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Distribution, Abundance and Morphological Characteristics of the Transcaucasian Rat Snake (Serpentes: *Zamenis hohenackeri strauch, 1873*) in Azerbaijan

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Abstract: The article deals with the distribution, number and morphological features and specifies new places for finding the Transcaucasian rat snake in Azerbaijan. Due to these findings, the distribution borders of the species in Azerbaijan along the slopes of the Greater Caucasus widened in the northeast direction (Guba region, Hashi village). The population size is established, which varies in the range of 0.02-0.03 individuals per hectare of biotope area. Locations of the main localities are shown. Morphological characteristics of the species and the main indicators of morphometry and folidosis are given. Morphometric indicators of both sexes indicate the presence of sexual dimorphism. Body length in females is greater (72.9 ± 4.6 cm) than in males (61.5 ± 2.3). Compared to males, the female has a longer body than the tail.

Key words: Transcaucasian Rat Snake · Distribution · Density · Morphometric Parameters

INTRODUCTION

The Transcaucasian rat snake (*Zamenis hohenackeri* Strauch, 1873, synonyms: *Coluber hohenackeri* Strauch, 1873; *Elaphe taurica* Werner, 1898) in Azerbaijan is represented by the nominative subspecies *Z.h.hohenackeri* Strauch, 1873. The natural habitat of the species occupies the territory of Asia Minor, Northwest Iran, the South Caucasus (Azerbaijan, Georgia, Armenia), North Ossetia, Checheno-Ingushetia, Dagestan and the mountain ranges of southern Lebanon and Northern Israel [1-4]. The subspecies *Z.h.hohenackeri* inhabits most of the natural habitat. Another subspecies of *Z.h.taurica Werner*, 1898 is common in the Cilician Taurus in southern eastern Turkey and in the isolated mountain range of southern Lebanon and northern Israel.

Currently, the Transcaucasian rat snake is one of 8 rare (VU) species of snakes of the official fauna of Azerbaijan. In addition, the Transcaucasian rat snake with different natural preservation status is included in the red books of a number of adjacent states (Russian Federation, Georgia and Armenia), as well as in the Red List of the IUCN as a species that is vulnerable and declining in numbers. Special studies on the study of biology, ecology and the state of populations of the Transcaucasian rat snake in Azerbaijan were not carried out. Therefore, sufficient information on the status of the species in Azerbaijan, in particular, information on the number does not exist. The available literature sources mainly include general information on the distribution, taxonomy, morphology, biology and ecology of the species [5-8]. Among the works performed recently and devoted to the study of the Transcaucasian rat snake, is the work of Akhmedov [8] which addresses issues of distribution, morphological characteristics (Folidosis, morphometric criteria) of the species.

This article is devoted to the study of the distribution, number and morphological features of the Transcaucasian rat snake in Azerbaijan.

MATERIALS AND METHODS

The materials of the study were field data on the distribution of the Transcaucasian rat snake, collected by the authors in May-June 2004-2006 and 2011-2016 on the slopes and foothills of the Greater Caucasus within

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Azerbaijan. The paper also uses data on the distribution and morphology of the species presented in the scientific literature. The registration of individuals was carried out by a common method [9]. In the biotope zones, pedestrian lines (Transects) with a width of 4 m were chosen. On the basis of the obtained data on the number of individuals on transect areas, the density (ind. / per ha) of the population in the area under study was determined. Studies were conducted during the period of the greatest activity of snakes. On the map, the places of detection of individuals were recorded; the coordinates of these places, the conditions of the biotope (Weather and terrain conditions, relief, vegetation), the state of activity, etc were recorded. Taking into account new locations of finds, as well as information known from the literature, points of location (cadastre) of the Transcaucasian rat snake in Azerbaijan (Fig. 1) were noted.

In order to collect morphological data, our own and collector's materials were used in 19 copies (11♂ and 8♀), 2 of which were young forms (3-3.5 years). Age-related variability in color and body patterns in adults and young individuals had been identified. The main morphometric criteria and the folidosis of the body were determined: body length - *L,* tail length - *Lcd*, length-to-tail ratio *L / Lcd*, number of scales around the middle of body - *Sq*, number of ventral scales - *Ventr*., number of pairs of subcaudal scales - *Scd* (Table)

RESULTS AND DISCUSSIONS

Distribution and Number: Locations of finds and cadastre of distribution of the Transcaucasian rat snake in Azerbaijan are indicated on the map (Fig. 1).

In western Azerbaijan, this species is widespread in the foothills of the Lesser Caucasus, since, as noted above, it was found by Gogenerk and Fritsch as far back as 1838-1840 in the vicinity of present-day Ganja and Goygel city. In the collections of the Museum of the Georgian Academy of Sciences there are specimens from the vicinity of village Zurnabad of Khanlar region (Now Goygel) [1,4]. Information on the distribution of the Transcaucasian rat snake on the foothill and mountain plots of the Lesser Caucasus is also given in the works of Dzhafarova [7]. She identified this species in the Kelbajar and Lachin regions (Fig. 1). We conducted a study to establish the density in the populations of the Transcaucasian rat snake on the slopes of the Lesser Caucasus. In the territory of the Gyokgol and Dashkasan regions, foothill forests-steppes and xerophytic stony slopes were surveyed. On the route lines with a total length of 184 km, we met only 2 adults (1 ♂, 1 ♀). One specimens were found on the territory of the Gyokgol district, in the vicinity of the village of. Hajikend on rocky, xerophytic slopes (height of 1,115 m) and the other in the vicinity of the village of. Zurnabad (altitude 980 m), on a stony slope under rocks (Fig. 1). The sizes of the individuals were respectively: the length of the trunk (L) was 69.3 and 78.5 cm and the length of the tail (Lcd) was 12.3-16.4 cm. Thus, in the transect area, 736.9 hectares (184 Km x 4 m) the number of the species was 2 individuals. The relative abundance of individuals in the population for these localities is 0.02 ind. / ha.

In the north-western and northern parts of the republic, the territories of the Transcaucasian rat snake cover mainly the southern slopes of the Greater Caucasus. There are specimen from the surroundings of village Zargeran of the Ismayilli region (Collection of Zoology Institute of the Russian Academy of Sciences), Agdash and Shamakhi cites (Collection of the Institute of Zoology of the National Academy of Sciences of Azerbaijan) [8]. For the north-western part of the republic in the literature this species is noted for the environs of Lagodekhi in the Belokan region and village Perzivan of Zakatala region [8]. S.B. Akhmedov in different years mentioned the Transcaucasian rat snake in the vicinity of the village Pirkuli and village Sis of Shemakha region on the outskirts of the forest, covered with xerophytic bushes [8].

The collections of the Institute of Zoology of the National Academy of Sciences of Azerbaijan include individuals found in the gorge of the river Vilyashchay (Masalli region) and near the village Alekseyevka of the Lenkoran region, as well as individuals caught in the porcine forests from the lower mountain zones.

Concerning the distribution of the Transcaucasian rat snake in the territory of the Nakhchivan Autonomous Republic, there are only obsolete information [5,6] in which this species is indicated for the vicinity of the city of Ordubad and village Bichenek of Shahbuz region.

During the 10-day expedition, we surveyed the foothill steppes with light forests, stony slopes and river banks and counted the number of individuals (The total length of the walking routes is 285 km). During the walking routes we met only 3 adults (♂, ♂, ♀). One individual was found on May 21, 2011 along the road, on a slope, among the stones near the hips (Height 1250 m

above sea level). In the surrounding village Perzivan of Zakatala region: length of trunk (*L*) - 66.3 cm and length of tail (*Lcd*) - 14.4 cm. The second individual was found on May 27, 2011 in the vicinity of village Junut of Gakh region on the stony banks of the river Gashgachay, germinated with dry herbs and xerophytic shrubs (Height 1420 m above sea level): length of trunk (*L*) - 70.2 cm and length of tail (*Lcd*) - 15.9 cm. The third individual was found in the area of Shemakha, near village Chuhuryurd on a stony slope with xerophytic shrubs (Height 1270 m above sea level): the length of the trunk (*L*) is 65.2 cm and the length of the tail (*Lcd*) is 13.5 cm. Thus, in the transect area, 114.0 ha (285 km x 4 m) the number of the species was 3 individuals. The density of the population in these areas, respectively, is 0.03 ind/ ha.

The following registration of individuals was conducted in the north-eastern part of the slopes of the Greater Caucasus within the Guba region of Azerbaijan. During the 8-day expedition to the mountainous areas, we surveyed different biotopes on walking routes with a total length of 86 km (Altogether 11 routes). Routes were laid in the mountains and foothills, on stony slopes covered with dry-loving vegetation, ravines and gullies, various kinds of thickets, among the outcrops of rocks, along river banks in thin forests. During the study, only 1 individual was found (Fig. 2-A). This discovery was made on August 06, 2016 at an altitude of 1328 m above sea level. (N 41^0 10'.16,963 E- 48^0 40 '21,688), in the vicinity of the village Khashi of Guba region, on the outskirts of the forest, on stony and rocky slope, overgrown with dry grasses. The site of the individual's discovery provided a heap of stones under a single tree of alcha (Fig. 2-B). The found individual was a young female, with body sizes *L* = 41.7 cm and *Lcd* = 8.2 cm, (Fig. 2-B). This find is the first and only for the north-eastern part of the slopes of the Greater Caucasus within Azerbaijan and at present can be considered the north-eastern edge of the range in Azerbaijan. Due to this finding, the border of the Transcaucasian rat snake along the slopes of the Greater Caucasus was expanded to the north-east of Azerbaijan. As a result of our studies, we determined the population density of the Transcaucasian rat snake in this part of the habitat, which was 0.02 individuals per hectare.

The discovery of the Transcaucasian rat snake on the north-eastern slopes gives grounds for assuming further distribution of this species in these territories, in order to confirm that it is required to continue the search for the Transcaucasian rat snake in these territories.

Morphology: Transcaucasian rat snake is a medium-sized snake (Table). The length of the body *(L*) of the adults that we measured, varied from 61.5 to 78.1 cm. The length of the tail (*Lcd)*, respectively, was 11.2-16.4 cm, i.e. 4,6-5,2 times shorter than body length.

Cervical Interception Is Weak: The wide intermaxillary scute with its blunt edge wedges between the nasal scutes. The infraorbital scute is not available, the preorbital scute 1 and large. The pupil is round. The scales of the anterior half of the back are smooth and the tail is slightly ribbed. The length of the body in females is greater (72.9 ± 4.6 cm) than in males (61.5 ± 2.3). The revealed difference is significant ($P<0.01$) and confirms the presence of sexual dimorphism. In comparison with males, the body is longer in females and the tail is shorter. Apparently, this is due to the reproductive function of females and has arisen as a result of the evolution of the reptilian reproduction strategy.

There was also a significant difference ($P<0,001$) in the characteristics of folidosis of females and males (Table): the number of abdominal scutes (S_{ventr}) in males is less (201.4 ± 4.73) than in females (220.2 ± 3.5). Around the middle of the body, there are 21-25 longitudinal rows (Sq) of scales. Number of subcaudal scales (S_{cd}) is 55-66 pairs. However, this sign did not reveal sexual dimorphism and there is no significant difference in the number of subcaudal scales. Anal fascia divided by a suture into 2 parts.

Colouring: On top, the body colour is brownish-brown or with shades of gray-brown colour. On the back there are two longitudinal rows of dark brown spots, separated by a narrow white longitudinal spine line. In young individuals, the brown background of the body is lighter than in adult forms. With age, the background colour will darken in individuals and the spots on the back become less noticeable. Such protective colouring makes the snake almost invisible among the substrate. The head is covered from top with small dark spots. In the cervical region, there is a fork-shaped spot with two long and broad, sometimes almost parallel wings directed towards the body. From the eye to the corner of the mouth the same colour strip stretches. The belly is brownish-gray. By colour and colouring, males and females do not differ.

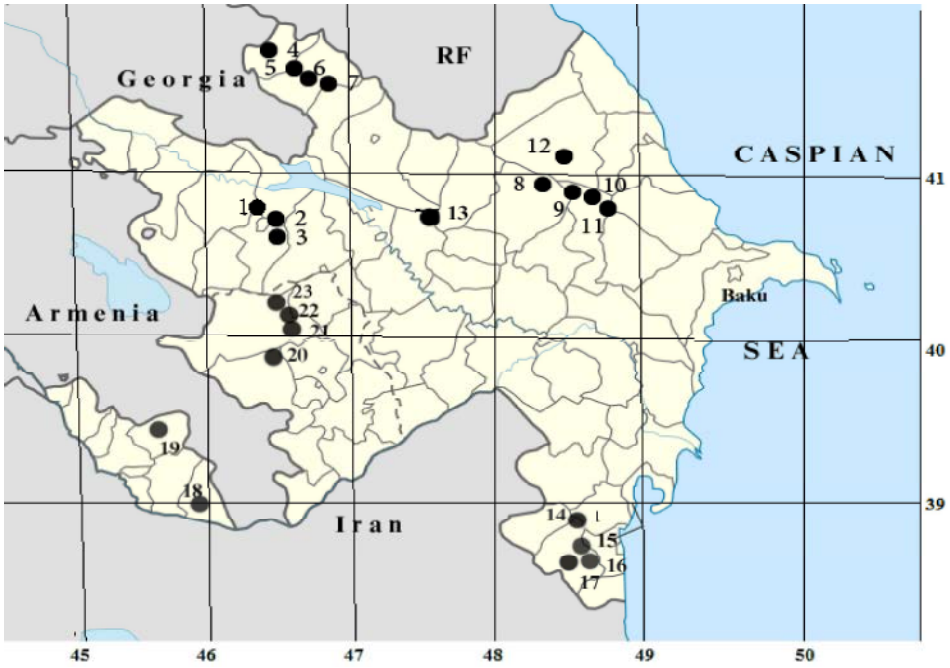

Fig. 1: Map of the distribution of Transcaucasian Zamenis hohenackeri in Azerbaijan. Cadastre to the figure: 1. Elizavetpol city (=Ganja, Hohenacker,1838); 2. Village Helenendorf (=Goygel, Friche); 3. Village Zurnabad of Goygel region [1] 4. Village Lagodekhi of Belokan region, Akhmedov [8] 5-6. Village Perzivan of Zakatala region, (Our data, 2006, 2011); 7. Village Junut of Gakh region (Our data, 2006, 2011); 8. Village Zargeran of Ismayilli region (Alekperov,1978); 9.10 and 11. Village Pirkuli, village Sis and village Chukhuryurd of Shemakha region (our data, 2006, 2011); 12. Village Khashi of Guba regioin (our data, 2016); 13. City Agdash (Alekperov,1978); 14. Gorge of the river Vilyashchay of Masalli region (Alekperov,1978); 15-17. Woodlands of the lower mountainous area of Talysh [1]; 16. Village Alekseyevka of Lenkaran region; 18. Village Bichenek of Shahbuz region of Nakhchivan Autonomous Republic [5]; 19. Neighborhoods of the city of Ordubad of Nakhchivan Autonomous Republic [6]. 20-23 – Village Kilinchli. Of Lachin region and Village Alchali, Nadirkhanli and Mishni of Kelbajer region [7]

(A) (B)

Fig. 2: A- specific biotope and place of finding of Transcaucasian rat snake Zamenis hohenackeri. B- Zamenis hohenackeri. Azerbaijan, Guba region, village Khashi, height 1328 m above sea level. 06.08.2016

Table 1: Comparative characteristics of morphometry and folidosis of males and females of the Transcaucasian rat snake Zamenis hohenackeri (Strauch, 1823)

	Metric (cm) and quantitative (pcs) indicators				
	L	Lcd	L/Lcd	S_{ventr}	S_{cd}
	Min-max	Min-max	Min-max	Min-max	Min-max
Individualsd quantity (n)	M±m	M±m	M±m	M±m	M±m
♂, n=11	51.5-70.2	11.2-16.4	4.1-4.9	195-209	56-66
	61.5±2.3	13.6±2.1	4.6±0.9	201.4± 4.7	63.9±2.2
♀, n=9	41.7-78.1	8.2-13.6	4.6-5.5	210-225	55-61
	72.9±4.6	9.0±1.4	5.2±0.8	220.2±3.5	57.1±1.9
t	t=2.3	t=3.3	t=2.8	t=3.7	t=1.9
P	P<0.01	P<0.001	P<0.01	P<0.001	P>0.05

CONCLUSION

Transcaucasian rat snake is a rare species of Azerbaijan's herpetofauna, which needs special protection. It is distributed sporadically, mainly on mountain-xerophytic territories. The main populations are found in the north-west of Azerbaijan on the territory of the Belakan, Zagatala and Shemakha regions. Populations are loose and the density of individuals per hectare of the biotope area is from 0.02/ha to 0.03/ha. The habitats investigated by us mainly consisted of unprotected territories that are affected to some extent by the anthropogenic press. Usually the biotopes that the Transcaucasian rat snake adheres to, because of their openness are often used by the local population for grazing.. An additional threat, both for all species of reptiles and for the Transcaucasian rat snake is the negative attitude of the population towards snakes. When drawing up measures for the protection and rehabilitation of the Transcaucasian rat snake, all these factors must be taken into account and measures are taken to preserve the most significant biotopes, as well as the education of people with tolerant attitude towards snakes. As a result of morphometric analysis, some signs of sexual dimorphism have been revealed, in particular in the size of the body and tail. The age variability of the body's color background was also revealed. Thus, we can draw the following conclusions:

1. The Transcaucasian rat snake is spread sporadically, mainly on mountainous xerophytic territories. On the territories of the Greater Caucasus, the eastern boundary of distribution reaches the north-eastern regions of Azerbaijan (Guba region, Hashi village).
2. The most stable populations of the Transcaucasus rat snake are found in the north-west of Azerbaijan on the territory of the Belakan, Zagatala and Shemakha regions, in the west within the Goygel region, in the south in the woodlands of the lower mountainous zone of Talysh.
3. The density of the populations of the Transcaucasian rat snake in Azerbaijan is low and varies from 0.02 ind/ha to 0.03 ind/ha. This requires the strengthening of conservation measures to preserve the species.
4. Statistical analysis of morphometric parameters of both sexes indicates the presence of sexual dimorphism in the length of the body and tail. Compared to males, females have a body longer than the tail.
5. On top of the colour of the body of the Transcaucasian rat snake is with brownish-brown shades. In young individuals, the colour background of the body is lighter than in adult forms.

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