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RANGE EXTENSION OF THE CRITICALLY ENDANGERED ANATOLIAN MEADOW VIPER *Vipera anatolica senliki* IN EASTERN ANTALYA PROVINCE

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ABSTRACT. *We report on a second population of the recently described* Vipera anatolica senliki *from Mühür Dağ, Geyik Mountains in eastern Antalya Province, Turkey. The new population is located 10 km farther southeast on Barçın Dağ, yet the two populations are separated by interjacent mountains. We briefly compare both populations morphologically, as well as include aspects of ecology and conservation.*

KEY WORDS: *Anatolian Meadow Viper, critically endangered, range extension, Turkey, morphology, habitat.*

INTRODUCTION

The Anatolian Meadow or Mountain Steppe Viper (*Vipera anatolica* Eiselt and Baran 1970) of southwestern Turkey is a small, mainly insectivorous species from high altitude, stony grasslands (alpine to sub-alpine meadows). It has long been regarded as a very rare species to even being extinct. Over more than four decades, only five individuals were known, all originating from the small area (ca. 2 x 5 km^2) of the terra typica on Kohu Dağ (Dağ=Mountain), western Taurus Mountains, Antalya Province (e.g. Nilson & Andren 2001; Göçmen et al. 2017). Since its description, many herpetological parties were unsuccessful in locating more animals. In 2013 and 2014, two dozen of *Vipera anatolica* were rediscovered within 5 km of the terra typica (Göçmen et al. 2014; Zinenko et al. 2016). Due to the very small range of less than 10 km^2 and threats from killing by locals, *V.*

anatolica was listed as critically endangered in the IUCN Red List of Threatened Species (Tok et al. 2009).

In 2016, a second population was discovered in the Geyik Mountains from eastern Antalya Province, ca. 200 km air distance from the terra typica of *V. anatolica* (Göçmen et al. 2017). This new population inhabited the southern slopes of Mühür Dağ (Dağ =Mountain), occurring on three plateaus on the foot of that mountain and was subsequently described as a subspecies, *V. anatolica senliki*, separate from its nominotypic taxon in the west (Göçmen et al. 2017). In addition to the 25 specimens registered until July 2016 from that new location, two more excursions in the fall yielded additional specimens on 15. September (n=5) and 22. October (n=3). One specimen from October 2016 was observed on the steep slope, possibly in front of its hibernaculum (Fig. 1A), and another specimen was found at the lowest altitude, 1585 m asl., recorded for this species so far (Fig. 1B).

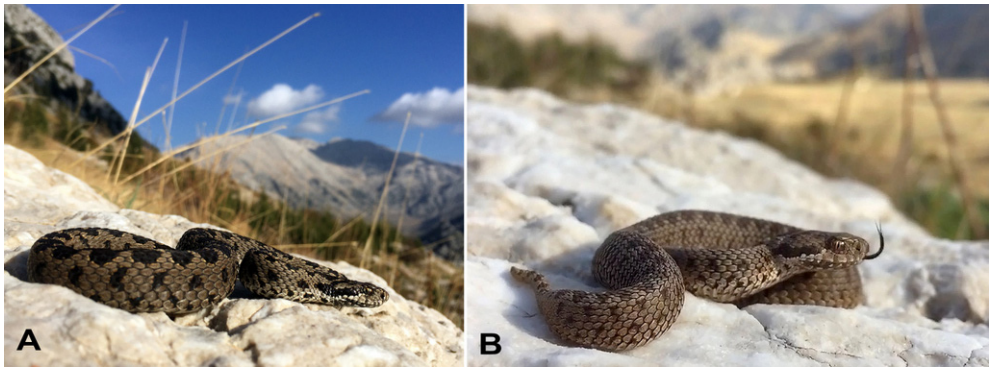


Figure 1. *Vipera anatolica senliki* from the southern slopes of Mühür Dağ (Dağ =Mountain), Gündoğmuş District, eastern Antalya Province. (A) Male sitting near its potential hibernaculum; and (B) a female at the lower end of Gelasandra Plateau at 1585 m asl.

Besides the 33 *V. anatolica senliki* from Mühür Dağ, several other valleys and mountain slopes with apparently suitable habitat in the immediate surroundings of 20 km were visited in 2016, but did not produce additional specimens. In this context, the discovery and reporting of such a rare species is particularly relevant for conservation issues. Herein, we report on a new population from eastern Antalya Province, relatively close, yet, still separated from the first population of *V. anatolica senliki* on Mühür Dağ (Göçmen et al. 2017).

MATERIALS AND METHODS

In June 2017, we explored mountain slopes to the southeast of Mühür Dağ, western Geyik Mountain Range, Gündoğmuş District, Antalya Province, Turkey. There, along the southern slopes of Barçın Dağ (36°48' N, 32°12' E; Fig. 2), we observed 16 *Vipera anatolica senliki* on two days, 23. and 27. June (see an adult female, a male, and a juvenile in Fig. 3). For each specimen, locality coordinates were recorded with a Magellan XL GPS receiver. Of the 16 meadow vipers, eight were photographed with detailed features of colour pattern and cephalic scale arrangements dorsally, laterally, and for the body also ventrally (Figs. 4-7). In addition, metric and meristic characters were measured (Table 1).

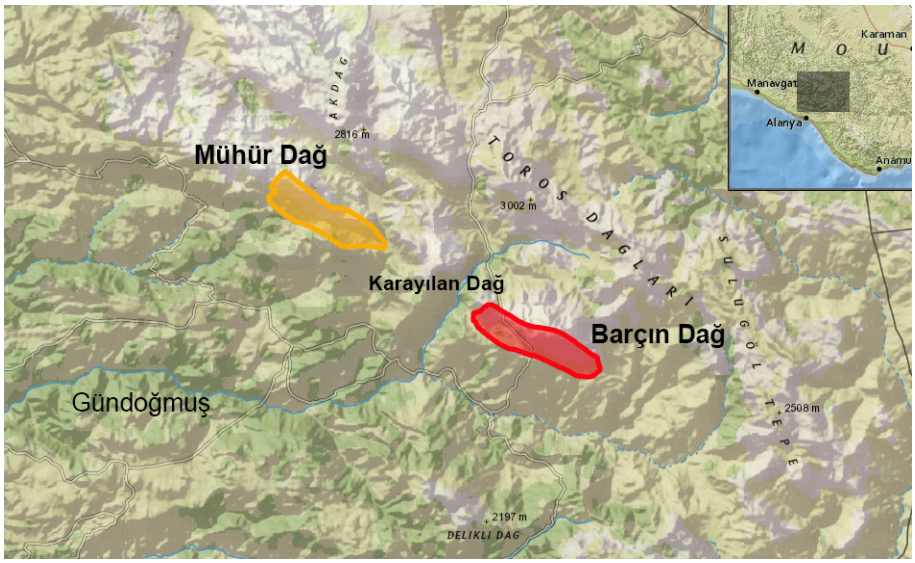


Figure 2. Geographic Areas: red (online version) or lower right (print version) encircled areas displays the new population of *Vipera anatolica senliki* at Barçın Dağ in the the Geyik Mountains, Gündoğmuş District, eastern Antalya Province. The orange (online version) or upper left (print version) encircled area shows the first population discovered in 2016 (Göçmen et al. 2017).

RESULTS AND DISCUSSION

One *V. anatolica senliki* was detected at 2232 m asl., the highest altitude for this subspecies recorded to this date. Together with the very first specimen photographed by Murat Senlik on 19. May 2016, a total of 50 *V.*

Table 1. Summarised statistics of relevant field, meristic and a few color pattern data of *Vipera anatolica senliki* from Barçın Mountain, Gündoğmuş District, Antalya Province (see also Göçmen et al. 2017 for details in characters definitions).

Specimem field nr.	1	2	3	4	5	6	7	8
Locality	Barçın Plateau				Başpınar	Barçın-Başpınar Plateau		
Wheather	Open	Open	Open	Open	Open	Open	Open	Open
Temperature (Celsius)	17	17	17	17	21	15	15	15
Time	09:00	09:30	10:00	10:30	13:30	10:00	10:30	11:00
Altitude	1781 m	1790 m	1807 m	1835 m	1948 m	2054 m	2159 m	2232 m
GPS (Longitude)	36°48'30" N	36°48'30"N	36°48'31"N	36°48'33"N	36°47'25"N	36°48'36"N	36°48'27"N	36°48'11"N
GPS (Latitude)	32° 9'8"E	32° 9'11"E	32° 9'15"E	32° 9'17"E	32°12'48"E	32° 9'44"E	32°10'8"E	32°10'23"E
Date	23.06.2017	23.06.2017	23.06.2017	23.06.2017	23.06.2017	27.06.2017	27.06.2017	27.06.2027
Sex	♀	♂	♂	♀	♀	♂	♀	Juv-♀
SVL (mm)	335	306	247	248	280	355	310	154
TL (mm)	35	45	38	28	35	47	27	15
Rostral width (mm)	2.54	2.59	2.29	2.30	2.28	2.58	2.40	1.64
Rostral length (mm)	2.98	3.07	2.71	2.58	2.88	2.94	2.56	2.29
Rostral index (RL/RW)	1.17	1.19	1.18	1.12	1.26	1.14	1.07	1.40
Head width (mm)	12.93	11.24	10.89	10.98	12.57	12.47	12.89	8.76
Head length (mm)	20.48	18.59	16.87	17.01	17.30	20.10	17.18	12.86
Head index (HL/HW)	1.58	1.65	1.55	1.55	1.38	1.61	1.33	1.47
Head depth	7.83	6.89	5.94	6.47	6.96	7.61	6.14	4.66
Frontal width	2.65	2.31	2.5	2.42	2.66	2.32	2.09	1.72
Frontal length	4.66	3.99	3.88	3.77	4.22	4.11	3.57	2.71
Frontal index (FL/FW)	1.76	1.73	1.55	1.56	1.59	1.77	1.71	1.58
Distance between the Nostrils	3.59	3.55	3.24	3.11	3.43	3.62	2.71	2.32

Table 1 (continued)

Specimem field nr.	1	2	3	4	5	6	7	8
Locality	Barçın Plateau				Başpınar	Barçın-Başpınar Plateau		
Dorsal scale rows (anterior)	21	21	21	21	21	21	21	21
Dorsal scale rows (mid-body)	21	21	19	21	21	21	19	21
Dorsal scale rows (posterior)	17	17	17	17	17	17	17	17
Ventrals	123	121	119	122	122	121	123	123
Preventrals	0	1	1	2	1	0	0	2
Gular scale rows	6	7	5	5	6	6	5	5
Subcaudals (right)	22	32	31	24	23	31	22	22
Subcaudals (left)	23	33	32	25	24	32	23	23
Supralabials (right)	8	8	8	8	8	8	8	8
Supralabials (left)	8	8	8	8	8	8	8	8
Sublabials (right)	8	8	8	8	8	9	9	8
Sublabials (left)	8	8	8	8	8	9	8	8
Circumoculars (right)	8	10	10	9	9	9	9	8
Circumoculars (left)	9	10	10	10	8	9	8	8
Loreals (right)	5	1	1	5	2	3	1	2
Loreals (left)	4	2	2	5	1	2	3	2
Crown scales	10	10	9	10	8	12	9	7
Parietals are divided/ fragmented or not	-	+	-	+	-	+	-	-
Frontal is divided or not	-	-	-	-	-	-	-	-
Upper preocular is in contact with nasal or not	+	+	+	+	+	+	+	+
Number of windings in dorsal zigzag band	57	59	63	56	58	66	55	60

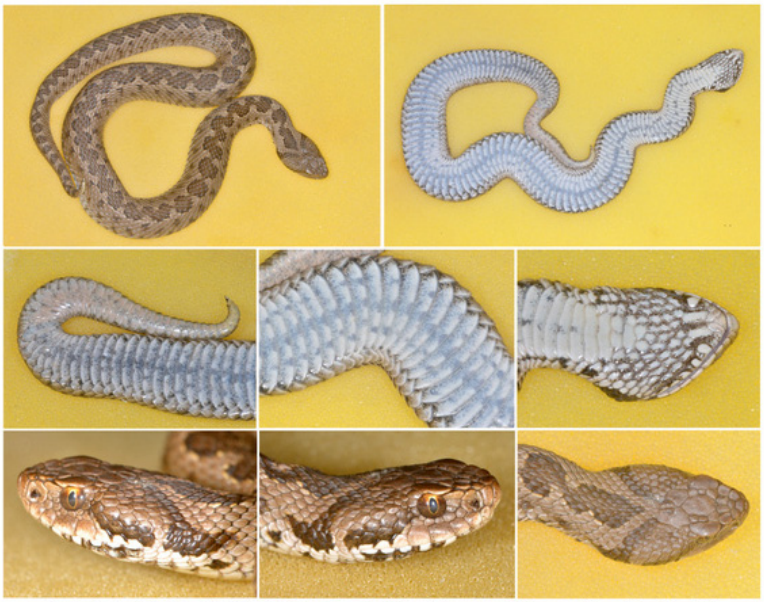
Figure 3. Adult female, male (more contrasting color pattern) and juvenile of *Vipera anatolica senliki* from Barçın Dağ, Gündoğmuş District, Antalya.

anatolica senliki have been recorded from these mountain sites in Gündoğmuş District in the two years since its discovery. Most but one specimen were found on slopes up to 2 km east of Barçın summer village; whereas one specimen was located 4 km farther east, near Başpınar summer village (Fig. 2). The population from Barçın Dağ is only 10 km east of Mühür Dağ, the original site of *V. anatolica senliki* (Göçmen et al. 2017). However, these two sites are separated by Karayılan Dağ, which is flanked by two valleys on both sides down to ca. 1200-1400 m asl. where the species-relevant rocky meadows or herbaceous slopes are missing (Fig. 2). It is likely, that Karayılan Dağ itself may yield a population of *V. anatolica senliki* at its higher altitudes, in particular on the south-exposed alpine meadows of Seyricek Plateau at 1700-2100 m asl.

Microgeographic variation between these neighbouring populations in eastern Antalya province is visible. For example, three out of eight specimens from the new population showed < 5 interruptions of the continuous mid-dorsal zig-zag band compared to usually > 5 interruptions in specimens form Mühür Dağ. Hence, Barçın specimens in this regard resemble more the nominotypic subspecies *V. a. anatolica*. Six of eight Barçın specimens showed a narrow mid-ventral line, which was observed only in 1 of 19 specimens from nearby Mühür Dağ, or consisted of a broad mid-ventral band (n=2), whereas no such mid-ventral design was observed in specimens from the nominate taxon (Figs. 4-7). Furthermore, Table 1. shows that *V. anatolica senliki* from Barçın Dağ yielded mostly 1 or 2 loreals (versus mostly four in Mühür Dağ specimens), and predominantly 8 infralabials (vs. 9 in Mühür Dağ).

These microgeographic differences may result from non-adaptive

1 Adult Female / SVL=335 mm / TL=35 mm / Dorsalia=21-21-17
23.06.2017 / Barcın Plateau, Gündoğmuş, Antalya, 1781 m. asl.



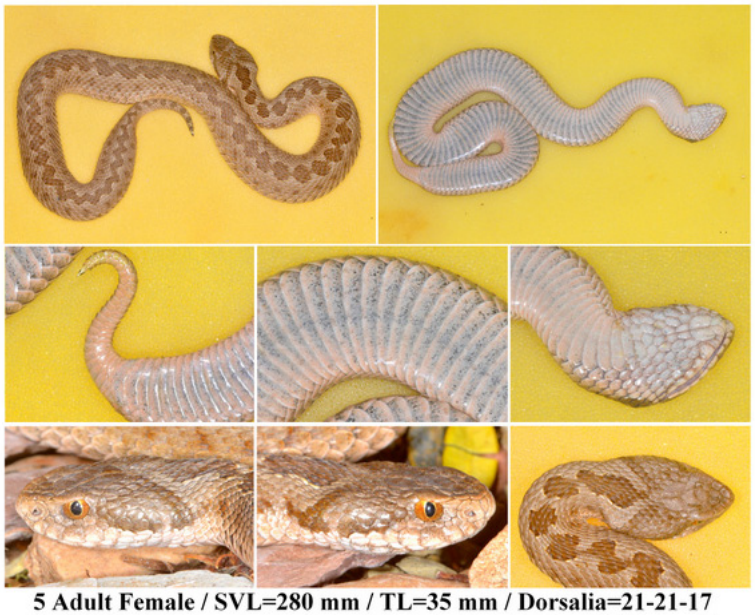
2 Adult Male / SVL=306 mm / TL=45 mm / Dorsalia=21-21-17
23.06.2017 / Barcın Plateau, Gündoğmuş, Antalya, 1790 m. asl.

Figure 4. *Vipera anatolica senliki* from the southern slope of Barçın Dağ, Gündoğmuş District, Antalya.

3 Adult Male / SVL=247 mm / TL=38 mm / Dorsalia=21-19-17
23.06.2017 / Barcın Plateau, Gündoğmuş, Antalya, 1807 m. asl.

4 Adult Female / SVL=248 mm / TL=28 mm / Dorsalia=21-21-17
23.06.2017 / Barcın Plateau, Gündoğmuş, Antalya, 1835 m. asl.

Figure 5. *Vipera anatolica senliki* from the southern slope of Barçın Dağ, Gündoğmuş District, Antalya.



5 Adult Female / SVL=280 mm / TL=35 mm / Dorsalia=21-21-17
23.06.2017 / Başpınar Plateau, Gündoğmuş, Antalya, 1948 m. asl.

6 Adult Male / SVL=355 mm / TL=47 mm / Dorsalia=21-21-17
27.06.2017 / Barcın Mountain, Gündoğmuş, Antalya, 2054 m. asl.

Figure 6. *Vipera anatolica senliki* from the southern slope of Barçın Dağ, Gündoğmuş District, Antalya.

7 Adult Female / SVL=310 mm / TL=27 mm / Dorsalia=21-19-17
27.06.2017 / Barcın Mountain, Gündoğmuş, Antalya, 2159 m. asl.

8 Juvenile (Female) / SVL=154 mm / TL=15 mm / Dorsalia=21-21-17
27.06.2017 / Barcın Mountain, Gündoğmuş, Antalya, 2232 m. asl.

Figure 7. *Vipera anatolica senliki* from the southern slope of Barçın Dağ, Gündoğmuş District, Antalya.

Figure 8. Habitat of *Vipera anatolica senliki* at the southern slope of Barçın Dağ, Gündoğmuş District, Antalya, with a mixture of rocks and herbaceous vegetation.

mechanisms, such as random genetic drift, founder effect, or local selection. In particular selection pressures might be strong enough to produce microgeographic variation across short distances (Bronikowski & Arnold 1999; Shine et al. 2012). Evidently, habitat characteristics appeared to differ between these two sites of *V. anatolica senliki*, with the area at Barçın Dağ being less steep and drier than at Mühür Dağ (Fig. 8). Crickets seemed more common on Barçın Dağ than on water-rich Mühür Dağ, where scorpions and centipedes were the most common prey (Göçmen et al. 2017). This, together with a partial or temporary isolation may also promote some diverging morphological traits through local selection pressure. However, microgeographic variations should be interpreted cautiously and primarily viewed in a local context, as diet, climate, and predation can have profound effects in forming external character expression and population traits that can change among sites in a region, even from valley to valley (e.g. Dubey et al. 2015; Mebert et al. 2015, 2017). After all and most importantly, we show that with experience, biological knowledge, and a concerted effort, one can efficiently promote the new discoveries of rare and endangered viper species.

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