

The snakes of the genus *Spalerosophis* JAN, 1865 in Indo-Pakistan and Iran (Squamata: Serpentes: Colubridae)

Die Schlangen der Gattung *Spalerosophis* JAN, 1865 in Indo-Pakistan und Iran
(Squamata: Serpentes: Colubridae)

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KURZFASSUNG

Die vorliegende Untersuchung beschäftigt sich mit Fragen zur Systematik bei Arten der Colubridengattung *Spalerosophis* JAN, 1865, insbesondere mit *Spalerosophis atriceps* FISCHER, 1885. Dieses Taxon wird seit langem unter anderem wegen unrichtiger Identifizierung der Typuslokalität von *Spalerosophis diadema* (SCHLEGEL, 1837) kontroversiell beurteilt. Die vorliegenden Untersuchungen weisen darauf hin, daß *atriceps* eine eigenständige Art repräsentiert und *schirazianus* ein Juniorsynonym von *Spalerosophis diadema* darstellt.

ABSTRACT

The present studies aimed to resolve some systematic issues related to species of the colubrid snake genus *Spalerosophis* JAN, 1865. The studies were carried out with particular reference to *Spalerosophis atriceps* FISCHER, 1885 that has been rated controversially since long among other things because of the incorrect identification of the type locality of *Spalerosophis diadema* (SCHLEGEL, 1837). The studies conclude that *atriceps* is an independent species and *schirazianus* is a junior synonym of *Spalerosophis diadema*.

KEY WORDS

Reptilia: Squamata: Serpentes: Colubridae *Spalerosophis*, *Spalerosophis diadema*, *Spalerosophis diadema diadema*, *Spalerosophis diadema schirazianus*, *Spalerosophis atriceps*, *Spalerosophis arenarius*, systematics, taxonomy, Saharo-Sindian faunal element, distribution, Pakistan, Afghanistan, Iran, India

INTRODUCTION

Spalerosophis JAN, 1865 (type species *microlepis*) earlier considered a synonym of *Coluber* (e. g. SMITH 1943) was subsequently resurrected on the basis of fragmentation of certain head shields, particularly prefrontals, circumoculars, loreals and temporals (SCHMIDT 1930; MARX 1959; ANDERSON 1963; MINTON 1966; MERTENS 1969; DAS 1997; BAIG 2001; WHITAKER & CAPTAIN 2004). GASPERETTI (1988) discussed the taxonomic validity of *Spalerosophis* in detail. The genus is also characterized by an undivided anal, ocular ring separating the supralabials from the eye, also in some species the presence of frontonasal(s) (scales between prefrontals and nasals; some authors considered them as prefrontals and mentioned higher number of prefrontals for the genus) and 25-33 (MARX 1959) longitudinal scale rows at mid-body (except *S. microlepis* where there are 41-43). The genus is widely distributed in arid and semiarid regions from

North Africa in the west through Arabia, Iran, Pakistan to central India in the east (MARX 1959; MINTON 1966; MERTENS 1969; GASPERETTI 1988; WHITAKER & CAPTAIN 2004); its Saharo-Sindian range area covers three distinct regions i. e. Afro-Arabia, Irano-Turan and Indo-Pakistan. MARX (1959) gave a detailed account of this genus and identified six taxa (*microlepis*, *arenarius*, *diadema*, *dolichospila*, *cliffordi*, *schiraziana*), the latter three of which were considered subspecies of *Spalerosophis diadema* (SCHLEGEL, 1837). Later on, *Spalerosophis josephscortecchi* LANZA, 1964 was described from Somalia, Africa.

Accordingly, the African and Arabian segment whose zoogeographic affinities are already established in several other studies is occupied by *Spalerosophis diadema cliffordi* (SCHLEGEL, 1837) with limited representation of *S. diadema dolichospila* WERNER, 1924 and *S. josephscortecchi* (MARX

1959; GASPERETTI 1988). In his character table, MARX (1959) referred to populations of *cliffordi* from different countries independently, although in many cases there is no ecological barrier between them. The range given by MARX (1959) for different characteristics ascribed to *cliffordi* is very wide, which calls for a more critical and analytical approach. Secondly, placement of *dolichospila* in the middle of the range area of *cliffordi* (both seem to be allopatric or do not produce intergrades) is apparently inappropriate. GASPERETTI (1988) gave a more detailed account of the distribution of *Spalerosophis*, particularly with reference to the Afro-Arabian component, while his Indo-Pakistan and Iranian distribution data was almost the same as mentioned by MARX (1959). *Spalerosophis josephscortecchi* described from Somalia, an area at the peripheral range of *cliffordi*, has been dealt with at species level (GASPERETTI 1988).

Dolichospila was raised to species level (*S. dolichospilus*) by PASTEUR (1967), a view which later was generally adopted (BONS & GENIEZ 1996; SCHLEICH et al. 1996), while *S. diadema cliffordi* remained fully accepted (GASPERETTI 1988; BONS & GENIEZ 1996; SCHLEICH et al. 1996; BAHA EL DIN 2006).

The Iranian segment represents three taxa, i. e. *S. diadema schirazianus* JAN, 1865), *S. microlepis* and *S. diadema cliffordi* (MARX 1959; GASPERETTI 1988). As was already done by SCHMIDT (1930) and KHALAF

(1959), LATIFI (1985/1991) ranked *cliffordi* at species level (without explanatory statement, however, sympatry with *S. diadema schirazianus* may have been the motivation). *Schirazianus* was treated at species level by SCHMIDT (1930) and KHAN in almost all his papers and books (e. g. 2006), while MINTON (1966), MARX (1959), MERTENS (1969) and LATIFI (1985/1991) ranked it as a subspecies of *diadema*.

The Indo-Pakistan segment is represented by *Spalerosophis arenarius* (BOULENGER, 1890), *S. diadema diadema*, *S. diadema schirazianus* and *S. atriceps* FISCHER, 1885 (MINTON 1966). *Atriceps* was considered a species of its own by MINTON (1966) and a color morph of adult *diadema* by MARX (1959), MERTENS (1969) and KHAN (e. g. 2006). MERTENS (1969) based his conclusion on the analysis of 27 specimens of *S. diadema* from Pakistan and the holotype of *atriceps*.

While the specific status of *arenarius*, *diadema*, *josephscortecchi* and *microlepis* remained undoubted, the hierarchical placement of taxa which at times were ranked as subspecies of *diadema* remained under debate. As to these taxa, MARX (1959), MINTON (1966), MERTENS (1969), PASTEUR (1967) and GASPERETTI (1988) presented material-based analyses; most other authors just reported names, usually without explanatory statement. The taxon *atriceps* was subject to a critical and detailed analysis in the present study.

MATERIALS, RESULTS AND DISCUSSION

Table 1 gives detailed morphometric data of nine specimens belonging to *S. arenarius* (Fig. 1) and 17 specimens of *atriceps* (Figs. 2-6) from different areas of Pakistan. Specimens # PMNH 1617, 1922 and 1923 in the Pakistan Museum of Natural History (Islamabad) collected from the western boundary of Pakistan, adjacent to Afghanistan, were identified as *schirazianus* (Fig. 6). The specimen PMNH 1617, measuring SVL 1095 mm and tail 305 mm, exhibits more than 80 distinct blotches that is the highest count for any Diadem Snake ever studied. The distribution map (Fig. 7) was constructed on the basis of material ex-

amined and information published by MARX (1959), MINTON (1966), ANDERSON & LEVINTON (1969) and GASPERETTI (1991).

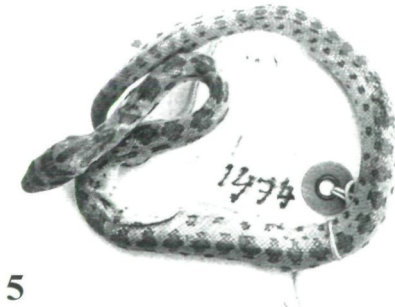
According to SMITH (1943), both *diadema* and *atriceps* occur throughout great parts of northern India but no intermediate has ever been reported. Surprisingly despite several dissimilarities, MARX (1959) did mention *atriceps* but did not consider it an independent taxon, concluding that the "color variety '*atriceps*' is a synonym of *d. diadema*". Several other workers (MERTENS 1969; KHAN 2004, 2006) also regarded it as color mutant of *diadema*. In his field guide to the snakes of India WHITAKER (1978)

Table 1: Morphological data of *Spalerosophis* species found in Pakistan. PMNH - Pakistan Museum of Natural History (Islamabad), dors - dorsals, vent - ventrals, cd - subcaudals, sl - supralabials, il - infralabials, pt - posterior temporals, at - anterior temporals, co - circumoculars, db - dorsal blotches, pf - prefrontals, fn - fronto-nasals, SVL - snout-vent length, TL - tail length, br - broken, tbr - tip broken, icbr - incompletely broken. If left and right counts are different, they were separated by a slash.

Tab. 1: Morphologische Daten der *Spalerosophis*-Arten aus Pakistan. PMNH - Pakistan Museum of Natural History (Islamabad), dors - Dorsalia, vent - Ventralia, cd - Subkaudalia, sl - Supralabialia, il - Infralabialia, pt - hintere Temporalia, at - vordere Temporalia, co - Zirkumokularia, db - Rückenflecken, pf - Präfrontalia, fn - Frontonasalia, SVL - Kopf-Rumpf-Länge, TL - Schwanzlänge, male - Männchen, female - Weibchen, br - abgebrochen, tbr - Spitze abgebrochen, icbr - unvollständig geteilt. Unterschiedliche Zählwerte für rechts und links sind durch Schrägstrich getrennt.

| PMNH | species | sex | dors | vent | cd | sl | il | at | pt | co | db | pf | fn | SVL | TL | SVL/TL | Pakistan localities |
|------|------------------|----------|------|------|--------|-------|-------|-----|-----|------|-----|----|----|------|---------|--------|-----------------------|
| | Art | | | | | | | | | | | | | (mm) | (mm) | | Pakistan. Fundorte |
| 1721 | <i>arenarius</i> | female | 27 | 235 | 78 | 10 | 12 | 4 | 5 | 8 | 58 | 4 | 0 | 1040 | 210 | 5.0 | Cholistan desert |
| 1115 | <i>arenarius</i> | female | 27 | 247 | br | 10 | 12 | 4 | 4 | 9 | 69 | 4 | 0 | 985 | 125 br | - | Cholistan desert |
| 496 | <i>arenarius</i> | female | 26 | 231 | 84 | 10 | 12 | 4 | 4 | 9 | 62 | 4 | 0 | 630 | 140 | 4.5 | DG Khan |
| 1116 | <i>arenarius</i> | female | 26 | 236 | 75 | 10 | 12 | 3 | 4 | 8 | 66 | 4 | 0 | 915 | 180 | 5.1 | Cholistan desert |
| 1449 | <i>arenarius</i> | female | 26 | 230 | 70 | 10 | 12 | 3 | 4 | 8 | - | 4 | 0 | 1065 | 250 | 4.3 | Cholistan desert |
| 1529 | <i>arenarius</i> | male | 25 | 228 | 77 | 11 | 12 | 4 | 5 | 8 | 65 | 3 | 0 | 880 | 190 | 4.6 | Cholistan desert |
| 1530 | <i>arenarius</i> | male | 26 | 247 | br | 10 | 12 | 4 | 4/5 | 8 | 69 | 4 | 0 | 1115 | 135 br | - | Cholistan desert |
| 397 | <i>arenarius</i> | male | 25 | 228 | 86 | 10 | 12 | 4 | 4 | 9 | 55 | 4 | 0 | 680 | 170 | 4.0 | Thar |
| 1133 | <i>arenarius</i> | subadult | 25 | 233 | 75 | 10 | 11 | 4 | 4 | 9 | 54 | 4 | 0 | 360 | 75 | 4.8 | Cholistan desert |
| 1908 | <i>atriceps</i> | subadult | 29 | 240 | 112 | 11 | 13 | 4 | 4 | 8 | 76 | 4 | 1 | 335 | 92 | 3.6 | Chakwal |
| 1909 | <i>atriceps</i> | female | 29 | 238 | 106 | 11/12 | 13 | 4 | 4 | 7/8 | 78 | 3 | 2 | 813 | 257 | 3.2 | Chakwal |
| 1474 | <i>atriceps</i> | subadult | 30 | 251 | 104 | 10 | 12 | 4 | 4/5 | 8 | 72 | 3 | 2 | 332 | 83 | 4.0 | Cholistan desert |
| 253 | <i>atriceps</i> | - | 29 | - | - | 12 | 13 | 5 | 5 | 8 | - | 4 | 2 | - | - | - | Fateh Jang |
| 358 | <i>atriceps</i> | - | 29 | - | - | 11/12 | 13 | 4 | 5 | 8 | - | 4 | 2 | - | - | - | Muzaffarabad, Kashmir |
| 1535 | <i>atriceps</i> | male | 29 | 230 | 100 | 12 | 13 | 4 | 5 | 8 | 55 | 3 | 2 | 760 | 190 | 4.0 | Cholistan desert |
| 1930 | <i>atriceps</i> | male | 29 | 235 | 104 | 11 | 13 | 4 | 5 | 9/10 | 62+ | 3 | 2 | 980 | 298 | 3.3 | Shugran |
| 1726 | <i>atriceps</i> | male | 29 | 241 | 108 | 12 | 13 | 4/5 | 5 | 9/8 | - | 4 | 2 | 1205 | 360 | 3.3 | Cholistan desert |
| 1723 | <i>atriceps</i> | male | 29 | 246 | 102 | 11 | 12 | 5 | 4 | 8 | - | 4 | 2 | 1230 | 315 | 3.9 | Cholistan desert |
| 42 | <i>atriceps</i> | male | 29 | 252 | 107 | 11 | 12 | 4 | 5 | 8 | - | 4 | 2 | 1185 | 335 | 3.5 | Thatta |
| 1460 | <i>atriceps</i> | male | 29 | 247 | 106 | 12 | 13 | 4 | 4 | 8 | - | 4 | 2 | 1320 | 353 | 3.7 | Cholistan desert |
| 1003 | <i>atriceps</i> | male | 29 | 246 | 55 tbr | 11/12 | 12 | 4 | 4 | 8 | - | 3 | 2 | 1095 | 185 tbr | - | Cholistan desert |
| 1001 | <i>atriceps</i> | female | 29 | 250 | 104 | 11 | 13 | 4 | 5 | 8 | - | 4 | 2 | 1415 | 385 | 3.7 | Cholistan desert |
| 1002 | <i>atriceps</i> | female | 29 | 238 | 100 | 11 | 13 | 5 | 5 | 8/9 | - | 4 | 2 | 1360 | 350 | 3.9 | Cholistan desert |
| 1117 | <i>atriceps</i> | female | 29 | 245 | 105 | 10/11 | 13 | 5 | 5 | 9 | - | 4 | 2 | 1255 | 345 | 3.6 | Cholistan desert |
| 1414 | <i>atriceps</i> | male | 29 | 247 | 102 | 11 | 12 | 5 | 5 | 8 | 67 | 4 | 2 | 1385 | 350 | 4.0 | Cholistan desert |
| 1725 | <i>atriceps</i> | male | 29 | 240 | 112 | 11 | 12/13 | 5 | 5 | 8 | - | 4 | 2 | 1185 | 390 | 3.0 | Cholistan desert |
| 1617 | <i>diadema</i> * | - | 29 | 249 | 105 | 11 | 13 | 5 | 5 | 8 | 84 | 5 | 1 | 1095 | 305 | 3.6 | Chitral |
| 1922 | <i>diadema</i> * | subadult | 28 | 246 | 109 | 11 | 10 | 5 | 6 | 8 | 56 | 4 | 2 | 392 | 100 | 3.9 | Karak |
| 1923 | <i>diadema</i> * | subadult | 28 | 255 | 107 | 12 | 13 | 4 | 5 | 8 | 64 | 3 | 2 | 375 | 98 | 3.8 | Karak |

* syn. *schiraziensis*



reported the presence of *S. diadema*, but the figure and description both were that of *atriceps*. He presumably did not consider *atriceps* a valid taxon, but rather a synonym of *S. diadema diadema*. DAS (1997) mentioned about the presence of *S. diadema diadema* but it is not clear whether that referred to *diadema* mentioned by WHITAKER (1978) or *diadema diadema* indicated by SMITH (1943). Subsequently, WHITAKER & CAPTAIN (2004) showed the presence of *S. atriceps* and *S. arenarius* in India but did

not mention anything about *S. diadema*. Unfortunately, no one who compared adequate series of *S. diadema* and *S. atriceps* (e. g. MERTENS 1969) had juveniles of known parentage. MINTON (1966) realized this problem and tried to resolve it, but only to the extent of the Pakistan population. He observed that in most parts of Sind and Las Bela, *atriceps* occurs with the exclusion of *diadema* but is widely sympatric with *arenarius*. On Quetta plateau, MINTON (1966) found *atriceps* sympatric with *schirzianus*.

Figs. 1-6 (opposite page) / Abb. 1-6 (gegenüberliegende Seite)

Fig. 1: Live *Spalerosophis arenarius* (BOULENGER, 1890), PMNH 1115, Cholistan Desert of Pakistan.

Fig. 2: Live *Spalerosophis atriceps* FISCHER, 1885, exhibiting faded blotched pattern, PMNH 1721, Cholistan Desert of Pakistan.

Fig. 3: Moderately melanistic female of *Spalerosophis atriceps* FISCHER, 1885, PMNH 1001, Cholistan Desert of Pakistan.

Fig. 4: Intensely melanistic *Spalerosophis atriceps*, FISCHER, 1885, PMNH 1002, Cholistan Desert of Pakistan.

Fig. 5: Subadult *Spalerosophis atriceps* FISCHER, 1885, PMNH 1474, Cholistan Desert of Pakistan.

Fig. 6: Subadult *Spalerosophis diadema* (SCHLEGEL, 1837) (syn. *schirazianus* JAN, 1865), PMNH 1922, Karak district, Pakistan.

Abb. 1: *Spalerosophis arenarius* (BOULENGER, 1890), lebend; PMNH 1115, Cholistan Wüste, Pakistan.

Abb. 2: *Spalerosophis atriceps* FISCHER, 1885 mit reduziertem Fleckenmuster, lebend; PMNH 1721, Cholistan Wüste, Pakistan.

Abb. 3: *Spalerosophis atriceps* FISCHER, 1885, mäßig verdunkeltes Weibchen; PMNH 1001, Cholistan Wüste, Pakistan.

Abb. 4: *Spalerosophis atriceps*, FISCHER, 1885, stark melanistisches Exemplar; PMNH 1002, Cholistan Wüste, Pakistan.

Abb. 5: *Spalerosophis atriceps* FISCHER, 1885, subadult; PMNH 1474, Cholistan Wüste, Pakistan.

Abb. 6: *Spalerosophis diadema* (SCHLEGEL, 1837) (syn. *schirazianus* JAN, 1865), subadult; PMNH 1922, Karak Distrikt, Pakistan.

BAIG (unpublished data) collected and reported *atriceps* and *arenarius* from the Cholistan Desert of Pakistan. The present study (Table 1) on the collection of *Spalerosophis*, which is presently at the Pakistan Museum of Natural History (PMNH) and has been procured from different areas of Pakistan, unfolds the details associated with these snakes. *Spalerosophis atriceps* when exceeding 1000 mm in snout-vent length gradually loses the blotched pattern and changes into straw yellow color with irregular flecks and blotches (Fig. 2), or any other melanistic form (Figs. 3-4), whereas *schirazianus* (in our opinion a synonym of *S. diadema*) retains its blotched pattern as is evident in PMNH 1617.

Spalerosophis diadema was described as *Coluber diadema* H. SCHLEGEL, 1837 - Essai sur la physiologie des serpens 2: 148. The type is based on RUSSELL's plate (1801: 34; Pl. XXX), type locality not explicitly specified in the original work of RUSSELL. Subsequently, mention of the type locality for *diadema* is stated as 'pris dans les environs de Bombay, mais RUSSEL suppose que l'espèce habite aussi le pays des Marrattes' (SCHLEGEL 1837: 148) and 'Buchier, in the environs of Bombay' (MINTON 1966; MARX 1959). MINTON (1966) and other workers failed to identify such locality near Bombay.

WALL (1914) also ruled out the possibility of finding *diadema* near Bombay. A locality with similar spelling is "Bushire" on the Persian Gulf (MINTON 1966). Bushire in fact belongs to the range area of *S. diadema schirazianus* that was described more than 25 years after the description of *S. diadema*. Indraneil DAS (Institute of Biodiversity and Environmental Conservation, University of Malaysia, Sarawak) on author's request (personal communication), regarding the presence of 'Buchier' in India, confirmed the absence of such locality in India. He (DAS) enquired from Van WALLACH (Museum of Comparative Zoology, Harvard University, Cambridge, MA), who says that RUSSELL (1801: 35) states that his two specimens "were received from Dr. SCOTT, of Bombay, sent to him from Buchier, by Mr. BRUCE". Since the collection was sent from India, it lead to the assumption that 'Buchier' was in India. In fact Bushire, the type locality of *diadema* is in Iran (28°58'30"N 50°50'17"E) and not in India, a view which was already proposed by MINTON (1966: 126, footnote). In this case it is now apparent that *S. diadema schirazianus*, which shares many characteristics with *diadema diadema*, as a matter of fact, is a junior synonym of *diadema*, and all previous records ascribed to *schirazianus* may be assigned to the nominate

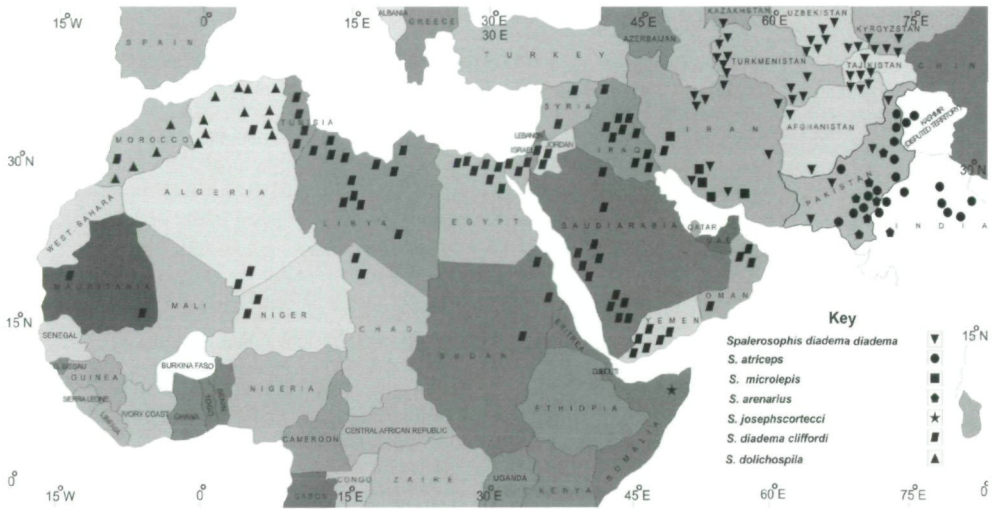


Fig. 7: Distribution of the *Spalerosophis* forms within the Saharo-Sindian range area of the genus based on data taken from MARX (1959), MINTON (1966), ANDERSON & LEVITON (1969) and GASPERETTI (1991).

Abb. 7: Die Verteilung der *Spalerosophis*-Formen im Saharo-Sindischen Verbreitungsgebiet der Gattung nach Angaben in MARX (1959), MINTON (1966), ANDERSON & LEVITON (1969) und GASPERETTI (1991).

form. The nominate form itself does not exist in India and adjacent areas of Oriental Pakistan called as Cholistan Desert. It is also evident that *diadema* (syn. *schirazianus*) is mainly distributed in Iran and its neighboring areas of Pakistan, Afghanistan and Turkmenistan (map Fig. 7) whereas Indo-Pakistan snakes of this genus are mainly *S. atriceps* and *S. arenarius* with some representation of *S. diadema* (PMNH 1617, 1922, 1923), along the Pakistan border with Iran and Afghanistan.

Despite that *atriceps* shares some characteristics with *diadema*, it is different in size, appearance and various morphological characteristics. For being sympatric with *diadema* in the Balochistan area of Pakistan (MINTON 1966), *atriceps* cannot be treated at a sub-specific level. According to our data [counts of MINTON 1966 in brackets], *S. atriceps* is characterized by its large size (snout-vent length may exceed 1400 mm and total length 1800 mm); mid-dorsals 29-30 [27-31]; ventrals 230-252 [232-254]; subcaudals 100-112 [96-114]. *Spalerosophis diadema diadema* is, however, smaller in size (total length may exceed 1316 mm - MINTON 1966 for *schirazianus*); mid-dorsals 25-31; ventrals 220 (LATIFI 1991 for *schirazianus*) - 254; subcaudals 78 (KHAN 2002, 2006 for

schirazianus) -114. In *S. atriceps* the color is highly variable (Figs. 2-5), adults mostly straw yellow (Fig. 2) with irregular black flecks and blotches, as if the snake had been spattered with tar; head red, mottled with black. The subadults and juveniles (Fig. 5) however exhibit the pattern ascribed to *S. diadema* (Fig. 6). This characteristic is perhaps the main reason that always confused the herpetologists to differentiate *atriceps* and *diadema*. Some herpetologists took it the other way and thought that they had no juvenile specimen of *atriceps*, and therefore placed *atriceps* and *diadema* side by side.

According to the present studies, *S. atriceps* and *S. arenarius* are sympatric Oriental species, of which *S. atriceps* is also distributed in some areas of the Himalayas (type locality), and to some extent on the west of the Indus River that represents the boundary between the Oriental and Palearctic region in Pakistan, but in any case does not enter into Iran and Afghanistan (Fig. 7). *Spalerosophis diadema* (syn. *schirazianus*) and *S. microlepis* are predominately Iranian with some representation in the adjoining areas (Irano-Turanian region). *Spalerosophis diadema cliffordi* is distributed mainly in the Afro-Arabian region whereas *dolichospila* and *josephscortecci* are purely African taxa.

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