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The poorly known Anatolian Meadow Viper, *Vipera anatolica*: new morphological and ecological data.

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Abstract. A total of seven specimens (5 males and 2 females) belonging to the poorly known Anatolian Meadow Viper, *Vipera anatolica* collected during the field trips of the late April and the mid-October 2014 were evaluated taxonomically by describing its pholidotic, metric features and other descriptive characteristics. Some biological and ecological information were also given.

Keywords: *Vipera anatolica*, distribution, habitat, morphology, Turkey.

Introduction

A new taxon within the *Vipera ursinii* complex was described by Eiselt & Baran (1970) based on two female snakes collected in 1969 by A. Budak (holotype) and F. Spitzenberger (paratype) in the Cedar Forest Reserve, Çığlıkara Ormanları, near Elmalı, Antalya province. At the time the taxon was given subspecific status and called *Vipera ursinii anatolica*.

Taxonomy of meadow and steppe vipers, viz. the *Vipera ursinii* complex, has long been debated, as many isolated but morphologically fairly similar taxa exist over a vast area from France in the west until China and Mongolia in the east. Most of the isolated mountain populations have been given specific status. The Anatolian meadow viper was indicated as a full species by Joger et al. (1992) and also considered as such by Nilson & Andrén (2001) in their extensive study on the *Vipera ursinii* complex.

Very few observations were made since 1969. We are aware of the following sightings. A specimen, presumably a male, was found by H. Sigg in 1984 (Billing, 1985 and Sigg, 1987), here referred to as the Sigg specimen. In the personal collection of G. Nilson and C. Andrén at the department of Zoology, University of Göteborg, Sweden (ZIG), there was a fourth specimen, female, depicted in Nilson

& Andrén (2001) and herein referred to as the ZIG specimen (apparently not a numbered collection item and maybe still alive at time of publication). The second locality 'in the same mountain range' indicated by Joger (1984) probably refers to this ZIG specimen. Saint Girons (1987) reported a further Turkish specimen present in the Muséum National d'Histoire Naturelle (MNHN 4000), but without locality information and therefore, without examination, not surely to be assigned to this taxon. Yet another female specimen was present in captivity, presumably in Germany, and was examined by Nilson & Andrén (2001). As a consequence a very limited number of specimens was known to science.

Extended knowledge about this taxon is needed concerning distribution, ecology and intraspecific variation, i.a. for planning conservation. Intensive surveys were performed in the past years, resulting in additional information presented in the present study.

Materials and methods

In 2014 high elevated locations in the Cedar Forest Reserve, Çığlıkara Ormanları, near Elmalı, Antalya province (1400-2300m asl) were searched for meadow vipers on five field trips between the end of April and the beginning of October. Data of this study were compared with information of the type specimens and all other published references.

To record colour and pattern characteristics animals were photographed while alive in their natural environment. Pholidotic features and descriptive characteristics were counted, measured and photographed. The ventral plates were counted using the system proposed by Dowling (1951). Snout-vent length and tail length were measured to the nearest millimetre using a ruler. Other morphometric measurements were taken using a digital calliper of 0.02 mm sensitivity (Mitutoyo 500-181 U). Head length was taken axially from the tip of the snout to the posterior protuberance of the jaw (Goren & Werner, 1993). For bilateral pholidotic features, counts were taken on both left and right sides (L/R) to enable a later study of asymmetry, which can be a taxon characteristic (Werner et al, 1991). Since the sample size is very low, we did not perform any summarised statistics and significance test.

The faecal contents of the caught vipers were examined under a stereomicroscope and the prey items were identified to the lowest possible taxa. Geographical coordinates of the observed specimens were recorded with a Magellan XL GPS receiver, but exact locations are not revealed here for conservation purposes.

The vipers had to be captured, handled and restrained in order to gather data. The authors received ethical permission (Ege University Animal Experiments Ethics Committee, 2010#43) and special permission (2011#7110) for field studies from the Republic of Turkey, Ministry of Forestry and Water Affairs. All specimens were released in their natural environment after investigation.

Results

Seven specimens were observed and caught. Five of them were male, two female. Pholidotic features and measurements are presented in Table 1. Some of the data are also highlighted below, because they give new insights, confirm characteristic features hitherto based on very few specimens or are conflicting with earlier publications.

Morphology. The maximum total length hitherto known was 344 mm (female). The largest viper in this study measured 368 mm, a male. A substantially low number of ventrals as characteristic for this taxon was confirmed by this study. In males ranging from 116-120, in females 118-119. The present data also confirm the high rostral index (rostral height to rostral width ratio), though the mean value can not differentiate between *anatolica* and the other related Turkish taxon *eriwanensis*.

Coloration. The dorsal pattern consisted of an almost continuous zigzag band darker than the ground colour, only in a few cases locally interrupted by one or two roundish blotches. In two longest (a female and a male) specimens the zigzag band is complete and the others have one blotch around the neck, one of the later ones has also another one blotch on the posterior 4/5 of the body. The number of windings in the dorsal zigzag band, including the tail, ranged from 51 to 63. Laterally, alternating with the windings, there was a row of dark spots. A second and third row of less conspicuous small dark spots or stripes occurred more ventrally on the side. Each row alternated with the other. The top of the head was not heavily pigmented. All specimens had conspicuously visible occipital blotches or stripes and sometimes some smaller spots in front of them. Frontal and lateral sides of the head were not whitish, but more or less of the same ground colour as on top of the head and elsewhere on the body. Most of the vipers had the lateral postocular stripes and occipital blotches fused in the shape of a furcula. Of the 14 head sides observed, 11 showed this Y-shape (Fig. 1).

The dorsal colour can be described as several kinds of greyish brown with a darker pattern upon a lighter ground colour. All specimens showed no difference between mid-dorsal and dorso-lateral ground colour, called a non-bilineate ground colour by for instance Nilson & Andrén (2001). The colours change considerably during the moulting cycle and are light and contrasting directly after moulting and become darker and less contrasting in due course, which makes it hard to precisely describe skin colours. Sexual dimorphism in dorsal coloration was slight, but females tended to show less contrast and be browner.

Table 1. Pholidotic features and measurements. Length in mm, lateral data left/right.

	1	2	3	4	5	6	7
Sex	♂	♂	♂	♂	♂	♀	♀
Snout vent length+Tail length	253+41	181+26	276+41	321+47	233+39	230+21	269+25
Head length	16.06	14.07	17.85	19.12	14.86	15.38	16.85
% Head length-SVL	6.35	7.77	6.47	5.96	6.38	6.69	6.26
Rostral width	2.25	1.58	2.14	2.24	1.85	1.64	2.07
% Rostral width-Head length	14.01	11.23	11.99	11.72	12.45	10.66	12.28
Rostral length	2.53	2.03	2.48	2.76	2.11	2.21	2.59
% Rostral length-Head length	15.75	14.43	13.89	14.43	14.2	14.37	15.37
Rostral index (height/width)	1.12	1.28	1.16	1.23	1.14	1.35	1.25
Head width	9.19	6.92	10.05	11.82	9.38	10.27	11.05
% Head width-Head length	57.22	49.18	56.3	61.82	63.12	66.78	65.58
Head depth	6.62	4.92	6.27	7.67	5.83	5.82	6.29
% Head depth-Head length	41.22	34.97	35.13	40.12	39.23	37.84	37.33
Distance between nostrils	3.42	2.59	3.48	3.65	2.93	2.92	3.37
Dorsal scale rows (anterior)	18	18	18	19	19	19	19
Dorsal scale rows (mid-body)	19	19	19	19	19	21	19
Dorsal scale rows (posterior)	17	17	17	16	15	17	17
Ventrals+preventrals	118+2	118+0	116+2	119+3	120+0	118+1	119+0
Subcaudals	31/30	31/30	30/29	30/29	31/30	23/22	23/22
Anal plate	1	1	1	1	1	1	1
Supralabials	8/8	8/8	8/8	8/8	8/8	8/8	9/9
Sublabials	10/9	10/10	10/10	10/10	10/10	10/9	11/10
Circumoculars	9/9	10/9	11/11	10/11	9/9	10/11	10/9
Supraoculars	1/1	1/1	1/1	1/1	1/1	1/1	1/1
Suboculars	1/1	1/1	1/1	1/1	1/1	1/1	1/1
Canthals	1/1	1/1	1/1	1/1	1/1	1/1	1/1
Supranasal	1/1	1/1	1/1	1/1	1/1	1/1	1/1
Loreals	4/4	6/7	6/6	5/6	5/5	6/7	3/4
Apical plates in contact with rostral	1	1	1	1	1	1	1
Total number of plates in contact with rostral	5	5	5	5	5	5	5
Crown plates	10	13	15	13	12	18	13
Parietals divided/fragmented	-	-	-	-	+	-	+
Frontal divided or not	-	-	-	-	-	-	-
Upper preocular in contact with nasal	+/+	-/+	-/-	+/+	+/+	+/+	+/+
Number of windings in dorsal zigzag band	57	59	56	63	58	51	56
Interparietal	+	+	-	-	+	-	-
Postfrontal	+	+	+	+	-	-	-
Y-shaped pattern on neck side	+/+	+/+	-/-	+/+	+/+	+/+	-/+

All ventrals were heavily powdered or finely speckled for about the inner three quarter of their surface and the outer caudal quarter is whitish. Most speckles were very small and only recognisable as such under magnification. These small speckles were beige brown in females and darker greyish brown in males. Larger speckles were present on ventrals too, with a diameter of about three quarter of the ventral's longitudinal width and these are often positioned bordering the caudal edge, thus partly covering the whitish edge. These large speckles were beige brown in females and blackish in males. The amount of large speckles per ventral was in the range of 0-2 in females and 1-4 in males (Fig. 2). The ventrals therefore showed sexual dimorphism in colour and pattern not indicated in earlier publications.

Habitat. The Anatolian meadow vipers were caught between 1980 and 2265 m. asl. In the region plants are characterized mainly as Mediterranean. Next to that, elements of the Irano-Turanian and Eurosiberian phytogeographical regions are present. The area is predominantly characterized at lower altitudes by *Oryzopsis holciformis-Cedrus libani* wood. Above 1000 m. asl *Juniperus foetidissima* becomes dominant. At about 1950 m. asl trees start to become scarce and make room for the Anatolian high mountain steppe vegetation.

Vipera anatolica was mainly found in this Karst doline-rich mountain steppe, with junipers and further only scarce vegetation. In these dolines the vipers seem to prefer stony slopes, having an angle of 10-20 degrees, interspersed by tall steppe plants (Fig. 3). The animals live inconspicuously among silvery-white haired plants reminiscent of their own colour. Typical plant species that can be seen in the habitat are: *Achillea teretifolia* (endemic), *Astragalus* sp., *Daphne gnidioides*, *Draba bruniifolia*, *Euphorbia characias wulfenii*, *Festuca jeanpertii jeanpertii, Sideritis libanotica linearis* (endemic), *Thymbra* sp. and *Thymus zygioides lycaonicus.*

Phenology. Animals were observed on May 3, in June, July and October. Four of the specimens were observed in the first week of October. During a visit at the same site at the end of April no specimens were observed. At the end of October there usually is already snow at the site. The active season therefore can be positioned as the period between the early May until the mid-October.

Food spectrum. Insects, in particular grasshoppers are a main part of the diet of meadow vipers in general (Baron, 1992) and this was to be expected for the Anatolian meadow viper too. Vipers were observed feeding on *Ablepharus chernovi* (a scincid lizard) and *Chorthippus* sp. (an acridid grasshopper). An attempt to grasp

Figure 1. Pair of Anatolian meadow vipers showing sexual dimorphism (male right, female left) and furcula-shaped head pattern.

Figure 2. Male (left) and female bellies showing sexual dimorphism.

Figure 3. Habitat of *Vipera anatolica* (looking from the southeast direction in June).

a juvenile *Anatololacerta oertzeni budaki* (a lacertid lizard) was also recorded. A second, pamphagid grasshopper (*Paranocarodes fieberi*) was abundant in the habitat. The stereomicroscopic investigation of the faecal contents also confirmed *Chorthippus* sp. as main part of the food spectrum.

Accompanying fauna. Syntopic amphibians and reptiles recorded were *Pseudepidalea variabilis* and *Ablepharus chernovi, Anatololacerta oertzeni budaki*, *Elaphe sauromates, Eirenis modestus* and *Zamenis hohenackeri*. Sympatrically recorded amphibians and reptiles, at a lower altitude, were *Pelobates syriacus, Pelophylax bedriagae* and *Dolichophis caspius, Hemidactylus turcicus, Lacerta trilineata*, *Mediodactylus kotschyi, Montivipera xanthina*, *Natrix natrix*, *Stellagama stellio* and *Typhlops vermicularis*.

Discussion

Up to the present study our knowledge about the Anatolian meadow viper was based on just three to four females and one presumed male. The additional five

males and two females presented here afford the opportunity to determine intraspecific variability as well as sexual dimorphism and adds ecological information.

Number of windings in the dorsal zigzag band of the specimens ranged 56-63 in males and 51-56 in females. For the holotype and paratype, both female, numbers of 34/33 and 33/34 were given, but this is without the windings on the tail and for that reason can not reasonably be compared. Taken from the published photographs the specimen found by Sigg (Billing, 1985; Sigg, 1987; Brodmann, 1987) had an estimated total number of 50 windings and was missing the tail tip and therefore fits perfectly within the range found in this study. Nilson & Andrén (2001) mentioned the confusing number of 38 as pooled mean value for this character, based on, as written, four specimens known up to then. Taking into account the low numbers of the type specimens we believe something is wrong here. Most likely they took the mean value of the number of windings (without tail) of just the Sigg specimen and the ZIG specimen.

Eleven of the fourteen neck sides newly available in this study showed an Y- or furcula-shape formed by fusion of the postocular stripe and the occipital blotch. This very characteristic feature was also present in the specimens known before. From the holotype and paratype Eiselt & Baran (1970) more or less pointed out this phenomenon in their own words as occurring '*in quite different degrees (even on the same animal*)'. Pictures presented by Billing (1985) and Brodmann (1987) and Sigg (1987) clearly show left and right sides of the Sigg specimen. Both sides showed this Y-shape. This phenomenon can be found incidentally in all viper species, regularly within the *ursinii* complex (no published data available), but is not very common at all. The high incidence in this taxon is very characteristic. Mulder (1994) indicated this phenomenon to be rare in mountain vipers (*Montivipera* sp.) with the exception of *Montivipera albizona*, where it could be found with an incidence of up to 50%.

Ventral coloration is described here in detail and is in sharp contrast to earlier publications. Andrén & Nilson (2001) in their extensive study on meadow and steppe vipers just stated for *anatolica* 'belly-pattern white' (description) and 'white belly' (diagnosis), probably wrongly citing Eiselt & Baran (1970). Also Joger et al. (1992) wrote 'Belly mainly white'. It must be said, that the original species description is not very clear in this. Translated from German the text in Eiselt & Baran (1970) states: 'Belly white, especially at head and throat region, but all scales in different proportions powdered middle grey, ventrals also appear to be speckled dark grey'. The publication contains a plate depicting the belly, which surely can not be called white.

The specimens in this study were found in more or less the same locality as the type specimens: Çığlıkara Ormanları, northwest of Kohu Dağ. The type specimens were said to be found at elevations between 1650 and 1750 m. asl, considerably lower than the specimens in this study (between 1980 and 2265 m. asl.). Many visits to other close-by sites in the region (1400-2100 m asl) prior to 2014 did not reveal any meadow viper. The ZIG specimen was collected '20 km away from the terra typica' without details on locality. Though occurrence is to be expected in other nearby mountainous regions, the species probably has a very limited range, far away from related taxa. The nearest known meadow or steppe vipers live 1060 km to the east (*eriwanensis*, Eiselt (1976) or about 850 km to the northwest in Greece (*graeca*, Dimitropoulos (1985). Six years of unsuccessful searching in the region in May and September (2007-2013) indicates the difficulties to deal with enlarging distributional knowledge. Further research is needed to confirm the range and population status.

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