0,61	4	4,33	3,26-5,19	0,83
FL	1	23	20,92	17,98-23,88	1,46	4	15,37	14,54-16,15	0,66
	2	23	29,87	26,74-32,56	1,45	4	32,99	30,25-35,67	2,79
HLL	1	23	24,62	22,15-26,68	1,26	4	17,34	15,98-19,02	1,31
	2	23	35,17	31,43-38,78	1,60	4	37,12	34,00-38,84	2,18
DFHL	1	23	37,86	34,01-42,10	2,55	4	24,62	22,42-25,80	1,55
	2	23	54,04	49,29-58,51	2,41	4	52,71	50,59-55,70	2,15
HW/HL	1	23	0,65	0,60-0,70	0,03	4	0,62	0,57-0,66	0,04
TL/TBL	1	23	0,43	0,41-0,45	0,01	4	0,43	0,40-0,46	0,02
PW/PL	1	23	0,33	0,25-0,43	0,05	4	0,35	0,29-0,40	0,05
NED/HL	1	23	0,17	0,13-0,20	0,02	4	0,16	0,15-0,17	0,01

16 and 18 °C at around 11 a.m. during the two trips (Table 2). Sympatric herptiles found were *Pseudoepidelea viridis, Ablepharus budaki anatolicus, Anatololacerta oertzeni ibrahimi, Blanus strauchi* and *Pelophylax bedriagae*. In the vicinity of the teleferic (Tahtalı Mt.) we observed a pair displaying similar defensive posture of the *L. arikani* n.sp. when manipulated (Fig.6f).

Although we scanned the nearby areas surrounding Kemer (the area between the Göynük stream and Kemer stream) and also the area between Tekirova and Beycik, as well as the western slopes of the Tahtalı Mt.; we found no other terrestrial salamander. It seems that the range of distribution of *L. yehudahi* is restricted to the area around the eastern parts of Tahtalı Mt., including Gedelme as an inland locality, i.e. the northwestern slopes of Tahtalı Mt., totaling an area of 35-40 km² at altitudes between 87 m (around the Servel Çukuru) to 646 m a.s.l. (around the Teleferic station). According to the criteria of IUCN Red list Annex-2 (IUCN 2001) *L. yehudahi* n. sp. can be defined as "critically endangered" since the estimated area of occupancy is less than 100 km² (B1a). The distribution area is a Special Protected Area opened to tourism by its historical Lycian roads that experience traffics by many visitors. Also the recent increase in unplanned urbanization that we observed, especially around Servel Çukuru and Kuzdere, gradually destroys the habitats of the new species. This indicates that the species needs additional protection measures. We

Table 5. Summarized statistics for males and females of *Lyciasalamandra yehudahi* n. sp. on various mensural characters (in mm) and ratios, together with obtained P values of these characters according to Student's T-test. The P values of characters which exhibit sexual dimorphism (P≤0.05) are in bold. 1: Values in raw data; 2: Values in PERCRA; N: number of specimens; SD: Standard deviation; the other abbreviations of characters were given in Material and Method.

		Males					T-test	Females				
		N	Mean	Range	SD	SE	P	N	Mean	Range	SD	SE
TBL	1	8	119,63	111,00-130,00	6,52	2,306	0,040	15	125,93	117,00-137,00	5,96	1,538
	2	8	176,62	170,27-181,82	3,75	1,325	0,998	15	176,62	174,29-182,81	2,34	0,604
RA	1	8	67,75	63,00-74,00	3,81	1,346	0,050	15	71,33	64,00-78,00	3,89	1,003
LT	1	8	43,98	41,58-46,91	1,98	0,702	0,005	15	47,10	43,18-51,04	2,63	0,680
	2	8	65,01	61,05-70,98	3,30	1,167	0,445	15	66,06	62,24-69,27	2,38	0,614
TL	1	8	51,88	47,00-58,00	3,36	1,187	0,065	15	54,60	52,00-59,00	2,29	0,592
	2	8	76,62	70,27-81,82	3,75	1,325	0,998	15	76,62	74,29-82,81	2,34	0,604
NED	1	8	2,64	2,22-2,92	0,23	0,080	0,068	15	2,86	2,30-3,43	0,32	0,081
	2	8	3,90	3,47-4,24	0,27	0,096	0,443	15	4,02	3,29-4,91	0,47	0,120
DBN	1	8	4,59	4,14-5,02	0,30	0,106	0,057	15	4,86	4,26-5,36	0,32	0,083
	2	8	6,77	6,27-7,27	0,31	0,109	0,732	15	6,82	6,09-7,60	0,41	0,106
ED	1	8	4,27	3,88-4,91	0,32	0,113	0,996	15	4,27	3,78-4,84	0,28	0,072
	2	8	6,30	5,88-6,84	0,33	0,118	0,071	15	5,99	5,48-6,98	0,42	0,110
HL	1	8	15,67	15,09-16,33	0,45	0,159	0,000	15	17,45	16,46-18,70	0,65	0,167
	2	8	23,16	22,07-23,98	0,68	0,241	0,001	15	24,49	23,13-25,78	0,85	0,219
HW	1	8	10,25	9,52-10,94	0,53	0,186	0,001	15	11,23	10,20-12,49	0,59	0,151
	2	8	15,15	14,42-16,14	0,61	0,217	0,048	15	15,76	13,90-16,88	0,74	0,192
PL	1	8	7,50	6,22-8,03	0,58	0,205	0,000	15	8,66	7,69-9,22	0,45	0,117
	2	8	11,07	9,72-11,68	0,69	0,243	0,003	15	12,16	10,53-13,19	0,77	0,200
PW	1	8	2,39	1,95-2,91	0,30	0,105	0,002	15	2,95	2,04-3,88	0,46	0,118
	2	8	3,52	3,05-4,28	0,42	0,150	0,010	15	4,14	2,96-5,11	0,59	0,153
FLL	1	8	20,06	17,98-22,68	1,38	0,489	0,042	15	21,39	19,34-23,88	1,31	0,339
	2	8	29,64	26,74-32,56	2,02	0,713	0,660	15	29,99	28,03-31,88	1,11	0,286
HLL	1	8	23,65	22,15-26,04	1,21	0,427	0,011	15	25,13	23,33-26,68	0,97	0,251
	2	8	34,96	31,43-37,21	1,88	0,666	0,677	15	35,29	33,13-38,78	1,49	0,385
DFHL	1	8	36,47	35,25-38,34	1,18	0,417	0,019	15	38,60	34,01-42,10	2,80	0,723
	2	8	53,93	50,84-58,51	2,53	0,895	0,874	15	54,10	49,29-56,89	2,43	0,626
HW/HL	1	8	0,65	0,61-0,69	0,03	0,009	0,392	15	0,64	0,60-0,70	0,03	0,008
TL/TBL	1	8	0,43	0,41-0,45	0,01	0,004	0,976	15	0,43	0,43-0,45	0,01	0,002
PW/PL	1	8	0,32	0,27-0,37	0,03	0,011	0,207	15	0,34	0,25-0,43	0,05	0,013
NED/HL	1	8	0,17	0,15-0,18	0,01	0,004	0,531	15	0,16	0,13-0,20	0,02	0,005

urge the Turkish ministries concerned with natural conservation to take additional legal steps towards the protection of the new species.

Relations

At first, the population around Erentepe Mt. (i. e. *L. arikani* n.sp.) seems to be more closely related with the *L. luschani* group since it has a light colouration on the head (especially in upper eyelids and parotoid glands), whereas the Kemer population appears more closely related to both Bille's salamander (*L. billae*) and Irfan's salamander (*L. irfani*), since their locations are very close to its known distribution area and also because of its similarly rather darkly coloured head. However, both populations are clearly different from *L. billae* by having more yellowish colouration, such as yel-

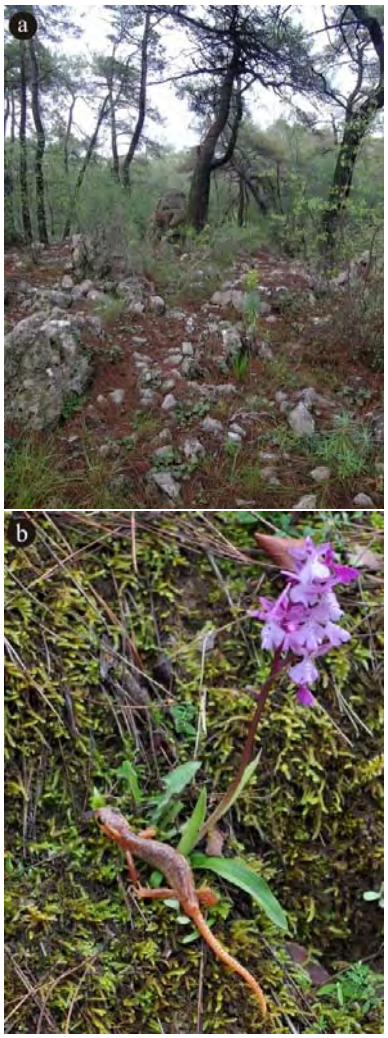

Figure 7. Some habitats of *Lyciasalamandra yehudahi*n. sp. **a:** general view (from the Servel Çukuru) where some typical plant elements are observed abundantly; **b:** a microhabitat –covered with mosses (*Brachythecium rutabulum*) and *Orchis anatolica*- view after rain where a male of *L. yehudahi* n. sp. is in movement (from Gedelme)

lowish white flecks, spots, blotches on their dorsum and also yellowish incomplete lateral lines on their flanks. They also show some affinity to *L. antalyana* by having more yellowish pattern as we noted in their differential diagnoses. The type locality of *L. arikani* n.sp. (i.e. Erentepe Mt., Kumluca) is situated almost in the middle between the ranges of *L. billae* and *L. luschani finikensis*. Hence, it is rather surprising that *L. arikani* n. sp. does not show dark brown colouration on the dorsum, especially in adults. To account for this, we may speculate that the ancestral colouration of *L. arikani* n.sp. was brown, this colouration still visible in semi-adults and also juveniles.

Regarding relationsips of the two new species with other neighbouring Lycian salamander taxa, we can state that the electrophoretic patterns (Fig. 8) of *L. arikani* n. sp. are clearly different from all other previously known species. It has more protein fractions (a total of 12: 10 globulins, 1 postalbumin and 1 albumin). However, it resembles more *L. irfani* by having a similar number of protein fractions (a total of 11: 9 globulins, 1 postalbumin and 1 albumin) and also similar corresponding fractions between G4 and G8 than comparisons to any other taxon previously described. The latter situation is also valid for *L. billae,* although it has a reduced fraction numbers (a total of 10: 8 globulins, 1 postalbumin and 1 albumin). Regarding *L. yehudahi* n.sp., it is obvious that it resembles more to *L. billae* by having the same number of protein fractions. However it is distinctly different from the latter species in the correspondence of fractions especially in the gaps of G1-G4 and G5-G7. It may also note that the highest peak is on the G4 in the first gap (G1-G4), whereas in *L. billae* it is on G2. Similarly in the second gap (G5-G7) the highest peak is located at G6 protein fraction, whereas it is on the G5 fraction in *L. billae*. Among the neighbouring Lycian salamander taxa examined, it was found that the total number of protein fractions was lowest in *L. luschani finikensis* (a total of 9: 7 globulins, 2 albumins). This means that the new taxa described here are more closely related with the other taxa located actually in the northern parts of Beydağları Mountain range, i. e. *L. billae, L. irfani* and *L. antalyana.*

Of course, geographic gaps exist between animal populations and does by itself not constitute grounds for new species. Even some geographic variation based on morphology and genetics is insufficient to determine whether two populations belong to the same biological species or not. However, the southern margin of Anatolia and especially Beydağları mountain range has undergone so many tectonic events and also climatic fluctuations in the past during the early to late Miocene (Weisrock et al. 2001, Veith et al. 2001, Hinsbergen et al. 2010). An example of the speciation around the northernmost parts of Beydağları mountain range was shown between two extremely near *Lyciasalamandra* species (*antalyana*

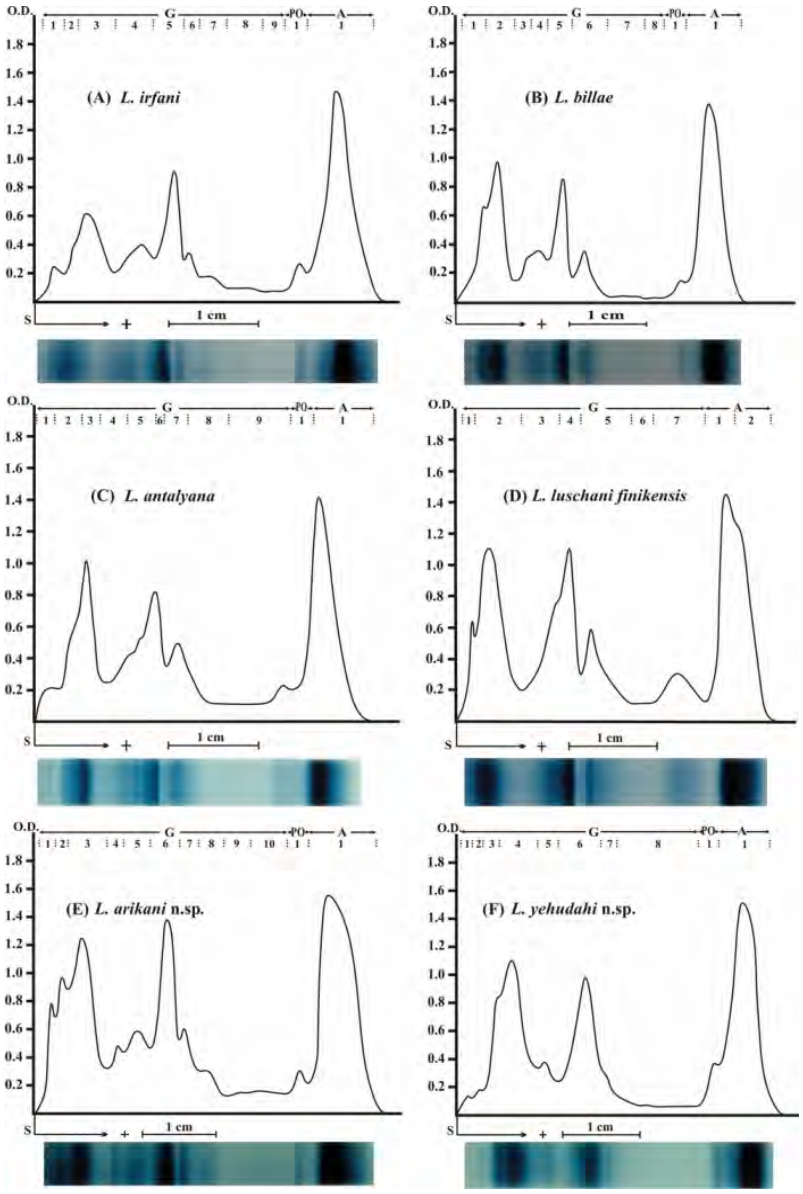

Figure 8. Electrophoregrams representing the electrophoretical separations of blood-serum proteins in some Lycian salamanders, together with their corresponding densitometric curves (OD: optical density, S: start - the border between the stacking and separation gels- , G: globulin zone, PO: Postalbumin zone, A: albumin-like proteins zone). All electophoregrams used here are selected from those of adult males.

and *billae*) based on molecular data (Weisrock et al. 2001, 2006, Veith et al. 2001, 2008).

Hinsbergen et al. (2010) have implied that the Beydağları mountain range underwent a 20^0 counterclockwise rotation between 16 and 5Ma, i.e. during the middle to late Miocene. When we take into consideration the current distribution areas of all *Lyciasalamadra* taxa, including the new ones, it can be speculated that the rotation could have divided a main ancestral population with canyons, streams and climatic changes formed during that time. The following isolations would have led to the divergence of these closely related salamanders. Our findings on the similarities in both elec-

trophoretic patterns and colouration which we mentioned in the differential diagnoses support this assumption. However, to obtain better idea on their phylogenetic relations, more detailed molecular studies based on nuclear DNA should be conducted, and mitochondrial DNA comparisons could shed light on the divergence times.

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