

## Range extension of *Lyciasalamandra antalyana* (Başoğlu & Baran, 1976) (Amphibia: Urodela: Salamandridae)

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**Abstract.** We report 17 specimens of the Lycian salamander *Lyciasalamandra antalyana*, endemic to Turkey from Burdur province, in the western Mediterranean region of Anatolia. Previously all known localities for *L. antalyana* were in Antalya province. These new records extend the known distribution area of the species to Burdur province in Turkey. These new specimens were compared with *L. antalyana* specimens from some other known localities (Hurma and Yağca populations) in terms of morphological and serological features. According to coloration and metric characters, our specimens can be included in *L. antalyana*. This paper represents a considerable range extension for this species, 32 km air distance to the north-east and reports *L. antalyana* from Burdur province for the first time.

**Key words:** Distribution, Turkey, Urodela, *Lyciasalamandra antalyana*, Antalya Salamander.

### Introduction

The first specimen of *Lyciasalamandra antalyana* was found by Eiselt (1966) at Kedetler (Gedeller) village in Turkey and he identified it as *Mertensiella luschani*. Thereafter, Başoğlu & Baran (1976) described the “Kedetler” population as a new subspecies, *M. l. antalyana*. With the most recent genomic studies, a new genus, *Lyciasalamandra* was described by Veith & Steinfartz (2004) to include the Lycian salamanders and then the Antalya’s Salamander’s name became *Lyciasalamandra antalyana*. The type locality of *L. antalyana* was given as “Kedetler” by Eiselt (1966) and Başoğlu & Baran (1976). However, Veith et al. (2001) found at the Kedetler village the *Lyciasalamandra billae* population. They pointed out that the type locality of *M. l. antalyana* lies along the Antalya-Altinyaka road, about 7 km north-east of Kedetler, at the edge of the village Hurma and they redefined the type locality of *L. antalyana* as “Hurma” (Hurma Village).

Antalya’s Lycian Salamander, *Lyciasalamandra antalyana* is known from Hisarçandır village (SW Antalya) to Yağca village (N Antalya), including Termessos National Park, Turkey, with a vertical distribution of 120-655 m asl. Distance is about 35 km by air between these two villages (Veith et al. 2001, Franzen et al. 2008, Göçmen et al. 2011, Göçmen & Akman 2012).

As a result of our survey, we concluded that the distributional range of Antalya’s Lycian Salamander extends to the north-east with a first record from Burdur province (Fig. 1). Additionally, we compared the new population with Hurma and Yağca populations in terms of morphology and serology in order to clarify its taxonomic position.

### Material and Methods

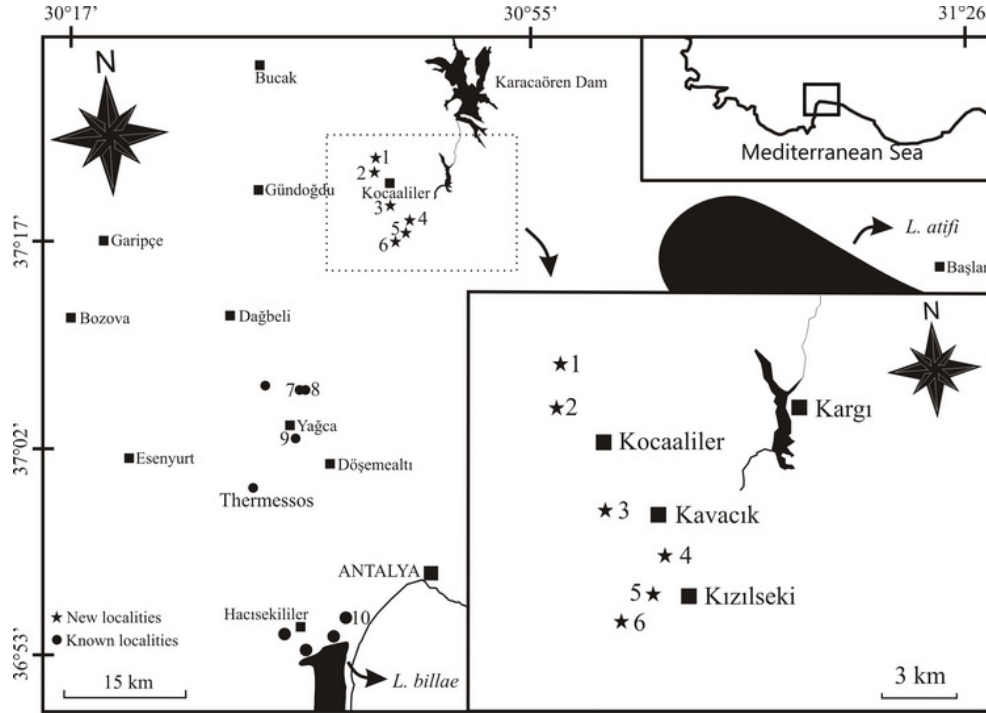
Material examined of the new populations is deposited in ZMHRU (The Zoology Museum of Harran University, Şanlıurfa, Turkey) (Table 1). The new populations and the comparative material for the other populations are listed in Table 1 and the localities are shown on the map (Fig. 1). The geographical coordinates of the sampled specimens were computed with a Magellan model XL GPS. 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 were used to facilitate interpopulation comparisons regarding blood-serum proteins. For this, polyacrylamide gel electrophoresis (PAGE) and densitometric analyses were utilized. Blood samples were taken in the laboratory within three days of collection after anaesthetizing with ether, by ventral abdominal vein puncture with heparinized hematocrit capillaries (Göçmen & Akman 2012).

The separations of blood-serum proteins followed the polyacrylamide “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 characteristics are 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 (Başoğlu & Atatür 1974, Öz & Arıkan 1990, Mutz & Steinfartz 1995, Öz et al. 2004, Göçmen & Akman 2012). They are 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), Parotid Length (PL), Parotid 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 Mitutoyo digital calipers of 0.01 mm sensitivity, except RA, TL and TBL, which were measured with a millimetric ruler. Summarized statistics of the metric values of the specimens from different populations and inter-population 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 were strengthened. The evaluations of all statistical analyses were based on the statistical significance level of “P≤0.05”.



**Figure 1.** Maps showing the new localities (asterisks) and known localities (solid circles) where the specimens were collected (numbers correspond to those in the text and Table 1).

**Table 1.** Geographic and some climatic information of the localities of new populations, as well as their museum numbers of the specimens. The numbers in brackets correspond to the localities shown in Fig. 1. Asterisk: At the time of collecting.

Museum numbers (ZMHRU)	Localities	Altitude (m)	Latitude (DMS)	Longitude (DMS)	Collection date, number of specimens	Temp.° (°C)
2012/6	North of Kocaaliler [1]	750 m	37° 20' N	30° 42' E	29.03.2012 1 specimen (1 juv.)	17
2012/5	Hamartaşı-Kocaaliler [2]	720 m	37° 20' N	30° 42' E	01.04.2012 5 specimens (2 ♂♂, 3 ♀♀)	16
2012/42	Hamartaşı/Kocaaliler [2]	720 m	37° 20' N	30° 42' E	10.04.2012 2 specimens (1 ♂, 1 juv.)	17
2012/9	Kavacık [3]	653 m	37° 17' N	30° 44' E	01.04.2012 2 specimens (1 ♂, 1 ♀)	16
2012/44	Kavacık [3]	653 m	37° 17' N	30° 44' E	10.04.2012 1 specimen (1 juv.)	17
2012/8	North of Kızılseki [4]	400 m	37° 16' N	30° 45' E	01.04.2012 4 specimens (2 ♂♂, 1 ♀, 1 juv.)	16
2012/7	West of Kızılseki [5]	438 m	37° 15' N	30° 44' E	01.04.2012 1 specimen (1 ♀)	16
2012/43	Ortaca mevki/Kızılseki [6]	541 m	37° 15' N	30° 44' E	10.04.2012 1 specimen (1 juv.)	14
2012/2	Kırkgözhan, Yağca [7]	348 m	37° 06' N	30° 34' E	07.03.2012 10 specimens (2 ♂♂, 6 ♀♀, 2 juv.)	13
2012/3	Kırkgözhan, Yağca [8]	350 m	37° 06' N	30° 34' E	12.03.2012 2 specimens (1 ♂, 1 juv.)	15
2012/4	Çıgllık [9]	313 m	37° 03' N	30° 33' E	12.03.2012 3 specimens (1 ♂, 1 ♀, 1 juv.)	15
2011/82	Hurma [10]	99 m	36° 51' N	30° 35' E	25.02.2011 12 specimens (1 ♂, 3 ♀♀, 8 juv.)	13
2012/1	Hurma [10]	99 m	36° 51' N	30° 35' E	06.03.2012 17 specimens (8 ♂♂, 8 ♀♀, 1 juv.)	14

**Table 2.** Some mensural characters (in mm) and ratios of the Burdur population  
[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]

		Juveniles					Adults				
		N	Mean	Min	Max	SD	N	Mean	Min	Max	SD
TBL	1	5	85.20	79.00	99.00	8.14	12	123.17	101.00	142.00	15.60
	2	5	179.30	172.00	192.86	8.09	12	180.40	165.57	189.33	5.89
RA	1	5	47.60	42.00	55.00	5.03	12	68.17	60.00	77.00	7.38
LT	1	5	33.61	31.94	36.94	2.04	12	45.44	39.50	52.36	4.84
	2	5	70.91	66.98	76.05	3.93	12	66.69	63.11	68.89	1.69
TL	1	5	37.60	34.00	44.00	4.04	12	55.00	40.00	67.00	8.54
	2	5	79.30	72.00	92.86	8.09	12	80.40	65.57	89.33	5.89
NED	1	5	2.24	2.09	2.52	0.18	12	2.72	2.22	3.27	0.33
	2	5	4.76	4.00	6.00	0.74	12	4.01	3.23	4.87	0.49
DBN	1	5	3.69	3.24	4.26	0.38	12	4.87	4.19	5.92	0.50
	2	5	7.75	7.26	8.26	0.35	12	7.16	6.50	8.02	0.49
ED	1	5	3.55	3.11	4.14	0.41	12	4.40	2.88	9.78	1.75
	2	5	7.52	6.38	9.00	1.13	12	6.57	4.80	16.30	3.10
HL	1	5	13.59	12.82	14.54	0.63	12	16.73	15.12	18.27	1.18
	2	5	28.74	26.44	32.14	0.63	12	24.65	22.60	26.33	1.22
HW	1	5	8.92	8.61	9.74	0.63	12	11.20	9.89	12.84	0.99
	2	5	18.84	17.62	20.60	0.63	12	16.48	15.68	17.93	0.65
PL	1	5	6.39	5.45	7.25	0.63	12	8.27	7.06	9.70	0.73
	2	5	13.47	11.85	15.05	0.63	12	12.18	11.01	13.78	0.83
PW	1	5	2.16	1.68	2.71	0.63	12	2.88	2.61	3.25	0.20
	2	5	4.55	3.65	5.26	0.63	12	4.26	3.67	4.98	0.40
FLL	1	5	16.17	14.59	18.63	0.63	12	21.63	18.45	24.75	1.97
	2	5	34.04	31.24	36.13	0.63	12	31.82	29.00	33.58	1.66
HLL	1	5	18.50	16.95	22.70	0.63	12	25.54	22.21	27.84	2.18
	2	5	38.87	35.60	41.27	0.63	12	37.56	35.83	40.43	1.46
DFHL	1	5	27.66	25.38	30.36	0.63	12	37.36	31.52	44.43	4.76
	2	5	58.39	54.52	64.74	0.63	12	54.75	51.52	58.46	2.41
KKDTY	1		-	-	-	-	6	2.64	1.45	3.15	0.63
	2		-	-	-	-	6	3.57	2.13	4.26	0.76
HW/HL	1	5	0.66	0.63	0.69	0.02	12	0.67	0.62	0.74	0.03
TL/TBL	1	5	0.44	0.42	0.48	0.02	12	0.45	0.40	0.47	0.02
PW/PL	1	5	0.34	0.28	0.37	0.04	12	0.35	0.30	0.40	0.03
NED/HL	1	5	0.17	0.15	0.19	0.01	12	0.16	0.13	0.19	0.02

## Results and Discussion

In 2012, we surveyed the actual distribution area of *L. antalyana* and detected six new localities (4 km north of Kocaaliler village [1], Hamartaşı, Kocaaliler village [2], Kavacık village [3], 1 km north of Kızılseki village [4], Kızılseki village [5] Ortacalar mevki, Kızılseki village [6]) (Fig. 1) in southeast Burdur province. All new localities are situated between the altitudes of 400 m asl (Kızılseki village) and 750 m asl (N of Kocaaliler village) in the eastern and southeastern part of Asar Mountain. Although we found many specimens, only 17 (6♂♂, 6♀♀ and 5 juveniles) (Table 1) were collected, in consideration of conservation. The body measurements in the juveniles as well as the adults were summarized in Table 2.

In terms of colour and pattern, the Burdur (and Yağca) populations differ from the Hurma population. The Burdur and Yağca populations have a more interrupted pattern than

Hurma populations (Fig. 2). Additionally, the interrupted dorsal pattern of Burdur population is dominated by darker background colour, while yellowish colour is dominant in Yağca population (Fig. 2). At the same time, colour and pattern of head is similar to *Salamandra infraimmaculata*. In terms of morphometric characters, there is no difference among these three populations (Table 2-3).

In regard to relations of the Burdur populations with Yağca and Hurma populations of *L. antalyana*, we found that the electrophoretic patterns of Yağca and Burdur populations are different from Hurma population (Fig. 3). The Burdur populations resemble more the Yağca samples by having similar number of protein fractions, totally 9 (7 globulins, 1 postalbumin and 1 albumin). Whereas in the Hurma population, we detected a total of 11 protein fractions (9 globulins, 1 postalbumin and 1 albumin).

The new specimens from eastern and southeastern part



**Figure 2.** *Lyciaslamandra antalyana* from new and known localities. (a) A pair (female in front side) from Kavacak village; (b) Juvenile from Kızılseki village; (c) Adult male from Yağca village; (d) Adult male from Hurma village.

**Table 3.** Some mensural characters (in mm) and ratios of the Hurma and Yağca populations.  
[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]

		Hurma Population-Adults					Yağca Population-Adults				
		N	Mean	Min	Max	SD	N	Mean	Min	Max	SD
TBL	1	19	126.58	94.00	150.00	16.44	11	136.82	108.00	153.00	13.75
	2	19	180.59	162.65	195.16	7.60	11	177.40	165.71	185.00	6.14
RA	1	20	69.90	54.00	83.00	8.19	11	77.00	64.00	86.00	5.90
LT	1	20	45.24	33.75	54.96	6.11	11	50.59	40.25	58.17	5.13
	2	20	64.62	61.12	69.06	2.38	11	65.60	61.13	69.04	2.54
TL	1	19	56.53	39.00	71.00	8.98	11	59.82	44.00	68.00	8.17
	2	19	80.59	62.65	95.16	7.60	11	77.40	65.71	85.00	6.14
NED	1	20	2.82	2.05	3.76	0.38	11	3.14	2.48	3.68	0.36
	2	20	4.04	3.48	4.70	0.31	11	4.08	3.54	4.66	0.29
DBN	1	20	4.74	3.58	5.56	0.54	11	5.25	4.13	5.92	0.57
	2	20	6.81	6.14	8.38	0.57	11	6.82	6.06	7.69	0.48
ED	1	20	3.97	3.28	4.62	0.40	11	4.00	3.26	4.43	0.30
	2	20	5.71	4.86	7.08	0.55	11	5.21	4.76	5.63	0.25
HL	1	20	17.21	13.93	20.03	1.70	11	18.37	16.44	20.94	1.43
	2	20	24.69	22.47	26.38	0.93	11	23.89	21.52	26.09	1.23
HW	1	20	10.86	8.72	13.08	1.15	11	11.52	9.88	12.46	0.85
	2	20	15.60	14.47	18.35	1.19	11	14.98	14.05	16.39	0.72
PL	1	20	7.96	5.97	10.04	1.10	11	8.80	7.31	10.29	0.87
	2	20	11.41	9.97	13.85	1.01	11	11.43	9.95	12.73	0.80
PW	1	20	2.92	1.95	3.92	0.52	11	3.54	2.81	4.11	0.43
	2	20	4.19	3.00	5.39	0.66	11	4.59	3.95	5.21	0.38

Table 3. (continued)

		Hurma Population-Adults					Yağca Population-Adults				
		N	Mean	Min	Max	SD	N	Mean	Min	Max	SD
FLL	1	20	20.37	16.62	22.94	1.79	11	21.62	18.20	22.97	1.39
	2	20	29.29	26.32	33.97	1.93	11	28.12	25.86	30.03	1.35
HLL	1	20	24.19	20.66	27.41	1.90	11	26.66	21.79	28.92	2.12
	2	20	34.83	29.84	41.07	2.63	11	34.62	33.50	36.61	1.01
DFHL	1	20	36.94	26.32	45.02	4.80	11	41.93	33.10	47.10	4.35
	2	20	52.79	48.61	56.28	2.17	11	54.38	48.96	57.84	2.70
KKDTY	1	9	2.42	1.45	3.17	0.58	4	2.79	2.35	3.34	0.47
	2	9	3.62	2.69	4.44	0.60	4	3.66	3.17	4.34	0.52
HW/HL	1	20	0.63	0.58	0.71	0.04	11	0.63	0.59	0.67	0.03
TL/TBL	1	19	0.45	0.39	0.49	0.02	11	0.44	0.40	0.46	0.02
PW/PL	1	20	0.37	0.25	0.49	0.06	11	0.40	0.34	0.44	0.03
NED/HL	1	20	0.16	0.14	0.19	0.01	11	0.17	0.15	0.20	0.01

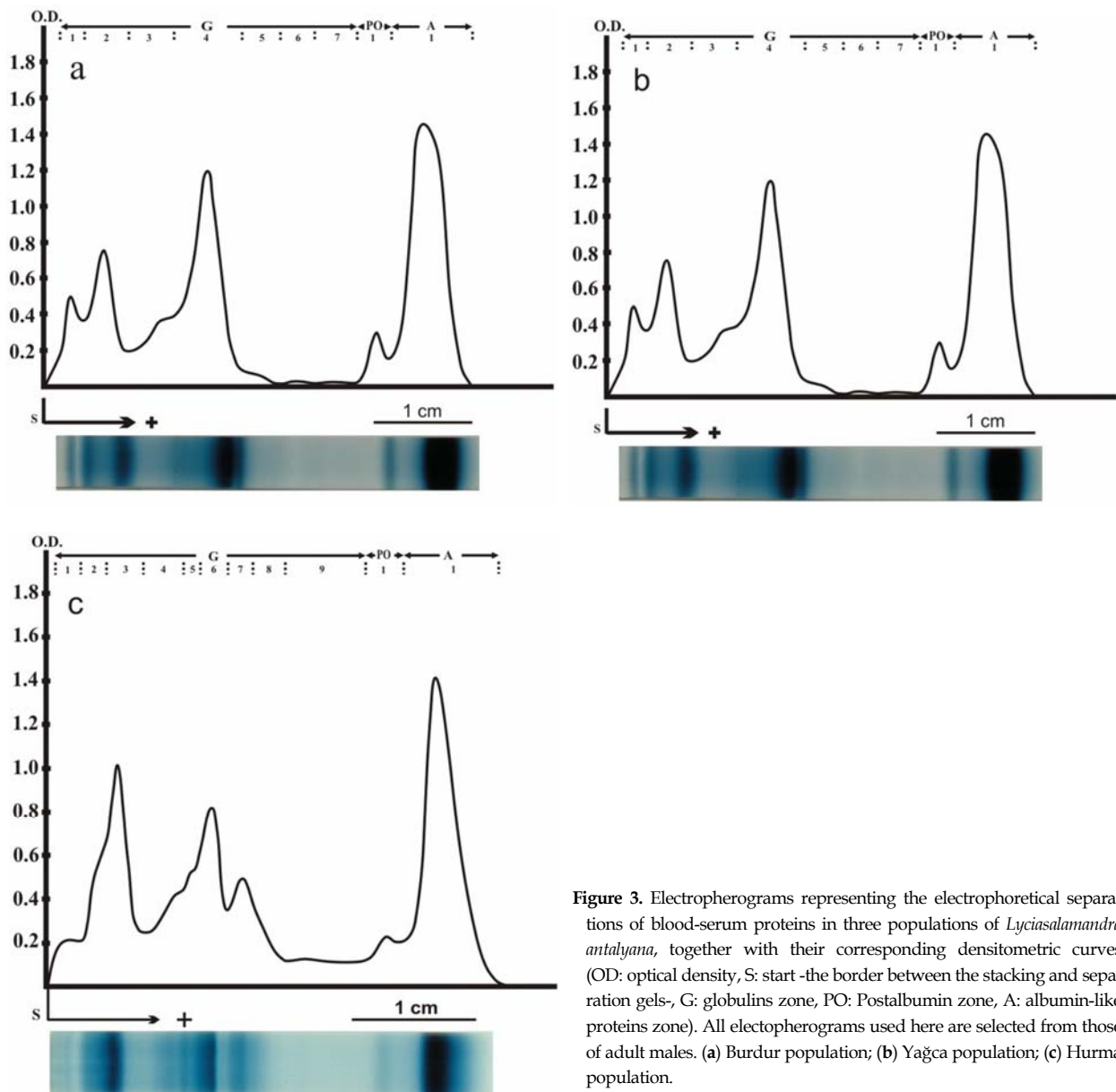
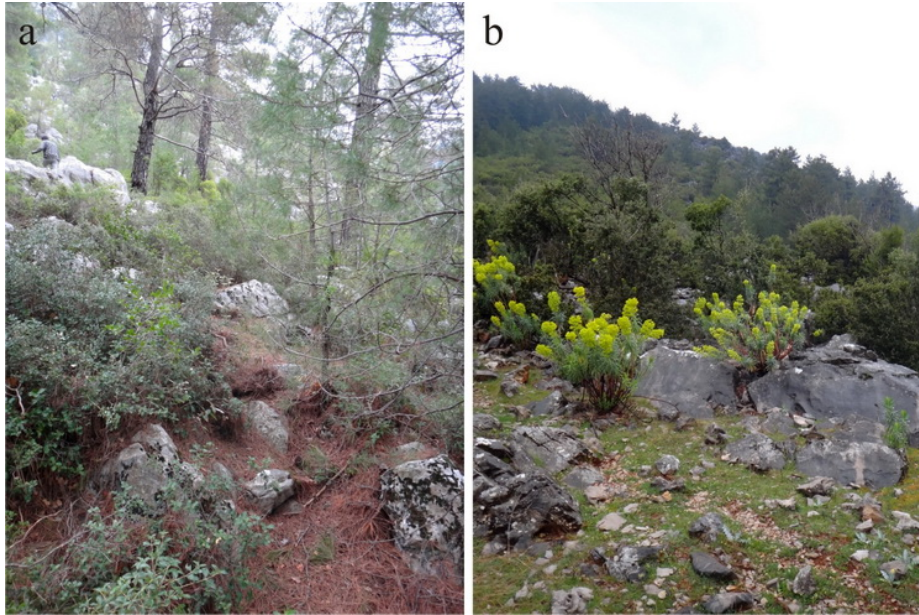


Figure 3. Electropherograms representing the electrophoretical separations of blood-serum proteins in three populations of *Lyciasalamandra antalyana*, together with their corresponding densitometric curves (OD: optical density, S: start -the border between the stacking and separation gels-, G: globulins zone, PO: Postalbumin zone, A: albumin-like proteins zone). All electropherograms used here are selected from those of adult males. (a) Burdur population; (b) Yağca population; (c) Hurma population.



**Figure 4.** General views of new localities of new populations from Burdur province.  
(a) Kavacık village; (b) Kocaaliler village.

of the Asar mountain were collected from under karstic lime stones located both in humid areas of pine forest in Kavacık village (this habitat type is similar to Hurma village) and in deforested areas surrounded by pine trees in Kızılseki and Kocaaliler villages (this habitat type is similar to Yağca village) (Fig. 4). This suggests that the species could be found almost everywhere having karstic structure and proper climatic factors mentioned by Veith et al. (2001).

As a result of this survey, the new records of *L. antalyana* extend the known distribution range of the species approximately 32 km air distance to the north-east, with a first record of the species from Burdur province. When the comparative results of colour, pattern and blood-serum proteins in the present study are evaluated together, Hurma population (terra typica) has been accepted as a nominate subspecies; Yağca and Burdur populations (Probably, including Thermessos population) of *L. antalyana* is recommended as a new subspecies. 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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