On the Distribution of *Coluber ravergieri* and *Coluber nummifer* in Turkmenistan and the Possible Evolutionary Reasons for their Polymorphism

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Abstract.- In Turkmenistan, *Coluber ravergieri* is found in mesic environments. This species was encountered in mountainous habitats, where there are springs, streams, and small rivers. Along large, permanent rivers that flow into the desert this species penetrates the desert zone. *C. nummifer* is more xerophilous and can tolerate temporary drying-up of riparian habitat, but in Turkmenistan, *C. nummifer* is not found in waterless regions as are typical desert snakes. It has been suggested that the polymorphism found in these two species may be due to mimicry with poisonous snakes. We believe that environmental background matching is the primary function of the coloration in these species and mimicry may only be considered a secondary explanation.

Key words: Reptilia, Squamata, Colubridae, *Coluber ravergieri*, *C. nummifer*, Turkmenistan, polymorphism.

Introduction

Two closely related species of snakes, *Coluber ravergieri* Menetries, 1832 and *Coluber nummifer* Reuss, 1834, were studied in Turkmenistan in Central Asia. The distribution of these snakes after their division (Schätti and Agasian, 1985) in general is known, but however the questions of polymorphisms within the species is of interest. The presence of partial and complete melanism in some individuals of the *ravergieri-nummifer* complex in the Central Asian region raises a special interest. The finding of a specimen similar to the so-called Glazunov's mountain racer (*Coluber ravergieri* morpha *glazunovi*) in the Eastern Kopetdag Mountains and the additional information on the distribution of both species in Turkmenistan serve as a basis for the this paper.

Methods and Materials

Approximately 30 specimens were collected from 1989-1993 throughout Turkmenistan. Scale characters were analyzed on 18 specimens; some of them are kept in the collection of the Institute of Zoology of the Turkmenian Academy of Sciences (IZT), and in the collection of the Caucasian State Biosphere Reserve (CSR), other animals were returned to nature. The characters examined included the number of scales around the middle of the body (Sq.), the number of ventral (Ventr.) and subcaudal (S.cd.) scales as well as gender, coloration and scalation of the head and body. Analysis also included habitat characteristics especially the availability of water and arboreal or shrub vegetation.

Results

Coluber ravergieri was found throughout the Kopetdag region from the Chandyr River Valley in the Kyurendag Mountains in the southwest to the Chaacha River in the east (Fig. 1) and in Badkhyz in the far east of Turkmenistan in the Kizilayak district on the Amu Darya River. Throughout the species range in Turkmenistan, we noted black-headed forms and specimens with the typical contrasting coloration as well as snakes that were only gray in color (Fig. 2-3). It is of special interest that a melanistic specimen was found in the Eastern Kopetdag (IZT, number free, Manysh settlement, Eastern Kopetdag, 04-06-1984, Coll.Ch.Atayev). This large female had a body length (L.) of 730 mm, a tail length (L.cd.) of 225 mm and 21 rows of scales around the middle of the body (Sq.), 199 belly scales (Ventr.), 87+1 ventral tail scales (S.cd.), and 9 upper labial scales (Lab.) on each side of the head. The coloration of the body on the upper side is dark-brown-black (Fig. 4). In side light, there's seen a darker contrasting coloration, typical for *C. ravergieri*. In the front one third of the body, there are 8 transverse light yellow stripes. Separate light-colored scales are present on the dorsal side of the anterior half of the body. The snake is a deep black color from below. On the laryngeal part of the belly there are yellow spots and separate light spots are on ventral scales to scale #47 inclusive (figs. 5-7). Situated very

Figure 1. The distribution of *Coluber ravergieri* and *Coluber nummifer* in Turkmenistan: 1. *C. ravergieri*; 2. *C. nummifer*. Coluber ravergieri: 1. Danata Village, Kyurendag Ridge (IZT, Coll. Atayev); 2. Ack Village,Chandyr River, Southwestern Kopetdag Mountains (IZT, 10.10.1990; Coll. Atayev); 3. Sayvan Village, Western Kopetdag (IZT, 10.10.1990; Coll. Atayev and CBR, No. 450-452.05.1992; Coll. Tuniyev); 4. Tretiy Birleshik Village, vicinity of Geoktepe settlement (IZT, 03.10.1966; Coll. Atayev); 6. Phiryuza Canyon, Central Kopetdag (IZT, Coll. Atayev); 7. Keltechinar River (IZT, Coll. Atayev); Gamy Village (IZT, 1977; Coll. Atayev); 8. Anau Village (IZT, 27.09.1970; Coll. Atayev); 9. Yablonevka Village (Khomustenko, 1985); 10. Manysh Village, Eastern Kopetdag (IZT, 04.06.1984; Coll. Atayev); 11. Kharchinnan River, Eastern Kopetdag; 12. Laensuv River, Khiveabad Village; 13. Chaacha River (CBR, No. 447-448, 04.1992. Coll. Tuniyev); 14. Khatab Village, Kizilayak region (IZT, 03.05.1977. Coll. Atayev).

Coluber nummifer: 1. Tashauz, Tahtynsky region (IZT, 1970, Coll. Annayev); 2. Keltechinar River (IZT, Coll. Atayev); 3. Kugitang Mountains, Svintzovy Rudnik (IZT, 1981, Coll. Zakharova).

near to Eastern Kopetdag. The presence of melanistic forms of *C. ravergieri* in the Eastern Kopetdag and the western part of Pamiro Alaj underlines the faunistic originality of this sector of Kopetdag mountains.

The polymorphism of the species *C. ravergieri-nummifer* complex is of evolutionary interest and has become a classical example of Batesian mimicry in the literature. The similarity to Viperids was described for different parts of distribution. Lantz (1916) noted the likeness of young *Zamenis ravergieri* coloration with that of adders. In spite of this, Lantz underlines that the behavioral mimicry in young *C. ravergieri* is persistent and when in danger instead of fleeing they coil up in a spiral, thickening neck and especially the back side of the head, hiss for a long time, furiously attacking. Werner (1983) points out the similarity of *C. nummifer* and *Vipera palaestina* in Israel. Schätti and Agasian (1985) describe the mimicry of *C. ravergieri* and *C. nummifer* with *Vipera lebetina*, *V. palaestina*, *V. xanthina* and with *Agkistrodon halys intermedius*. The presence of black-headed specimens in Central Asian connect it with *Boiga trigonatum* (*melanocephala*) and *Naja naja* dwelling there.

In fact, we noted the similarity of these mountain racers with adder snakes in some regions of the former Soviet Union. In Armenia, in the Khosrov Reserve male of *C. ravergieri* were observed with zig zag dorsal patterns similar to *Vipera raddei*. In Razdan Canyon near Erevan (the village of Zovuni), we observed *C. nummifer* similar in appearance to

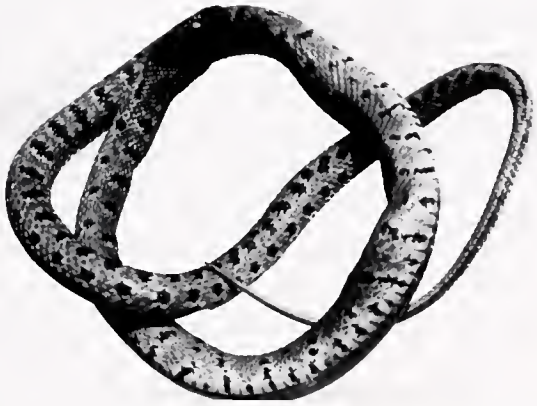

Figure 2. A blackheaded specimen of Coluber ravergieri with a contrasting coloration of the body (IZT, Keltechinar River, 1990; Coll. Atayev).

Figure 3. An uniform grey specimen of C. ravergieri with an unclear picture of the back side of the body and tail (IZT, village Sayvan, 1990; Coll. Atayev)

Figure 4. A melanistic specimen of *C. ravergieri* (IZT, Eastern Kopetdag, village Manysh, 04.06.1984; Coll. Atayev): general view from above.

Figure 5. A melanistic specimen of *C. ravergieri* (IZT, Manysh Village): general view from below.

Figure 6. The head and anterior part of the body of melanistic specimen of *C. ravergieri* from above (IZT, Manysh Village).

Figure 7. The head and the anterior part of the body of C. ravergieri, melanistic specimen from below (IZT, Manysh Village).

Figure 8. A young specimen of *Coluber nummifer* (IZT, Kugitang Mountains, 1981; Coll. Zakharova).

subadult *V. lebetina obtusa*, and this similarity extended to this species behavioral threat response. In Central Asian, young *C. nummifer* (Fig. 8) look like young *V. lebetina* (*turanica/chernovi*), but *C. ravergieri* may be only remotely similar to *Boiga trigonatum melanocephala*.

The problems of snake mimicry, including *C. ravergieri-nummifer*, have been considered by Werner (1983a, 1983b, 1984, 1986). Beside the likeness in coloration, Werner discusses the matters of behavior, triangular shape of the head of Colubrid snakes in Israel, postulating Batesian or Mullerian mimicry. The similarity of *C. nummifer* and *C. ravergieri* with venomous snakes in Central Asia is intriguing, especially if the ranges of the models and mimics are considered. Werner's (1983b) explanation that the evolution of protective coloration by all snakes in the area is a precursor to mimicry applies here. Earlier Lantz proposed (1916) that reptiles tend to match dominant environmental color. Sweet (1985) in analyzing the possible Batesian mimicry in *Pituophis melanoleucus* and *Crotalus viridis*, pointed out that phenotypic similarity in these two species may be a result of cryptic adaptation and not selection for mimicry or only additive because the importance of mimicry varies geographically.

In fact, the diurnal snakes of Turkmenistan (excluding the burrowing species or the species with limited surface activity; *Typhlops*, *Eryx*, *Eirenis*) are remarkably similar in appearance as are the nocturnal species similar to each other. The diurnal snakes (*Vipera lebetina*, *Coluber ravergieri*, *C. nummifer*, *Agkistrodon halis caucasicus*) distributed in the mountains and foothills are of gray to brown, rusty colors with black or dark-brown elements forming spots or a zig zag pattern. In more mesic areas of the mountains (mainly in the upper elevations), snakes are bright with contrasting colors, and in dry, bare foothills they are monochrome generally the color of burnt soil.

The nocturnal species (*Echis multisquamatus*, *Boiga trigonatum*, *Spalerosophis diadema*, *Lytorhynchus ridgewayi*) are characterized by contrasting coloration or with transverse light (almost white) stripes located in an irregular manner. The latter resembles burnt grass or brush and twigs, typical habitat where these snakes occur. The nocturnal species tend to be slow and sluggish in behavior.

We observed the triangular head shape described by Werner in *V. Lebetina* and *Naja oxiana* as well as other venomous snakes which we have observed in nature (Vipera *kaznakovi*, *V. dinniki*, *V. ursinii*, *V. aspis*, and *Agkistrodon halis*). When threatened these venomous snakes first try to hide and then take a defensive position characteristic for this species only if it is necessary. We can noted similar behavior for Colubrid snakes independent of coloration. We observed the triangular head shape character in Turkmenistan in 20 specimens of *C. rhodorhachis* not taking into account whether they were red-stripe animals (*forma typica*) or cross-banded snakes (*forma ladacensis*). We also observed triangular head shape in *C. karelini*, *C. atayevi*, *Boiga trigonatum*, and *Spalerosophis diadema*.

Triangular head shape, coiling, hissing and striking as well as protective coloration are the mechanisms for avoiding predation. However, in specialized snake predators such as *Circaëtus gallicus* attack is stimulated by the snake form, irrespective of the coloration and the shape of the head. One pair of *C. gallicus* on the Badkhyz Reserve eats about 1800 *V. lebetina* in one summer (pers. comm. L. Simakin).

In the case of the *C. ravergieri-nummifer* complex polymorphism (and other colubrid species of Turkmenistan) we believe that environmental background matching is the primary function of this coloration for diurnal snakes. And mimicry may only be considered as a secondary explanation. The presence of melanistic specimens of *C. ravergieri* in the mountains of Pamiro Alaj and the Eastern Kopetdag may be related to adaptive thermoregulation and these higher, cooler locations. The black-headedness of *C. ravergieri* in the Central Asia may be interpreted as a rudimentary state of ancestral melanistic coloration and it can also carry a more subtle physiological meaning as for example being a sensing element of daily and seasonal temperature changes. The black-headedness can increase the role of pineal complex as a sensing element of solar radiation (Ralph et al, 1979) and in controlling the thermoregulatory behavior. It was also

noted that the head of black-headed forms of *C. ravergieri* emerging of holes were difficult to see in the shadow of the hole.

Appendix I

Physical and pholidotic characters of Coluber ravergieri from Turkmenistan.

Location	Ventr.	S.cd.	Sq.	Sex	Specimen location
Khatab Village, Amu Darya River	217	90	21	M	IZT
Anau Village, Eastern Kopetdag	201	92	21	M	IZT
Keltechinar River, Eastern Kopetdag	198	92	21	M	IZT
Keltechinar River, Eastern Kopetdag	198	88	21	M	IZT
Ack Village, Western Kopetdag	192	87	21	M	CBR, N 453
Sayvan Village, Western Kopetdag	200	89	21	M	CBR, N 450
Turkmenistan	201.1 (192-217)	89.7 (87-92)	21	MM	Our data
Turkmenistan	198.8 (194-206)	88.0 (86-90)	21	MM	Schätti & Agasian, 1985
Keltechinar River, Eastern Kopetdag	212	84	21	F	
Keltechinar River, Eastern Kopetdag	221	84	21	F	
Chaacha River, Eastern Kopetdag	208	84	21	F	CBR, N 447
Chaacha River, Eastern Kopetdag	217	84	21	F	CBR, N 448
Chandyr River, Western Kopetdag	199	90	21	F	CBR, N 449
Sayvan Village, Western Kopetdag	206	72	21	F	CBR, N 451
Western Kopetdag, Sayvan village	203	81	21	F	CBR, N 452
Turkmenistan	209.4 (199-221)	82.7 (72-90)	21	FF	Our data
Turkmenistan	211.0 (207-216)	84.5 (82-87)	21	FF	Schätti & Ahasian, 1985

Appendix II

Scale characters of Coluber nummifer from Turkmenistan

Location	Ventr.	S. cd.	Sq.	Sex	Specimen location
Kugitang, Svintsovyi rudnik	208	102	23 (17)	M	IZT
Tashauz	210	94	23 (15)	M	IZT
E. Kopetdag, Keltchinar R.	205	90	23 (17)	M	Our data
Turkmenistan	207.7 (205-210)	95.3 (90-102)	23 (15) 17	MM	Our data
Turkmenistan	205.6 (200-211)	98.0 (93-103)	23 (17) 15	MM	Schätti & Agasian, 1985
Kugitang	217	96	23 (17)	F	IZT
Central Kopetdag	216	98	23 (17)	F	IZT
Turkmenistan	215.3 (214-217)	100.0 (97-103)	23 (17) 15	FF	Schätti & Agasian, 1985

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