

RESEARCH ARTICLE

**New locality record of the critically endangered and endemic species,
Lyciasalamandra billae (Franzen & Klewen, 1987)
(Amphibia: Salamandridae) from Turkey**

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Introduction

The Lycian Salamanders (Amphibia: Salamandridae) are distributed in Turkey and Greece. One species (*Lyciasalamandra helversini*) of the group is endemic to Greece, while other five taxa [*Lyciasalamandra billae* (Franzen & Klewen, 1987); *Lyciasalamandra atifi* (Başoğlu, 1967); *Lyciasalamandra antalyana* (Başoğlu & Baran, 1976); *Lyciasalamandra fazilae* (Başoğlu & Atatür, 1974); *Lyciasalamandra flavimembris* (Mutz & Steinfartz,

1995)] are consisted of endemic species of Turkey. Only one species, *Lyciasalamandra luschani* (Steindachner, 1891) is native to both Greece and Turkey.

The Bille's Lycian Salamander, *Lyciasalamandra billae* is an endemic species of Turkey and it has been classified as CR (Critically Endangered) in the IUCN Red List of Threatened Animals (Kaska *et al.*, 2017). It is present at altitudes of 15-1090 m a.s.l. The specimens of the species are found on the calcareous rocks, in maquis and pine forests (Baran *et al.*, 2021). *L. billae* is only distributed in Antalya Province of Turkey. Range of the nominate

Abstract

Objective: The Bille's Lycian Salamander, *Lyciasalamandra billae* is an endemic salamander species of Turkey and it has a very narrow distribution area in the Antalya province of the country. A limited number of the reported populations of this critically endangered species are known. The present study aims to show that the distribution of the species extends towards the northeast of Antalya province.

Materials and Methods: Two adult individuals (1 ♂ and 1 ♀) were caught from the Sarısu (Antalya, Turkey) population. The morphometric features of the individuals were measured using a digital caliper. After morphometric measurements of the individuals were taken without performing any anesthetic procedure and killing any animals, the salamanders were released back to the habitat where they were caught.

Results: We recorded a new locality of the species located about 11 km northeast of Gedeller village. The habitat of the individuals from Sarısu consisted of a forested area. Vegetation of the habitat generally comprised pine trees and dwarf scrub plants. Rostrum–Anus length (RA) was 59.68 mm in the female individual and 59.03 mm in the male. The tail length (TL) was 50.14 mm in the female and 47.12 mm in the male.

Conclusion: The morphometric characters and color-pattern features of the specimens were compared with the specimens reported in the literature. We found that the morphometric proportions and ratios of the Sarısu population were similar to the results of the specimens in literature, except a slightly higher HW/HL ratio of the Sarısu population. Based on our morphological findings, we concluded that our specimens belonged to the *L. b. billae*. However, our conclusion was not dependent on molecular data.

Keywords: Bille's Lycian Salamander; Distribution; Sarısu; Antalya

subspecies (*Lyciasalamandra billae billae*) covers only an area of 15 km from the Gedeller (Hisarçandır) neighborhood of Konyaaltı district to Beldibi neighborhood of Kemer district in the north-south direction (Kaska *et al.*, 2017; Baran *et al.*, 2021). Although there are studies in the literature reporting different taxa of this species until recently, the validity of these taxa is controversial and the systematic uncertainty of the subspecies of *Lyciasalamandra billae* continues.

The present study provides information indicating the occurrence of this endemic species in a new locality (Sarisu Neighborhood of Konyaaltı District) and shows that the distribution of the species extends towards the northeast of Antalya province.

Material and Methods

The present study includes some morphometric characters and color-pattern features of *L. billae* specimens captured from a locality about 11 km northward of the known distribution areas of the species. During the field studies, two adult individuals (1 ♂ and 1 ♀) were caught from the Sarisu population (10 February 2021, 36°49'52.6" N, 30°34'56.8" E, 54 m a.s.l.). The locality is shown in Fig. 1.

After morphometric measurements of the individuals were taken without performing any anesthetic procedure and killing any animals, the salamanders were released back to the habitat where they were caught. The morphometric features of the individuals were measured using a digital caliper (0.01 mm precision). Measurements of body proportions and ratios were applied according to the study of Godmann *et al.* (2016) who described a new subspecies, *Lyciasalamandra billae eikeae* from Geyikbayırı (Konyaaltı, Antalya). We followed the measurements as below:

Mensural (metric) characters: Total Body Length (TBL): length of the whole body including the tail, Rostrum-Anus Length (RA): length from the snout to the anterior tip of the cloacal opening, Length of Trunk (LT): length from the gular fold to the anterior edge of the cloacal opening, Tail Length (TL), Nostril-Eye Distance (NED), Distance Between Nostrils (DBN), Eye Diameter (ED), Head Length (HL): distance from the snout to the posterior end of the parotoid gland, Head Width (HW), Parotoid Length (PL), Parotoid Width (PW), Fore Limb Length (FLL), Hind Limb Length (HLL), Distance between Fore and Hind Limbs (DFHL), Height of Dorsal Protuberance on Base of the Tail in males (HDPBT).

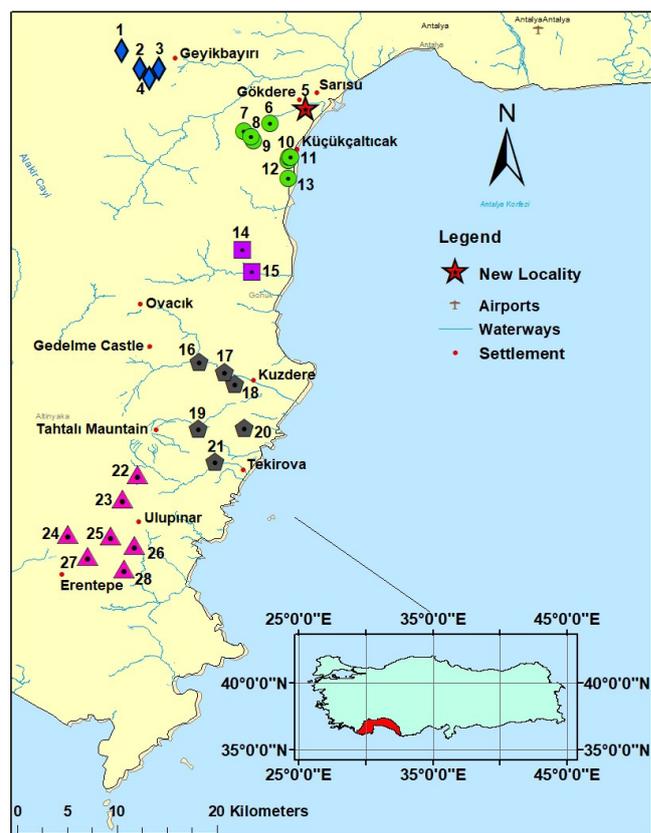


Figure 1. The map showing the distribution area of *Lyciasalamandra billae* in Turkey. Blue diamonds represent distribution area of *L. b. eikae* according to Godmann *et al.* (2016). The green circles show the localities of *L. b. billae* according to Godmann *et al.* (2016); Johannesen *et al.* (2006); Veith *et al.* (2013); Veith & Stenfurtz (2004) and the red star shows the new locality (Sarisu). The purple squares reflect the locations of *L. b. irfani* according to Göçmen *et al.* (2013), while gray pentagons show the localities of *L. b. yehudahi* and lilac triangles points the localities of *L. b. arıkanı* according to Akman & Göçmen (2012).

Computed characters (Ratios): Ratios of the characters; HW/HL, TL/TBL, PW/PL, and NED/HL were computed. The habitat of the individuals from Sarisu consists of a forested area. Vegetation of the habitat generally comprises pine trees and dwarf scrub plants (Fig. 2). The individuals were found during a day excursion between 9 and 11 a.m. The air temperature was about 12 °C.

Results

Morphometric measurements

Rostrum–Anus length (RA) was 59.68 mm in the female individual and 59.03 mm in the male. The tail length (TL) was 50.14 mm in the female and 47.12 mm in the male. Head length was 15.84 mm in the female while it was 15.56



Figure 2. The habitat of *Lyciasalamandra billae* in Sarısu.

mm in the male. Head width was 11.97 mm in the female and 11.83 mm in the male. All morphometric measurements of the individuals collected from the population are given in Table 1.



Figure 3. A general view of a female individual of *Lyciasalamandra billae* from Sarısu population.

Color-pattern

The dorsal color was salmon pink in both individuals. On the middle of the body, there were dark brown spots in two rows. These spots extended to the end of the hindlimbs. There were also these spots on the tail. The color of the paratoid glands was dirty yellow. There were almost twenty dark brown spots on both paratoid glands. The lateral sides of the body were silvery-white colored. The coloration of the ventral side was creamy white (Fig. 3).

Table 1. Comparison of measurements of body proportions (in mm) and ratios of Sarısu specimens of *L. billae* with those given by Godmann *et al.* (2016). For abbreviations, see text.

Character	This study (Sarısu specimens)		Godmann <i>et al.</i> (2016) (Gökdere and Küçükçaltıcak specimens of <i>L. b. billae</i>)	
	1 ♂	1 ♀	Mean values of 8 ♂♂	Mean values of 8 ♀♀
TBL	106.15	109.82	114.38	120.50
RA	59.03	59.68	62.25	63.50
LT	43.41	41.31	47.27	47.45
TL	47.12	50.14	52.13	57.00
NED	2.98	3.02	2.91	2.93
DBN	4.36	4.41	4.38	4.52
ED	4.43	4.42	4.64	4.63
HL	15.56	15.84	14.98	16.05
HW	11.83	11.97	10.71	11.37
PL	7.02	7.10	7.31	8.05
PW	2.12	2.31	2.01	2.20
FLL	18.91	19.55	18.87	19.53
HLL	22.43	24.49	21.96	23.57
DFHL	31.32	31.60	32.68	34.28
HDPBT	2.32	-	2.41	-
HW/HL	0.76	0.75	0.72	0.71
TL/TBL	0.44	0.45	0.46	0.47
PW/PL	0.30	0.32	0.28	0.27
NED/HL	0.19	0.19	0.19	0.18

Discussion

The systematic evaluations reporting new species or subspecies of the genus *Lyciasalamandra* were performed in previous studies (Veith *et al.*, 2001; Göçmen *et al.*, 2011; Göçmen & Akman, 2012; Göçmen *et al.*, 2013; Akman & Godmann, 2014; Yıldız & Akman, 2015; Godmann *et al.*, 2016). Populations of the same taxon, which occur only a few kilometers apart, often show distinct color and pattern differences (Veith & Steinfartz, 2004). The new species, *Lyciasalamandra irfani* was reported by Göçmen *et al.* (2011) from Göynük Canyon (Antalya) in southwestern Anatolia. It was characterized by having a rather darkly colored head part and also an aubergine reddish-brown ground color on the dorsum with irregularly scattered white flecks. According to the coloration of the individuals, the new species, *Lyciasalamandra arikani* was described by Göçmen & Akman (2012) in Antalya province from the southern mountainous parts of Tahtalı Mountain between Beycik and Kumluca, and across the elevations (slopes and plains) of Ulupınar. They also reported the second new species, *Lyciasalamandra yehudahi* according to some morphological features [e.g. the ground color 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] around Kemer, including Gedelme (an inland locality) between the Kemer stream at the north and Tekirova at the south within the coastal strip. However, Veith *et al.* (2016) suggested that the recently described species *L. arikani*, *L. irfani* and *L. yehudahi* to be treated as subspecies of *Lyciasalamandra billae* based on levels of molecular differentiation. In addition, a new subspecies, *Lyciasalamandra billae eikeae* was described according to its coloration and pattern by Godmann *et al.* (2016) from Geyikbayırı (Konyaaltı, Antalya). As it can be understood from the studies in the literature reporting different taxa of this species until recently, the validity of these taxa is controversial and the systematic uncertainty of the subspecies of *Lyciasalamandra billae* continues. The systematic status of *Lyciasalamandra billae* was given as *Lyciasalamandra billae* ssp. *billae* in the web page of IUCN by Kaska *et al.* (2017). This taxon was originally assessed at species-level, but is now demoted to being the nominate subspecies, hence the need for this amended assessment. Finally, Baran *et al.* (2021) reported that the range of the *Lyciasalamandra billae* covers only an area of 15 km from Gedeller (Kedetler) village of Konyaaltı district to Beldibi neighborhood of the Kemer district in the north-south direction.

In the present study, we provided the new locality record (Sarısu, Konyaaltı-Antalya) of *Lyciasalamandra billae* and based on the systematic reviews detailed above we marked this new population in Fig. 1 and showed the populations of other subspecies given in the literature on the same Figure. When we compared our results from the Sarısu population to the records of Godmann *et al.* (2016) related to specimens of Gökdere and Küçükçaltıcak populations of *L. b. billae*, we determined the morphometric proportions and ratios of the Sarısu population were similar to the results of the specimens in the study of Godmann *et al.* (2016) except for a slightly higher HW/HL ratio of the Sarısu population.

The color pattern characteristics of the individuals of Sarısu population were similar to the specimens of *L. b. billae* collected by Godmann *et al.* (2016). The individuals of Sarısu population had continuous lateral white band on both flanks. Dorsum, head and tail were salmon colored. Although the results of the Sarısu population were similar to the specimens of *L. b. billae* in the current literature, the number of specimens in our study was very low. More specimens should be investigated to evaluate the similarity of the Sarısu population with the other populations of *L. b. billae*. Based on our morphological findings, we concluded that our specimens belonged to the *L. b. billae*. However, our conclusion is not dependent on molecular data.

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