

Present Distribution and Numbers of the Eastern Steppe Viper (*Vipera renardi* (Christoph 1861), Squamata, Viperidae) in Azerbaijan

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Abstract—The distribution, abundance and range change of the Eastern steppe viper (*Vipera renardi* (Christoph 1861)) are updated for the Republic of Azerbaijan. The range of this species in Azerbaijan, based on information dating back to the 1970s–1980s, mainly covered the vicinity of the city of Shamakhi of the northern Greater Caucasus within Azerbaijan. To clarify the current range and population density, individuals were counted en route, new locations identified, and the numbers determined. The modern range of the species has somewhat shifted and expanded in the northwesterly and northeasterly directions along the southern macro slopes of the Greater Caucasus, presently also covering the higher parts of the distribution area, up to 1870 m a.s.l. The reasons for the change seem to lie in the increased anthropogenic pressure, which has led to a change in habitat conditions at the lower range limits. Our study shows that, in Azerbaijan, the numbers of *Vipera renardi* have decreased. In the vicinity of Shamakhi, it averages 0.05 ± 0.02 ind./ha. In the elevated areas of the northwestern and northeastern macro slopes, the density is relatively higher and averages 0.1–0.2 ind./ha. However, closer to the lower limits of the range (650–700 m a.s.l. elevations), the density decreases to 0.06 ind./ha. *Vipera renardi*, a rare species with a limited distribution, is recommended to be included in the Red Data Book of the Azerbaijan Republic.

Keywords: change in distribution, abundance, faunistic records

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INTRODUCTION

Taking into account the modern taxonomy of the ophidiofauna of the Caucasus (Ananyeva et al., 2004; Tuniev et al., 2009) and the results of our research (Iskenderov et al., 2017), the taxonomic spectrum of steppe vipers in Azerbaijan currently includes three species belonging to the genus of true vipers (*Vipera*) and the subgenus shield-heads (*Pelias*): (1) the eastern steppe viper (*Vipera renardi* (Christoph 1861)), (2) the Yerevan steppe viper (*Vipera eriwanensis* Reuss 1933), and (3) the steppe viper Lotiev (*Vipera lotievi* Nilson et al., 1995). At the same time, the presence of two more species of steppe vipers in Azerbaijan is expected: *Vipera ebneri* (Knoepffler et Sochurek 1955) and *V. dinniki* (Nikolsky 1913). Unfortunately, the search for these two species of vipers has not yet yielded positive results.

We studied the distribution and abundance of the eastern steppe viper (*Vipera renardi* Christoph 1861) in order to assess its current state and possible changes in its range in Azerbaijan. The need for these studies was also associated with the intensive transformation of

natural habitats into anthropogenic landscapes, which poses a great threat to the survival of populations. This article is devoted to the results of these studies.

MATERIALS AND METHODS

The collection of material was carried out in the years 2019–2021, during field studies on the territories of the southern macroslope of the Greater Caucasus, in the Sheki, Ismayilli, Akhsu, Shemakha, and Gobustan administrative regions. The presence of *Vipera renardi* was established by direct discovery of living individuals or their remains, as well as by the results of a survey of local residents. To determine the population density, individuals were counted according to standard herpetological methods (Denisman and Kaletskaya, 1952; Bannikov et al., 1977; Darevsky and Shcherbak, 1989). On the basis of literature data and our own materials, a cadaster of distribution was compiled for *Vipera renardi* in Azerbaijan. In the biotopes under study, pedestrian transects were laid 500–2000 m long and 2 m wide on each side of the counter.

The total length of the transects was 324 km; in total, 18 individuals were found. For this work, we also used the literature data on the distribution and abundance of *V. renardi* in Azerbaijan (Aleksperov and Sharifov, 1969; Aliyev, 1973; Aleksperov, 1978; Aliyev and Ganiev, 1985; Tuniyev et al., 2013), as well as catalogs and specimens from the collections of the Zoological Institute of the National Academy of Sciences of Azerbaijan. Based on all the data collected, a cadaster and a map of the distribution of the eastern steppe viper in Azerbaijan were compiled.

RESULTS

Taxonomic status. The steppe viper, which is widespread in Azerbaijan, belonged for a long time in the scientific literature to the subspecies *Vipera ursini renardi* Christoph 1861 (Bannikov et al., 1977; Aleksperov, 1978). However, after a taxonomic revision of the *Vipera ursini* species complex, the subspecies *V. u. renardi* (Christoph 1861), common in the eastern part of the range, was recognized as an independent species, the eastern steppe viper (*Vipera renardi* (Christoph 1861)) (Nilson et al., 1994, 1995; Nilson and Andr en, 2001). Subsequently, a population of vipers distributed in Azerbaijan in the northeastern part of the Greater Caucasus, taking into account some differences in morphology, pholidosis, and DNA structure, were presented as a new, independent species *Vipera (Pelias) shemakhensis* (Tuniyev et al., 2013). However, most researchers are critical of such taxonomic definitions, the recognition of *Vipera shemakhensis* as an independent species is considered inconclusive (Fretitas et al., 2020). The controversy in the scientific community surrounding this group of vipers continues at present (Kukuschkin et al., 2012). In order to determine its taxonomic status and phylogenetic relationships in the group of steppe vipers, we continue to conduct research. Considering that the taxonomic status of the populations distributed on the southern slopes of the Greater Caucasus in the group of vipers "renardi" is debateable, we attribute them to the species of the eastern steppe viper (*Vipera renardi* Christoph 1861).

Distribution and abundance. The range of the eastern steppe viper (*Vipera renardi*) occupies vast territories and includes Southeastern Europe, southern Ukraine, steppe Crimea, steppe regions of Ciscaucasia, the Greater Caucasus, Central Asia, the northwestern parts of Central Asia, Kazakhstan, and southern Siberia (Ananyeva et al., 2004; Tuniev et al., 2009). On the territory of the South Caucasus (Azerbaijan and Georgia), there lives one isolated population (Nilson and Andr en, 2001; Nilson et al., 2009; Tuniev et al., 2009). The species inhabits the steppe, forest-steppe, and semi-desert zones and lives in flat and mountain wormwood steppes, dry and wet meadows, and rocky slopes of mountains rising to 1500 m above sea level (Ananyeva et al., 2004; Tuniev et al.,

2009), while at the same time avoiding intensively cultivated agricultural land (Nilson and Andr en, 2001).

The steppe viper in Transcaucasia was known from the territories of Georgia and Azerbaijan, as well as from the northern and northeastern regions of Armenia; it was first caught by Mochulskii in 1839 (Aleksperov, 1978). However, Strauch (1873) erroneously identified it as a subspecies of the common viper (*Viper berus*). Only in 1949 did P.V. Terentiev and S.A. Chernov establish that the subspecies *Vipera ursini renardi* Christoph 1861 lives in Transcaucasia (Aleksperov, 1978). Over time, the spread of the steppe viper *Vipera ursini renardi* (= *Vipera renardi*) in Transcaucasia has been studied by many authors (Aleksperov, 1951, 1978; Aleksperov and Sharifov, 1969; Muskhelishvili, 1964; Aliev, 1973; Aliev and Ganiev, 1985; Tuniyev et al., 2013, 2018). In Azerbaijan *V. renardi* occurs mainly in the northern and northeastern parts of the Greater Caucasus and in the territories of the Sheki, Ismayilli, Shamakhi, and Gobustan administrative regions (Aliev, 1973; Aleksperov, 1978; Aliev and Ganiev, 1985; Tuniyev et al., 2013). These works indicate the focal distribution of *V. u. renardi* (= *V. renardi*) and mention the main localities by which one can judge the range of the species in Azerbaijan.

According to Aleksperov (1978), *V. u. renardi* (= *V. renardi*) is found mainly on the territories of the Shamakhi region, the author indicates the places of finds in the city of Shemakha and its environs in the villages of Hynysli, Engakharan, and Kyz Kalasy; in the tract of Yeddi Kyumbez; and in the northern part from the city of Shemakha to the village of Demirchi (Fig. 1, 1–5). The altitude of these finds varies from 700 (Eddi Kyumbez) to 1500 m a.s.l. (village of Demirchi). It is noted in the literature that the viper is also found in the northwestern part of the southern slopes. According to Aleksperov (1978), two specimens of vipers caught by A.N. Nikolskii in May 1907 in the vicinity of the village of Karatala of Nukhinskii district (now Sheki district) are stored in the museum of the Georgian Academy of Sciences (Fig. 1, 6). Aliyev and Ganiev (1985) found vipers on the territory of Sheki (village of Akhmedbeyli), Ismayilli (village of Khankend), Akhsu (Akhsu pass), Shamakhi (village of Orta Bulakh), and Khizi (village of Altyagaj) districts (Fig. 1, 7–10). The latest find expands the range of *V. renardi* in Azerbaijan on the southern macroslopes of the Greater Caucasus in an easterly direction.

Renardi vipers were encountered (Fig. 1, 11, 12), according to oral reports of the snake-catcher of the Baku nursery Iskender Mamedov, in 1984 in the vicinity of the village of Madrasas (40°3721' N, 48°3313' E, height 683 m a.s.l.) and in 2011 near the village of Dzhangii in the steppe hills (40°2942' N, 49°1553' E, height 354 m a.s.l.) according to a former employee of the Institute of Zoology, herpetologist A. Jafarov. The collection of the Institute of Zoology, National Acad-

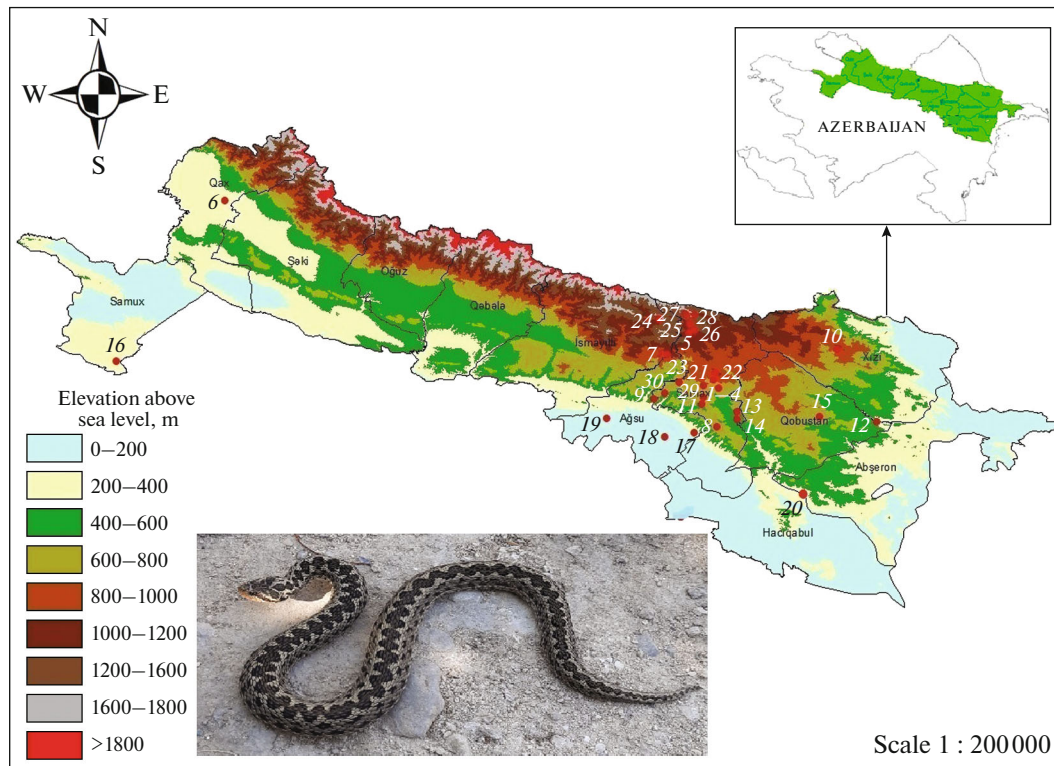


Fig. 1. Distribution of the eastern steppe viper (*Vipera renardi* Christoph 1861) in Azerbaijan (southern slopes of the Greater Caucasus): 1–30, places of finds (explanations in the text).

emy of Sciences of Azerbaijan (expedition of the Azerbaijani Branch, Soviet Academy of Sciences, July 1937) contains one specimen of viper, caught in the Ajidere tract, Shamakhi district (40°3337' N, 48°4539' E, height 546 m a.s.l.). Our observations in these places confirmed this finding, and in June 2011, on the way to the old Sheikh Eyuyub cemetery, on a rocky slope at an altitude of 672 m, we found one individual (40°3118' N, 48°4709' E) (Fig. 1, 13, 14). There is information (Tuniyev et al., 2013) about finding a *V. renardi* (= *V. shemakhensis* Tuniyev et al., 2013) viper in the Gobustan region in the vicinity of the village of Marazy, at an altitude of 800–900 m a.s.l. (Fig. 1, 15).

In the localities indicated above, the height of the distribution of the viper varies within 500–1500 m a.s.l. and the habitats are mountainous dry or xerophytic steppes or forest–steppes overgrown with herbaceous and shrubby plants. However, there is information on the distribution of *V. renardi* in Azerbaijan and at lower altitudes, i.e., in dry steppes of the foothills and even semi-deserts at an altitude of 50–350 m a.s.l. The collections of the Institute of Zoology, Russian Academy of Sciences, contain specimens collected in the village of Akhmedbeyli, Elizavetpol province (now Samukh district) (Fig. 1, 16). According to Alekperov and Sharifov (1969), the steppe viper *V. u. renardi* (= *V. renardi*) was found in the foothill steppes of the

Aksu district, in the vicinity of the villages of Bidzho (40°3056' N, 48°3332' E, height 323 m) and Kangarli (40°2729' N, 48°2042' E, height 46 m). The catalog, compiled on the basis of the collection materials of the Institute of Zoology, National Academy of Sciences of Azerbaijan, contains a note about finds of this viper in the vicinity of the village of Noijsi, Aksu district (40°3230' N, 48°1543' E, height 112 m) (Fig. 1, 17–19). According to an oral report by Burchak-Abramovich, the steppe viper is found in the hilly steppes of the Pirsaat valley, north of the Salyan district (40°1710' N, 48°5343' E, height 283 m) (Fig. 1, 20) (Alekperov, 1978). However, the habitation of the viper at such low altitudes (16–20) was not confirmed by our observations.

Thus, in Azerbaijan a relatively high density of *V. renardi* was previously distributed in the vicinity of the city of Shemakha (Alekperov and Sharifov, 1969; Alekperov, 1978; Aliev and Ganiev, 1985). This is also evidenced by the large number of individuals (more than 35) that were caught from 1937 into the 1940s in the vicinity of the city of Shamakhi and that are still kept in the collection of the Institute of Zoology, National Academy of Sciences of Azerbaijan. In the numerical data on *V. renardi* in Azerbaijan, most publications of previous years are missing. Only in the work of Aliev and Ganiev (1985) are data given on the low abundance of



Fig. 2. Characteristic biotope of the eastern steppe viper (*Vipera renardi* Christoph 1861) in Azerbaijan, Ismailinskii district, village of Koidan, July 2021.

the steppe viper in Azerbaijan. According to the data of the above authors, in some biotopes in the Shamakhi region, 0.1–0.2 individuals were found per hectare of area, in rare cases up to 0.4–0.5 individuals.

Our research in May–July 2019–2021 showed a different picture of the modern distribution and density of this species. Despite the patchy distribution of *V. renardi* in different distant geographical points, which made it very difficult to detect individuals, we managed to identify new finds. Some help in our search was provided by a survey of local residents who indicated the places of the most frequent encounters with snakes during the haymaking period. We note right away that despite many years of searching in the places indicated in the literature, i.e., in the vicinity of Shamakhi (villages of Hynysly, Yeddi Kyumbez, and Engakharan), not a single individual was found. During the passage of hiking routes (96 km), only one individual was noted in the rocky slope of the Kyz Kalasy fortress (40°3924' N, 48°3714' E, height 845 m) (Fig. 1, 21) and one individual was seen in the vicinity of the village of Chukhuryurd, near a small reservoir (40°4243' N, 48°3620' E, height 1235 m) (Fig. 1, 22). Thus, the density of individuals in the vicinity of the city of Shamakhi currently averages 0.05 ± 0.02 ind./ha, which indicates a sharp decline in abundance. Vipers were not found in the Akhsu (villages of Bidzho, Kangerli, and Noiji), Sheki (villages of Karatala and Ahmedbeyli), or Shemakha (villages of Orta Bulag and Madras) regions, where the territories are mainly developed and transformed into farmland. In

the Ismayilli district, the territories along the valley of the Girdiman River (July 2021) and the rocky slopes in the vicinity of the villages of Baskal, Khankend, and Lagich (transects, 54 km) were studied. In the vicinity of the abandoned village of Khankend, one individual was found in a stone heap (40°4513' N, 48°2526' E, height 925 m) (Fig. 1, 23). A new find was also noted in the Ismayilli district (Fig. 2). On July 31, 2021, one individual was found (40°5335' N, 48°2425' E) at an altitude of 1564 m, on a grassy xerophytic slope, in the vicinity of the village of Koidan (Fig. 1, 24). Thus, transects with a total length of 54 km were surveyed in the Ismayilli region and only two individuals of the viper were found. Therefore, the density is 0.09 ind./ha.

Within the Shemakhi region, this research was also carried out at a higher altitude. In July 2021, in the vicinity of the villages of Demirchi and Shafaly at an altitude of 1520–1600 m a.s.l. in transects with a total area of 32.8 ha (82 km × 4 m), we managed to find two juvenile (40°5034' N, 48°3511' E) and two adult (40°5036' N, 48°3332' E) individuals (Fig. 1, 25, 26). In this area, the density of individuals is 0.12 ± 0.08 ind./ha. The search for the viper continued in August 2021 at an altitude of 1750–1950 m, in the vicinity of the village of Zarat-Khaibar, on summer pastures, rocky slopes, and mountain steppes along the upper reaches of the Pirsaat River. The count of vipers was carried out on transects with a total area of 31.6 ha (79 km × 4 m); six individuals were noted, of which four individuals were found on rocky slopes at an altitude of 1870 m (40°5420' N, 48°3209' E) and

two individuals, at an altitude of 1750 m, among nettle thickets (40°5424' N, 48°3141' E) (Fig. 1, 27, 28). The average density of vipers is 0.2 ± 0.1 ind./ha.

Comparison of population densities of *V. renardi*, distributed at different heights, shows that the density on higher slopes (1700–1950 m a.s.l.) is relatively high (0.1–0.2 ind./ha). The populations of low altitudes (750–950 m a.s.l.) have a low density (0.05–0.9 ind./ha). Perhaps this is due to the weak anthropogenic load and relatively favorable environmental conditions in high-altitude areas. We also noted new finds in the western part of the range. To the west of the city of Shamakhi, territories were explored at an altitude of 700–900 m a.s.l. (vicinity of the villages of Meysari, Madras, Shirvan, Sharadil, and Muganly). On transects with a total length of 119 km at an altitude of 700–900 m a.s.l., three individuals were caught: two, in the vicinity of Muganly (40°3953' N, 48°3138' E, height 852 m a.s.l.) and one, on the Akhsu pass, near the Shemakha Place hotel (40°3741' N, 48°2827' E, height 702 m a.s.l.) (Fig. 1, 29, 30). Therefore, the average density was 0.06 ± 0.02 ind./ha. Concerning the distribution of the steppe viper in these places, there is also an oral report from the employee of the Institute of Zoology, National Academy of Sciences of Azerbaijan, A. Jafarov, who encountered a viper in the vicinity of the village of Muganly.

The places of finds of *V. renardi* indicated in this article show that in Azerbaijan the lower boundary of the range of the steppe viper passes through localities located at an altitude of 650–700 m, and the upper boundary, at an altitude of 1750–1870 m above sea level.

CONCLUSIONS

This study showed that currently within the range of *Vipera renardi* Christoph 1861 in Azerbaijan there is a change in the spatial localization of populations. The range of *V. renardi* in Azerbaijan was previously limited mainly to the territory of the Shamakhi region, in particular, the city of Shamakhi. The localities indicated earlier for the environs of the city of Shamakhi had a relatively high density (0.4–0.5 ind./ha). However, at present the numbers of *V. renardi* in these localities have sharply decreased (0.05 ± 0.02 ind./ha) and the population is on the verge of extinction. The absence of this species in its former localities, in particular, in the lower steppes (50–400 m a.s.l.), may be due to anthropogenic pressure (expansion of vineyards and settlements), which disrupts the landscape and ecological structure of typical habitats. This increased anthropogenic pressure has contributed to a shift in the range of the steppe viper population in the northerly and northeasterly directions along the macroslopes of the Greater Caucasus with higher altitudes. Currently, rocky xerophytic mountain steppes and subalpine meadows at an altitude of 700–1950 m a.s.l. are the most favorable for populations of *V. renardi* in Azerbaijan. These territories are used only as summer

pastures; they are distinguished by the least anthropogenic pressure and a higher quality of the habitat. The density of the viper population in these places is relatively high (on average, 0.1–0.2 ind./ha). However, closer to the lower boundary of the range, the density decreases to 0.06 ind./ha.

(1) The modern range of populations of *Vipera renardi* covering the southern macroslopes of the Greater Caucasus in Azerbaijan has expanded in the northerly and northeasterly directions and is noted in higher areas (up to 1900 m a.s.l.).

(2) The range expansion of *Vipera renardi* in the northeasterly direction, i.e., towards the range of Lotiev's viper (*Vipera lotievi* Nilson et al. 1995) may lead to overlapping and even merging of the ranges of these two related species.

(3) At present, in Azerbaijan, the numbers of the eastern steppe viper (*Vipera renardi*) have decreased and vary, on average, within 0.06–0.2 ind./ha.

(4) It is proposed to include *Vipera renardi* (Christoph 1861), a species with limited distribution and declining numbers, in the Red Book of Azerbaijan with VU protection status.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interest. The authors declare that they have no conflicts of interest.

Statement on the welfare of animals. All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

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