

## Taxonomic Notes on Pakistani Snakes of the *Coluber karelini-rhodorachis-ventromaculatus* Species Complex: A New Approach to the Problem

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**Abstract.** -Taxonomic characters used for definition of Pakistani species of *Coluber* snakes are analyzed and discussed. New combinations of characters are used to devise a key for identification of Pakistani snakes of the genus *Coluber*. Zoogeographical distribution is discussed.

**Key words:** Taxonomy, *Coluber karelini-rhodorachis-ventromaculatus* species complex, Pakistan.

### Introduction

The taxonomic status of Pakistani racers belonging to the genus *Coluber* (*C. ventromaculatus* Gray and Hardwicke 1834, *C. karelini* Brandt 1838 and *C. rhodorachis*) Jan 1865, has long remained enigmatic to herpetologists (Minton, 1966; Mertens, 1969; Khan 1982). Despite the problematic taxonomy of *C. ravergieri* in the circum-Mediterranean region (Boulenger, 1893; F. Werner, 1905; Mertens, 1952; Baran, 1976; Bannikov et al., 1977; Schatti and Agasian, 1985), it is readily differentiated from its Pakistani congeners by 21 midbody scale rows (Khan, 1982). However, *C. karelini*, *C. rhodorachis* and *C. ventromaculatus*, due to their dubious color variations and overlapping scale counts, have always posed taxonomic problems to the herpetologists working in Middle East and southeast Asia (Clark et al., 1969; Leviton, 1959; Leviton and S. Anderson, 1969, 1970; Minton, 1966; Mertens, 1969; Haas and Y. Werner, 1969; Khan, 1977, 1982; Latifi, 1991; Tiedemann, 1991; Leviton et al., 1992).

The present work has been undertaken to assess the validity of various morphological characters which have usually been used to define these colubrid taxa. New combinations of readily observable morphological characters are suggested for identification of these species, gathered from the material coming from different parts of Pakistan and Azad Kashmir.

### Materials and Methods

For this study a total of 27 *C. karelini*, 92 *C. rhodorachis* and 142 *C. ventromaculatus*, from different parts of Pakistan and Azad Kashmir, were available. States of the following morphological characters, usually used in the taxonomic determination of these snakes, were recorded for each species: i. Measurements: total length (from anterior tip of snout to the posterior

tip of tail); body or snout-vent length (from anterior tip of snout to anterior lip of anal aperture); tail length (from posterior lip of anal aperture to the tip of tail); head length (from anterior tip of snout to posterior margin of the last supralabial); head width (at the level of last supralabials across head), were recorded to the nearest 0.1 mm. ii. Snakes under 500 mm total length are taken as juveniles, up to 750 mm subadults, and above, adults. iii. Scutellation: number of scale rows at midbody and just anterior to vent were counted on both sides of the same ventral; pre- and postsuboculars lie below the level of eye; first broader than long scale in the gular region was counted as the first ventral, and the preanal scale is not counted. iv. Color pattern: For description of dorsal body pattern, formed by the deposition of sooty pigment, Fig. 11 and 1A (Peters, 1964) and Fig. 27 (Khan, 1993a) were followed. v. For hemipeneal study three *Coluber ventromaculatus*, one *C. rhodorachis* are available with fully everted hemipenes. However, for additional comparative material for these species and for *C. karelini*, the technique suggested by Pesantes (1994) was used to evert the organ of preserved specimens. Description of the organ follows Dowling and Savage (1960) and Khan (1993b).

### Characteristics of Pakistani *Coluber* snakes

Long, narrow, cylindrical body with distinct elongated head, long tail with very gradual taper with a fine tip. Head with large, symmetrically arranged scales; rostral strongly hollowed underneath, a pair of internasals and prefrontals; single supraorbital and frontal, a pair of parietals, single loreal, 1-2 pre- and postoculars, 1-2 pre- and postsubocular, upper preocular in contact with frontal; 9 supralabials, 1-2 in contact with eye; frontal broad, elongated, parietals broad and elongated; temporals 2+3 or 3+3. Genials 2, posterior longer, separated from each other by small scales;

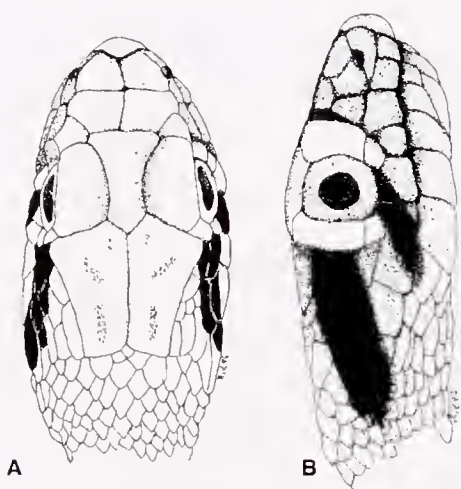


Figure 1. *Coluber karelini*. A. Dorsal head scales; B. Lateral head scales.

eyes large, with distinct round pupil. Snout projecting, distinct canthus, a pair of nasals. Body scales smooth, 19-21 at midbody, reduced to 11-13 at vent, anal divided; ventrals rounded, ranging 192-277; subcaudals paired, ranging 82-145; hemipenis is simple with single sulcus spermaticus, distal portion calyculate, proximally spinose, spines enlarged.

### Evaluation of Characters used in *Coluber* taxonomy

Various morphological characters have been used in different combinations for Taxonomic determination of Pakistani *Coluber* racers. In the following section these characters are examined in the light of the data collected from present collections:

i. *Circumocular scales*: Basic circumocular scalation consists of one supraocular, one preocular and two postoculars. Usually one supralabial, the fifth, touches orbit in *C. karelini* (Fig. 1b), while two supralabials, 5th and 6th (rarely 4th and 5th) touch the orbit in both *C. rhodorachis* and *C. ventromaculatus*. Circumocular conditions are complicated by the appearance of a presubocular or a postsubocular scale preventing either 4th or 5th, rarely 6th supraocular to come in contact with orbit, so that one, two, three, or none of the supralabials comes in contact with orbit and conditions like that seen in *C. karelini* may appear in *C. rhodorachis* and *C. ventromaculatus* (Bannikov et al., 1977; Gasperetti, 1988). Rarely, presubocular and postsubocular are fragmented in 3-4 scales at loreal and postocular region.

Table 1 summarizes different circumocular states observed in the present collection: in 97% *C. karelini* 5th supralabial is in contact with orbit on both sides,

Table 1. Variations in circumocular scutellation of Pakistani colubrid snakes: (1= *C. karelini*; 2= *C. rhodorachis*; 3= *C. ventromaculatus*. Note: figures with oblique represent bilateral configurations, while those in parentheses represent number of specimens of each species present in present collection).

Number of supralabials in contact with eye	1 (27)	2 (92)	3 (142)
4, 5	—	2	8
5	25	3	5
5/5, 6	2	7	3
5, 6	—	68	103
4, 5, 6	—	3	7
4, 5, 6/5, 6	—	5	5
Damaged, not included	2	4	11

3% have 5th on one side and 5th and 6th on the other, one specimen has none in contact on one side, one on the other. More variation is observed in *C. rhodorachis* and in *C. ventromaculatus*.

ii. *Number of ventrals and subcaudals*: Ventral and subcaudal counts overlap in these snakes; however, *C. rhodorachis* is recognized due to its high subcaudal counts (139-144), well above range of *C. karelini* and *C. ventromaculatus*. To make ventral and subcaudal counts taxonomically more meaningful, Mertens (1969) and Leviton (1986) computed ventrals together with subcaudals to single out *C. rhodorachis*, where low ventral counts for this species may overlap high counts for the other two species (Table 2).

iii. *Number of dorsals anterior to vent*: Nineteen midbody scale rows, in *C. karelini* and *C. ventromaculatus*, are reduced to 13 just anterior to vent and 10-13 in *C. rhodorachis*. A clear distinction between these taxa, on this basis, is not possible.

iv. *Loreal scale*: Shape of loreal scale has been considered a taxonomically important character (Smith, 1943; Khalaf, 1959). In *C. karelini* the loreal scale is almost squarish to triangular (Fig. 1b), while in *C. rhodorachis* and *C. ventromaculatus* it is usually longer than high, rarely squarish.

v. *Hemipenial morphology*: Typically, the hemipenis is a simple single-lobed cylindrical organ, with a

Table 2. Range of ventral (V) and subcaudal (Scd) counts in *Coluber* species in present collection.

Taxon	V	Scd	V+Scd
<i>C. karelini</i>	192-207	90-11	282-317
<i>C. rhodorachis</i>	205-277	139-144	344-421
<i>C. ventromaculatus</i>	195-220	82-119	277-339

Table 3. Distribution of sex in a collection of *C. karelini*, *C. rhodorachis*, and *C. ventromaculatus* from Pakistan.

Sex	<i>C. karelini</i>	<i>C. rhodorachis</i>	<i>C. ventromaculatus</i>
Sample size	27	92	142
Males	15	73	95
Females	6	13	32
Undetermined:			
Juveniles	3	4	5
Damaged	3	2	10

median sulcus spermaticus. Distally, the organ is calyculated with deeply scalloped cups fringed with spines, while the proximal portion is spinose with several rows of large proximally curved spines extending to the organ's base, with several transverse rows of much smaller scales at the middle. In *C. karelini* the calyculated part is more extended, and cups are much longer than broad, more deeply scalloped, and are fringed with much longer spines. The proximal spiny half of the organ merges abruptly into the distal calyculated half. On the other hand, cups in *C. rhodorachis* and *C. ventromaculatus* are shallower, squarish, fringed with smaller spines and the proximal spiny portion gradually merges with the scalloped distal part through spines, which gradually decrease in size.

Males predominate in our collections of these snakes from Pakistan (Table 3).

vi. *Extension of rostral scale*: The dorsal part of the rostral scale is more acutely pointed behind and raised in *C. ventromaculatus*, and extends between internasal scales to almost 1/4 of the internasal suture, while in *C. karelini* and *C. rhodorachis* it is not raised and is broadly rounded off, just touching the internasal suture (Fig. 1a).

vii. *Number of temporals*: Usually the temporal formula for these snakes is 2+3+3, however, 1+2+3,

2+2+3 and 1+3+3 temporal counts unilaterally or bilaterally are recorded in all the species.

viii. *Dorsal body pattern*: There is no marked difference between adult and juvenile patterns in *C. karelini* and *C. ventromaculatus* except size of spots and blotches; however, adult/juvenile differences are quite marked in *C. rhodorachis*.

The head of *C. karelini* is relatively light in color, with slight darkening of supralabials and internasals, while the head of *C. rhodorachis* is more melanistic and dark mottling is not discernible. The head of *C. ventromaculatus* is lighter with distinct dark-brown mottlings at the supralabials, frontal and parietals. The suboculo-labial and a postoculo-temporal stripe is vividly marked in *C. karelini* (Fig. 1A, B), hardly discernible in *C. rhodorachis* and well marked in *C. ventromaculatus*.

Grayish, pale-gray, buff, sandy, pale, reddish-brown, brownish and greenish body hues have been reported for these snakes by different herpetologists. The basic body color is due to the deposition of minute dots of different colors, to which additional sooty-black pigment is deposited in three specific patterns (Khan, 1993a).

In *C. karelini* the sooty pigment is uniformly deposited on the whole scale, resulting in the vivid dorsal pattern in this snake. It consists of a median



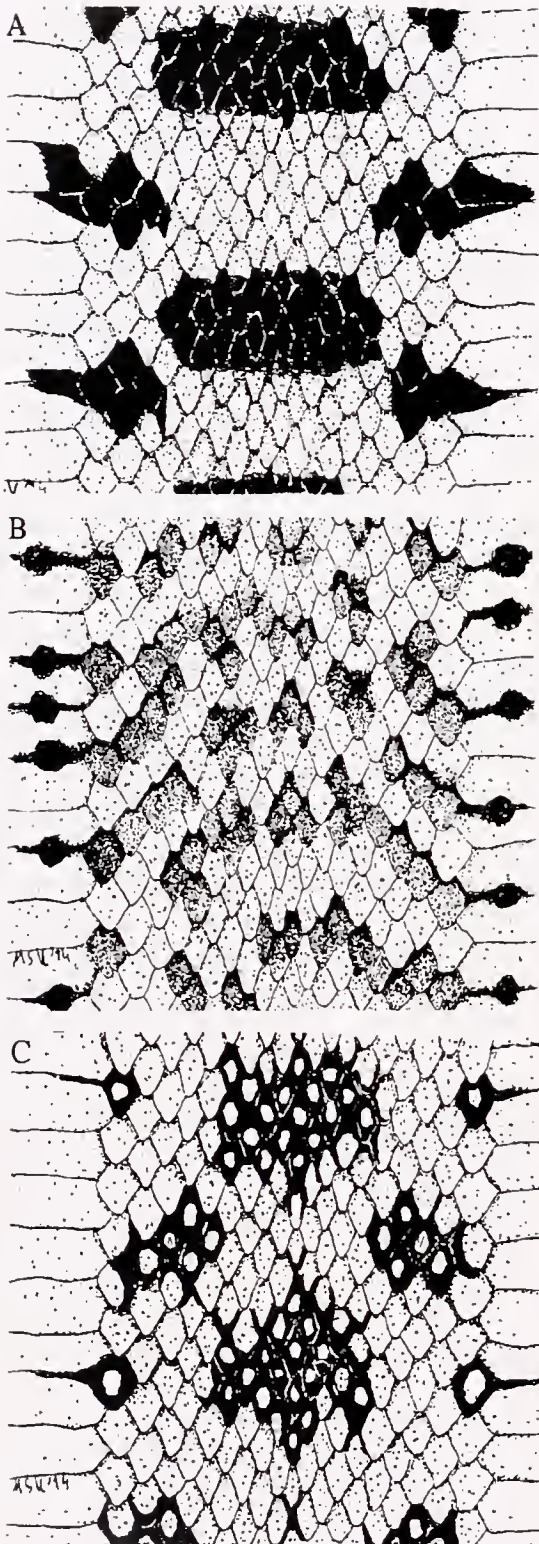


Figure 2. Pigmentation of dorsal pattern. A. *Coluber karelini*; B. *Coluber rhodorachis*; C. *Coluber ventromaculatus*



Figure 3. *Coluber karelini*



Figure 4. *Coluber rhodorachis*



Figure 5. *Coluber ventromaculatus*

row of vivid sooty-black transverse bars extending from nape to base of tail. In the anterior half of the body, the bars are 2-3 scales thick, narrower than interspaces, occupying 10-11 median rows of dorsals, alternating with a transversely enlarged lateral row of spots, the bases of which touch tips of adjacent ventrals (Fig.2A). Ventrums are spotless ivory.

In *C. ventromaculatus* the fine dark brown dots are uniformly deposited on the scales, more densely on scales of dorsal pattern while sooty pigment is rare. A median row of squarish or rectangular blotches or sad-

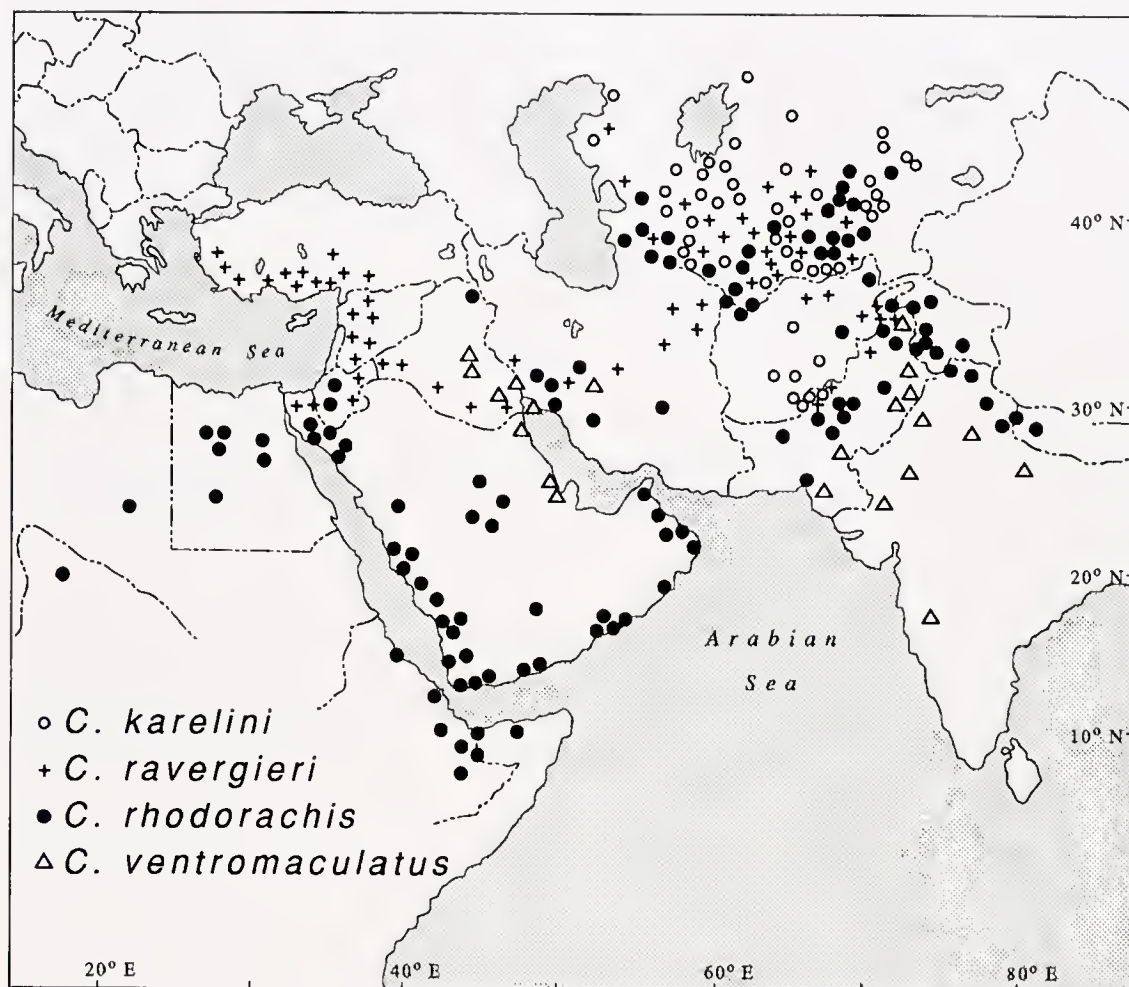


Figure 6. Geographic distribution of *Coluber ravergeri* (+), *Coluber karelini* (o), *Coluber rhodorachis* (●), *Coluber ventromaculatus* (Δ)

dles is characteristic of this species. The blotches are broader than interspaces, occupying 8-9 median dorsal scale rows, alternating with a pair of lateral rows of spots, the outermost row is just of dark specks which occasionally touch edges of corresponding ventrals. Here the sooty pigment is deposited on the periphery of the scales, leaving their centers clear, resulting in a dull pattern (Fig. 2C). A distinct 6-9-scale long, 2-4-scale thick nuchal blotch or stripe is characteristic of this species, this mark generally flanked by a large blotch on temporals. In specimens from the Middle East, the nuchal stripe is long and thin, occupying half scales of the median dorsal pair of scales. Ventrums are ivory white, with occasional lateral spots on ventrals.

In juvenile *C. rhodorachis*, the anterior half of the body is lighter with distinct 4-5 alternating rows of dark irregular blotches or spots, replaced in the poste-

rior, darker half by a mosaic of close-set vertical narrow, dark streaks. The streaked pattern is due to a concentration of pigment between adjacent rows of scales, creating a light/dark zigzag mosaic pattern (Fig. 2B), ventrum melanistic, due to deposition of pigment between ventrals.

Adult *C. rhodorachis* are more melanistic anteriorly, while the posterior half, which appeared darker in juveniles, now appears lighter. Juvenile spotted pattern is either lost altogether in darker adult specimens as is usual in snakes from Kashmir (Khan, unpublished data; Murthy and Sherma, 1976; 1979), or is replaced by fine light/dark streaked mosaic pattern as in snakes from Baluchistan (Mertens, 1969, Fig. 17). Ventrals, in adults, are ivory, except for occasional lateral spottings.

ix. *Geographical distribution* (Fig. 6): Racers are nocturnal, alert and shy snakes. They generally prefer



open semidesert country with sparse grass and scrubby vegetation. They are widely distributed from Transcaspia to Transcaucasia in the north, to the African Sahara in the west, extending in the east to Kashmir and Nepal, and descending through the Indo-Gangetic plains into the Indian peninsula in the south.

*Coluber ravergieri* is a wide-ranging Central Asian species, extending from the Turanian Plateau to the Anatolian highlands in the west, through Turkey, Israel, Jordan, northern Egypt, Iraq, Iran, and Afghanistan. It reaches the western border of Pakistan at its eastern limit of distribution.

*Coluber karelini* is widely distributed in the Middle East, from the Turanian Plateau to the Kazakh uplands in the north, entering Afghanistan, and extending south to the low hills of the Quetta-Pishin area in Baluchistan (Khan, 1980, 1987).

*Coluber rhodorachis* is the most wide-ranging Saharo-Sindian racer, extending from Algeria to the western and northwestern highlands of Pakistan through Egypt, Ethiopia, Arabian Peninsula, Iraq, Kuwait, Iran, and extending northwards to the Aralo-Caspian region and Afghanistan. In Pakistan it is widely distributed in Baluchistan to the Makran coast, extending through Waziristan into the Siwaliks in Kashmir, Utter Pardesh, India to Nepal.

*Coluber ventromaculatus* is primarily an Indian species. It is widely distributed in the Indo-Gangetic plains and does not extend west of the Indus. I regard all reports of this snake from Iran and Iraq as pertaining to local races of *C. rhodorachis* with low ventral and subcaudal counts.

*Coluber karelini*, *C. ravergieri*, and *C. rhodorachis* are sympatric in most of their northern Caucaso-Turanian and Afghanistan range. However, in the Saharo-Sindian belt *C. ravergieri* is primarily a northern species, while *C. rhodorachis* is a southern form extending to northern Somalia. In Pakistan *C. karelini* is sympatric with *C. ravergieri* and *C. rhodorachis* in western Baluchistan, while *C. ventromaculatus* is in sympatry with *C. rhodorachis* in northern, northwestern and coastal foothills (Fig. 6).

## Diagnoses of Pakistani species of *Coluber*

### *Coluber ravergieri* Ménétériés, 1832

#### Diagnosis:

- i. Midbody scale rows 21, reduction to 15 just anterior to vent.
- ii. Dorsum buff or grayish with a dorsal series of dark rhomboidal spots or narrow cross-bars alternating with a series of smaller spots on sides.

iii. Temporals 3+3.

iv. Ventrals 197-234, subcaudals 82-101.

**Distribution in Pakistan (Figure 6):** Central Asian; reaches western Baluchistan and northwestern hills in N.W.F.P., collected at 3,000 to 5,000 m elevation.

### *Coluber karelini* Brandt, 1838 (Figures 2A, 3)

#### Diagnosis:

- i. Midbody scale rows 19, reduction to 12-13 just anterior to vent.
- ii. Vivid sooty pigment is uniformly deposited on scales of the dorsal pattern (Fig. 2A).
- iii. Dorsal pattern vivid, consisting of a median row of black crossbars, narrower than interspaces, alternating with a lateral row of spots touching ventrals.
- iv. Vivid oculo-labial and oculo-temporal stripes always present.
- v. Almost always 5th (rarely 6th or 5th, 6th, or none) supralabial in contact with orbit.
- vi. Ventrals 192-207, subcaudals 90-110.

**Distribution in Pakistan (Fig. 6):** From Transcaspia to low hills of Quetta-Peshin area, at an elevation of 1600-1840 m; does not extend eastward into Sind and Punjab.

**Remarks:** Often *C. rhodorachis* is confused with this taxon due to occasional occurrence of *C. rhodorachis* with one supralabial in orbit and dorsal row of lighter cross bars. Specimens are illustrated by Gasperetti (1988, Fig. 29) from Afghanistan and Nushki (Baluchistan); specimens from this region have neither dorsal pattern nor orbito-labial and temporal stripes as vivid as observed in *C. karelini* from Quetta-Peshin, Baluchistan. Mertens (1969) erected his *C. karelini mintonorum* on similar *C. rhodorachis* from the Baluchistan highland. In southern Turkmenistan, *C. karelini* is known to hybridize with *C. rhodorachis* (Bannikov et al., 1977).

### *Coluber rhodorachis* Jan, 1865 (Figures 2B, 4)

#### Diagnosis:

- i. Midbody scale counts 19, reduced to 11-13 at the level of vent.
- ii. Colored dots are uniformly deposited on dorsal scales, while the dorsal pattern is formed by concentration of colored dots, however, melanicity of older snakes is due to additional deposition of sooty pigment (Fig. 2B).
- iii. Juvenile pattern is of spots on anterior part of body, unicolor or streaked posteriorly; venter melanistic. Adults become melanistic anteriorly, losing spots, sometimes having fine, streaked pattern anteriorly and

are unicolor posteriorly. Venter ivory, with sides of ventrals darkly smudged.

iv. Usually two, 5th and 6th (rarely 4th and 5th or 5th or three, 4th, 5th, and 6th) supralabials touching orbit.

v. Ventrals 205-277, subcaudals 139-144.

vi. Distinct oculo-labial stripe, indistinct oculo-temporal stripe.

**Distribution in Pakistan (Figure 6):** Widely distributed in Baluchistan, western and northern sub-Himalayan (N.W.F.P.) highland and inland low ranges (Punjab and Sind). From sea level (along Makran coast) to about 2300 m. It does not extend onto plains.

**Remarks:** Unaware of Jan's (1865) erection of the nominal taxon, J. Anderson (1871) described *Zamnis ladacensis* from Ladakh, Baltistan. Later, he (1895) compared *rhodorachis* with *ladacensis* and found them identical. Despite proven conspecificity, a *rhodorachis* with a median dorsal pinkish-red (Nikolskii, 1916), drab (Corkill and Cochran, 1965), light orange to vermilion (Minton, 1966), red (Mertens, 1969) vertebral line has been regarded as *ladacensis*. The so-called "colored vertebral line" is discernible only in living snakes, as it is soon lost on preservation, especially in formalin. This is why the validity of *ladacensis* as a separate taxon has frequently been questioned (Mertens, 1956; Kramer and Schnurrenberger, 1963; Leviton and S. Anderson, 1961; Kral, 1969; Ataev, 1985).

*Coluber rhodorachis* from southern Israel (F. Werner, 1896, Fig. 2A, B) has more close-set (2 scales wide) transverse stripes which are much broader than interspaces. Leviton et al., (1992, Plate 15) show two color morphs of *C. rhodorachis* from the Arabian peninsula: Fig. C, from Tabuk Emirate, anterior half of body spotted, posterior unicolor; Fig. D, from Taif, Makkah Emirate, is unicolor melanistic, while Fig. E, from Khuzistan Province, Iran, is a banded form, the bands broader than interspaces. Latifi (1991, Plate 16) shows two more color morphs from Iran: Fig. 41 unicolor and Fig. 42 spotted, the spots are more like broken transverse bands. *C. rhodorachis* is known to exhibit high variability of color and pattern throughout its range (Y. Werner, 1971).

***Coluber ventromaculatus* Gray and Hardwicke, 1834 (Figures 2C, 5)**

#### Diagnosis:

i. Midbody scale rows 19, reduced to 13 at level of vent.

ii. The sooty pigment is confined to each scale's periphery in dorsal body pattern (Fig. 2C).

iii. Dorsal pattern consists of a median row of rhombs or saddles, broader than interspaces, alternating with a lateral row of spots, usually touching ventrals.

iv. Two supralabials, 5th and 6th or 4th and 5th, touch orbit.

v. Ventrals 195-220, subcaudals 82-119.

vi. Loreal scale longer than high.

**Distribution in Pakistan:** Plains of Punjab and Sind; rarely extends above 300 m elevation. (Fig. 6).

**Remarks:** This taxon is based on Plate 80, Fig. 1, a, b of Gray and Hardwicke (1834), with only the inscription, "spotted bellied snake *Coluber ventromaculatus*"; no description or type locality is given. The figured snake has approximately 220 ventrals, 70 subcaudals, with a median row of more than 60, 1-2-scale-wide narrow cross bands, replaced on tail by narrow transverse streaks formed of dark edges of lateral scales, distinct orbito-labial and temporal stripes. Figure 1a shows an irregular cross band between the orbits and a few spots on temporals and a distinct median dorsal one-scale-narrow nuchal streak. The lower jaw is shown distinctly countersunk, abnormal for this species.

Schmidt (1939) restricted the type locality to Bengal, since, according to Smith (1931), Hardwicke mostly collected from the region. A comparison with Pakistani snakes of this taxon shows differences in dorsal pattern, which usually consists of 3-4-scale-wide diamonds or saddles, obscure oculo-temporal bar, 2-4-scale-wide nuchal streak always flanked by larger temporal blotches obscuring oculo-temporal streak; pigment is peripherally deposited on scales, head with indistinct dark mottling. However, a pair of snakes from southeastern Thar Pakar, Sind, has a single scale-wide uninterrupted median nuchal streak, running to the midbody, passing through dorsal saddles, while snakes from Punjab and most of Sind have a short, 2-4-scale-wide and 5-6-scale-long streak or blotch, which seldom extends between saddles.

Leviton et al., (1992, Pl. 15) illustrate two snakes as *C. ventromaculatus*: Fig. F, from Sabiya Peninsula, near Kuwait City, with a long narrow nuchal streak and transverse bands, broader than interspaces, and a row of lateral spots, while Fig. H, from Ghizri, Karachi, with indistinct spottings on anterior half of body, is just like snakes mostly from Baluchistan.

*Coluber ventromaculatus* and *C. rhodorachis* sometimes indistinguishably intergrade into each other in appearance, scale counts and dorsal body pattern. For a long time, Russian herpetologists confused *C. rhodorachis* with *C. ventromaculatus* (Nikolskii, 1916; Terentev and Chernov, 1949; Levi-

ton, 1959; Leviton and S. Anderson, 1970), and still this confusion exists (Baran, 1982). I am inclined to believe that all *C. ventromaculatus* reported from west of the Indus (Fig. 6) are actually color morphs of *C. rhodorachis*, and *C. ventromaculatus* does not extend westward beyond the Indus. Reports of this species from Chitral, Dir and Swat (McMahon, 1901a,b), actually pertain to *C. rhodorachis*. Mostly, the confusion between these taxa is created by dorsal pattern figured in the type, Fig. 1, Plate 80 (Gray and Hardwicki, Vol. II, 1834). Famous Indian ophiologist Wall (1923) found no option but to unite *C. ventromaculatus* with *C. rhodorachis* to settle this taxonomic tangle.

### Key to Pakistani Snakes of the Genus *Coluber*

A satisfactory key for identification of Pakistani *Coluber* has long been needed. The following key is based on diagnostic characteristics gathered from the present collection, satisfactorily helping in diagnosis of these taxa (Khan 1993):

**1a.** Midbody scale rows 21; collected from Chitral and northern Baluchistan ..... *C. ravergeri*

**1b.** Midbody scale rows 19 ..... 2

**2a.** Subcaudals 125-144; unicolor, spotty, or with close-set transverse striations; sooty pigment deposited between scales, main dorsal pattern formed by concentration of tiny dots; collected from western and northern highland and Salt Range, Punjab ..... *C. rhodorachis*

..... *C. rhodorachis*

**2b.** Subcaudals 80-120; dorsal pattern of saddles, diamonds, or transverse bars ..... 3

**3a.** One (5th, rarely 6th, or none) supralabial in contact with orbit; dorsal pattern of vivid black transverse bars, narrower than interspaces; sooty pigment deposited uniformly on scales; collected from western Baluchistan ..... *C. karelini*

**3b.** Two (5th and 6th) supralabials in contact with orbit; dorsal pattern a median row of saddles or diamonds, broader than interspaces; sooty pigment deposited on periphery of scales; collected from Punjab and Sind plains ..... *C. ventromaculatus*

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### Appendix I

Snakes for this study were collected from within a radius of 5-10 km around the following localities in Pakistan and Azad Kashmir. Figures in parentheses indicate the number of snakes collected from each locality.

*Coluber ravergeri*: Baluchistan: Boostan (1); Shaddezai (2).

*Coluber karelini*: Baluchistan: Punj Pai (4); Quetta (4); Peshin (6); Boostan (3); Chaman (4); Loi Banda, Zob (4); Muslim Bazar, Zob (2).

*Coluber rhodorachis*: Baluchistan: Punjpai (2); Quetta (3); Peshin (2); Boostan (1); Chaman (2); Loi Banda, Zob (1); Muslim Bazar, Zob (1); Khuzdar (3); Karna, Khuzdar (2); Waddh, Khuzdar (3); Arnachh, Khuzdar (1); Naal, Khuzdar (2); Nushki (1); Kalat (1); Mastung (5).

Northwestern Frontier Province: Wana (1); Tank (1); Bannu (1); Kohat (1); Nowshera (3); Peshawer (4); Mardan (2); Manshera (2); Dadar (1); Abbottabad (2); Ghari Habibullah (2); Swat (2); Kalam (2).

Punjab: Rohtas Fort (2); Islamabad (2); Chattrar (2); Attock (1); Pir peahai (2); Pind Dadan Khan (2); Dandot (1); Khewara (2); Choa Saidan Shah (2).

Sind: Chauki (1); Band Murad Khan (1); Karachi (2); Thatta (1).

Azad Kashmir: Mirpur (1); Bhimbar (2); Dulaih Jattan (1); Kotli (3); Goi Madan (8); Aram Bari (2); Palandri (1), Punch (1); Bagh (1); Muzaffarabad (3).

*Coluber ventromaculatus*: Punjab: Jhelum (2); Lala Musa (1); Gujrat (2); Wazirabad (1); Sialkot (3); Gujranwala (1); Lalian (3); Rabwah (25); Chiniot (14); Sargodha (4); Mianwali (5); Khushab (10); Nurpur (12); Bhakkar (4); Leiah (3); Toba Tek Singh (2); Multan (5); Dera Ghazi Khan (6); Rajanpur (3); Bahawalnagar (3); Fort Marot (2); Rahimyar Khan (4);



Sind: Sukkur (2); Sehwan (3); Larkaa (2); Nawab Shah (3); Dadu (3); Hyderabad (1); Mithi (2); Diplo (3).

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