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FIELDIANA

Zoology

NEW SERIES, NO. 40

The Colubrid Snake, *Psammophis schokari*, from the Arabian Peninsula

Hymen Marx

January 29, 1988
Publication 1383

PUBLISHED BY FIELD MUSEUM OF NATURAL HISTORY

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Grubb, P. J., J. R. Lloyd, and T. D. Pennington. 1963. A comparison of montane and lowland rain forest in Ecuador. I. The forest structure, physiognomy, and floristics. Journal of Ecology, **51:** 567–601.

Langdon, E. J. M. 1979. Yagé among the Siona: Cultural patterns in visions, pp. 63–80. *In* Browman, D. L., and R. A. Schwarz, eds., Spirits, Shamans, and Stars. Mouton Publishers, The Hague, Netherlands.

Murra, J. 1946. The historic tribes of Ecuador, pp. 785–821. *In* Steward, J. H., ed., Handbook of South American Indians. Vol. 2, The Andean Civilizations. Bulletin 143, Bureau of American Ethnology, Smithsonian Institution, Washington, D.C.

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The Colubrid Snake, *Psammophis schokari*, from the Arabian Peninsula

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Accepted for publication February 10, 1986
January 29, 1988
Publication 1383

PUBLISHED BY FIELD MUSEUM OF NATURAL HISTORY

ISSN 0015-0754
PRINTED IN THE UNITED STATES OF AMERICA

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The Colubrid Snake, *Psammophis schokari*, from the Arabian Peninsula

Abstract

The distribution of a widely distributed Afro-Asian colubrid species of snake, *Psammophis schokari*, from the Arabian Peninsula is analyzed. Cluster analysis demonstrates that there are three Arabian groups. A neotype is designated for the species name described by Forskål in 1775.

Introduction

The colubrid species *Psammophis schokari* has long presented a confusing systematic problem (Anderson, 1898; Loveridge, 1940; Parker, 1949; Marx, 1958). This taxon was considered a related species or a subspecies of *P. sibilans*. Parker (1949) and Marx (1958) established the specific distinction of *P. schokari* by comparing sympatric populations of this taxon with specimens of *P. sibilans* from Somaliland and Egypt. The geographic range of *P. schokari* is continuous throughout northwestern Africa, across northern Africa south through Somaliland, through southwestern Asia to central Asiatic Russia, Baluchistan, and Sind. Elucidation of the complex systematics of this species over so large and continuous a range must wait for a sturdier investigator to decipher the variation of this species throughout the Old World zones plus its relations with other congeneric species.

In this study I investigated the external morphology of the species from its designated type locality—Yemen—given by Forskål (1775), its geographic variations in the extended range within the extensive Arabian Peninsula, its relations with adjacent populations in Africa to the northwest (Egypt) and southwest (Somaliland), and designated a neotype and restricted it to a specific type locality (fig. 1). Hopefully, this report will facilitate the comparison of populations from different parts of its vast range to that of the typical range in Arabia. *Psammophis schokari* is the only species of the genus to occur in the Arabian Peninsula (Leviton & Aldrich, 1984).

Fortunately, with the opening of Arabian lands in the past few decades, collecting of specimens has been fruitful, and dozens of these animals are presently housed in the British Museum (Natural History) and the California Academy of Sciences (Appendix). I was able to accumulate 121 specimens with specific localities from the Arabian Peninsula.

The accumulation and tabulation of data on similar morphological characters as used by Marx (1958) for Egypt are presented for the Arabian Peninsula samples (table 1). These data were analyzed individually, then lumped into more inclusive groupings (see below) for comparison with allopatric populations to the northwest (Abu Rawash, Egypt), southwest (Somaliland and Eritrea [now incorporated into Ethiopia]), and each other. In addition, sympatric samplings of *P. schokari* were compared with *P. sibilans* at a single locality (Abu Rawash, Egypt) (table 2).

It is evident that there are geographic differences in morphology between groups of sampled localities of *P. schokari* within Arabia. For example, the frequency distribution of the number of subcaudals (table 3) and the color pattern (table 4) indicate regional differentiation of the species within the Arabian Peninsula. Statistical analysis was performed to detect the extent of the geo-

TABLE 1. Geographic variation of certain morphological characters of *Psammophis schokari* from Arabian Peninsula (see fig. 1 for zone codes).

Characters	Region 1											
	Sample 1 (localities 1-8)			Sample 2 (localities 9-16)			Sample 3 (localities 17-24)			Sample 4 (localities 25-27)		
	Range	(mean)	No.	Range	(mean)	No.	Range	(mean)	No.	Range	(mean)	No.
Lateral stripe through eye	+	(100.0)	20	+	(100.0)	20	+	(100.0)	19	+	(100.0)	4
Mid-dorsal stripe	+	(90.0)	20	+	(75.0)	20	+	(72.2)	18	+	(25.0)	4
Lateral band	+	(90.0)	20	+	(70.0)	20	+	(61.1)	18	+	(50.0)	4
Dark midventral band	+	(89.5)	19	+	(45.0)	20	+	(38.9)	18	+	(0)	4
Black stripe near edge on ventrals	+	(26.3)	19	+	(5.0)	20	+	(16.7)	18	+	(75.5)	4
Scale rows, midbody	17	(100.0)	19	17	(100.0)	20	17	(100.0)	18	17	(100.0)	3
Ventrals, ♂	172–185	(180.3)	9	173–184	(176.6)	11	167–184	(175.6)	12	170–175	(172.5)	2
Ventrals, ♀	174–192	(182.4)	8	171–192	(180.0)	8	175–189	(179.4)	5	179	(179.0)	1
Subcaudals, ♂	141–155	(146.0)	5	133–156	(147.7)	6	133–150	(146.5)	6	135–136	(135.5)	2
Subcaudals, ♀	146–155	(150.8)	5	144–167	(152.2)	6	...		0	...		0
Supralabials*	8–10	(8.95)	40	8–10	(9.1)	40	9–10	(9.05)	38	9	(9.0)	8
Supralabials entering eye*	5–6	(90.0)	40	5–6	(92.5)	40	5–6	(100.0)	38	5–6	(100.0)	8
Infralabials*	10–12	(10.9)	40	10–12	(11.0)	40	10–12	(11.1)	38	11	(11.0)	8
Infralabials in contact with first pair of chin-shields*	4–5	(4.9)	40	4–6	(5.0)	40	4–5	(5.0)	38	5	(5.0)	8
Preoculars*	1–2	(1.01)	40	1	(1.0)	40	1–2	(1.03)	38	1–2	(1.13)	8
Postoculars*	2–3	(2.01)	40	2–4	(2.2)	40	2–3	(1.97)	38	2	(2.0)	8
Temporals, anterior*	1–2	(0.98)	40	2	(2.0)	40	2	(2.0)	38	2	(2.0)	8
Temporals, posterior*	2–3	(2.6)	40	2–3	(2.56)	40	2–3	(2.56)	38	3–4	(3.13)	8
Total length, ♂ (mm)	403–1,149	(793.6)	5	336–1,386	(700.8)	6	326–1,117	(590.5)	6	656–933	(794.5)	2
Total length, ♀ (mm)	722–1,210	(921.3)	6	333–573	(430.0)	6	...		0	...		0
Tail length, relative, ♂	.362–.392	(.377)	5	.351–.402	(.378)	6	.371–.392	(.380)	6	.248–.342	(.297)	2
Tail length, relative, ♀	.370–.400	(.392)	6	.364–.403	(.372)	6	...		0	...		0

TABLE 1. *Continued.*

Characters	Region II											
	Sample 5 (localities 28-30)			Sample 10 (localities 49-52, 59)			Sample 11 (localities 53-58)			Sample 12 (locality 60)			Sample 13 (localities 61-62)		
	Range	(mean)	No.	Range	(mean)	No.	Range	(mean)	No.	Range	(mean)	No.	Range	(mean)	No.
Lateral stripe through eye	+	(100.0)	6	+	(100.0)	9	+	(100.0)	6	+	(100.0)	1	+	(100.0)	2
Mid-dorsal stripe	+	(80.0)	6	+	(88.9)	9	+	(83.3)	6	+	(100.0)	1	+	(100.0)	2
Lateral band	+	(80.0)	6	+	(100.0)	9	+	(83.3)	6	+	(100.0)	1	+	(100.0)	2
Dark midventral band	+	(100.0)	6	+	(88.9)	9	+	(100.0)	6	+	(100.0)	1	+	(100.0)	2
Black stripe near edge on ventrals	+	(100.0)	6	+	(88.9)	9	+	(100.0)	6	+	(100.0)	1	+	(100.0)	2
Scale rows, midbody	17	(100.0)	6	17	(100.0)	9	17	(100.0)	6	17	(100.0)	1	17	(100.0)	2
Ventrals, ♂	173–179	(173.0)	2	172–181	(175.0)	3	167–173	(169.0)	3	...		0	179	(179.0)	1
Ventrals, ♀	170–181	(175.5)	4	172–178	(176.4)	5	172–181	(176.5)	2	177	(177.0)	1	176	(176.0)	1
Subcaudals, ♂	129	(129.0)	1	116–130	(125.3)	3	109–123	(116.0)	2	...		0	...		0
Subcaudals, ♀	121	(121.0)	1	108–115	(112.7)	3	116	(116.0)	1	118	(118.0)	1	108	(108)	1
Supralabials*	8–9	(8.9)	12	9	(9.0)	18	8–9	(8.9)	12	8	(8.0)	2	9	(9.0)	4
Supralabials entering eye*	5–6	(91.7)	12	5–6	(100.0)	18	5–6	(91.7)	12	4–5	(100.0)	2	5–6	(100.0)	4
Infralabials*	10–11	(10.9)	12	11	(11.0)	18	11	(11.0)	12	8	(8.0)	2	11	(11.0)	4
Infralabials in contact with first pair of chin-shields*	5	(5.0)	12	5	(5.0)	18	5	(5.0)	12	4	(4.0)	2	5	(5.0)	4
Preoculars*	1	(1.0)	12	1	(1.0)	18	1	(1.0)	12	1	(1.0)	2	1	(1.0)	4
Postoculars*	2–3	(2.4)	12	2	(2.0)	18	2	(2.0)	12	2	(2.0)	2	2	(2.0)	4
Temporals, anterior*	2	(2.0)	12	2	(2.0)	18	2	(2.0)	12	1–2	(1.5)	2	2	(2.0)	4
Temporals, posterior*	2–3	(2.75)	12	2–3	(2.4)	18	2–3	(2.5)	12	2	(2.0)	2	2–3	(2.25)	4
Total length, ♂ (mm)	1,033	(1,033)	1	648–906	(777.0)	2	532	(532)	1	...		0	...		0
Total length, ♀ (mm)	459	(459)	1	372–874	(674.0)	3	741	(741)	1	580	(580)	1	802	(802)	1
Tail length, relative, ♂	.367	(.367)	1	.343–.360	(.352)	2	.344	(.344)	1	...		0	...		0
Tail length, relative, ♀	.336	(.336)	1	.320–.335	(.327)	3	.339	(.339)	1	.331	(.331)	1	.318	(.318)	1

(*Continued on next page*)

TABLE 1. *Continued.*

Characters	Region III											
	Sample 6 (localities 31-32)			Sample 7 (localities 33-44)			Sample 8 (localities 45-47)			Sample 9 (locality 48)		
	Range	(mean)	No.	Range	(mean)	No.	Range	(mean)	No.	Range	(mean)	No.
Lateral stripe through eye	+	(100.0)	9	+	(100.0)	14	+	(100.0)	3	+	(100.0)	4
Mid-dorsal stripe	+	(11.1)	9	+	(21.4)	14	+	(0.0)	3	+	(0.0)	4
Lateral band	+	(33.3)	9	+	(21.4)	14	+	(66.7)	3	+	(75.0)	4
Dark midventral band	+	(22.2)	9	+	(78.6)	14	+	(100.0)	3	+	(100.0)	4
Black stripe near edge on ventrals	+	(66.7)	9	+	(71.4)	14	+	(33.3)	3	+	(50.0)	4
Scale rows, midbody	17	(100.0)	9	17	(100.0)	14	17	(100.0)	3	17	(100.0)	4
Ventrals, ♂	170–190	(175.2)	5	170–179	(175.4)	9	177	(177.0)	2	173–178	(174.7)	3
Ventrals, ♀	171–176	(174.0)	3	173–178	(174.5)	4	169	(169.0)	1	181	(181.0)	1
Subcaudals, ♂	119–122	(120.0)	3	126–138	(130.3)	3	130	(130.0)	1	110–125	(115.3)	3
Subcaudals, ♀	119–125	(121.7)	3	130–135	(132.0)	4	...		0	...		0
Supralabials*	8–9	(8.9)	18	9–10	(9.1)	28	9	(9.0)	6	8–9	(8.75)	8
Supralabials entering eye*	5–6	(94.4)	18	5–6	(92.9)	28	5–6	(100.0)	6	5–6	(50.0)	8
Infralabials*	11	(11.0)	18	11	(11.0)	28	11	(11.0)	6	10–11	(10.75)	8
Infralabials in contact with first pair of chin-shields*	5	(5.0)	18	5	(5.0)	28	5	(5.0)	6	4–5	(4.75)	8
Preoculars*	1	(1.0)	18	1	(1.0)	28	1	(1.0)	6	1	(1.0)	8
Postoculars*	2	(2.0)	18	2	(2.0)	28	2	(2.0)	6	2	(2.0)	8
Temporals, anterior*	2	(2.0)	18	2	(2.0)	28	1–2	(1.8)	6	2	(2.0)	8
Temporals, posterior*	2–3	(2.7)	18	2–3	(2.7)	28	1–3	(2.2)	6	2–3	(2.25)	8
Total length, ♂ (mm)	289–832	(613.7)	3	405–959	(736.7)	3	821	(821)	1	386–969	(473.7)	3
Total length, ♀ (mm)	347–871	(619.0)	3	326–1,290	(872.3)	4	...		0	...		0
Tail length, relative, ♂	.327–.346	(.334)	3	.336–.371	(.339)	3	.362	(.362)	1	.314–.329	(.321)	3
Tail length, relative, ♀	.329–.364	(.342)	3	.334–.376	(.361)	4	...		0	...		0

* Each side of head.

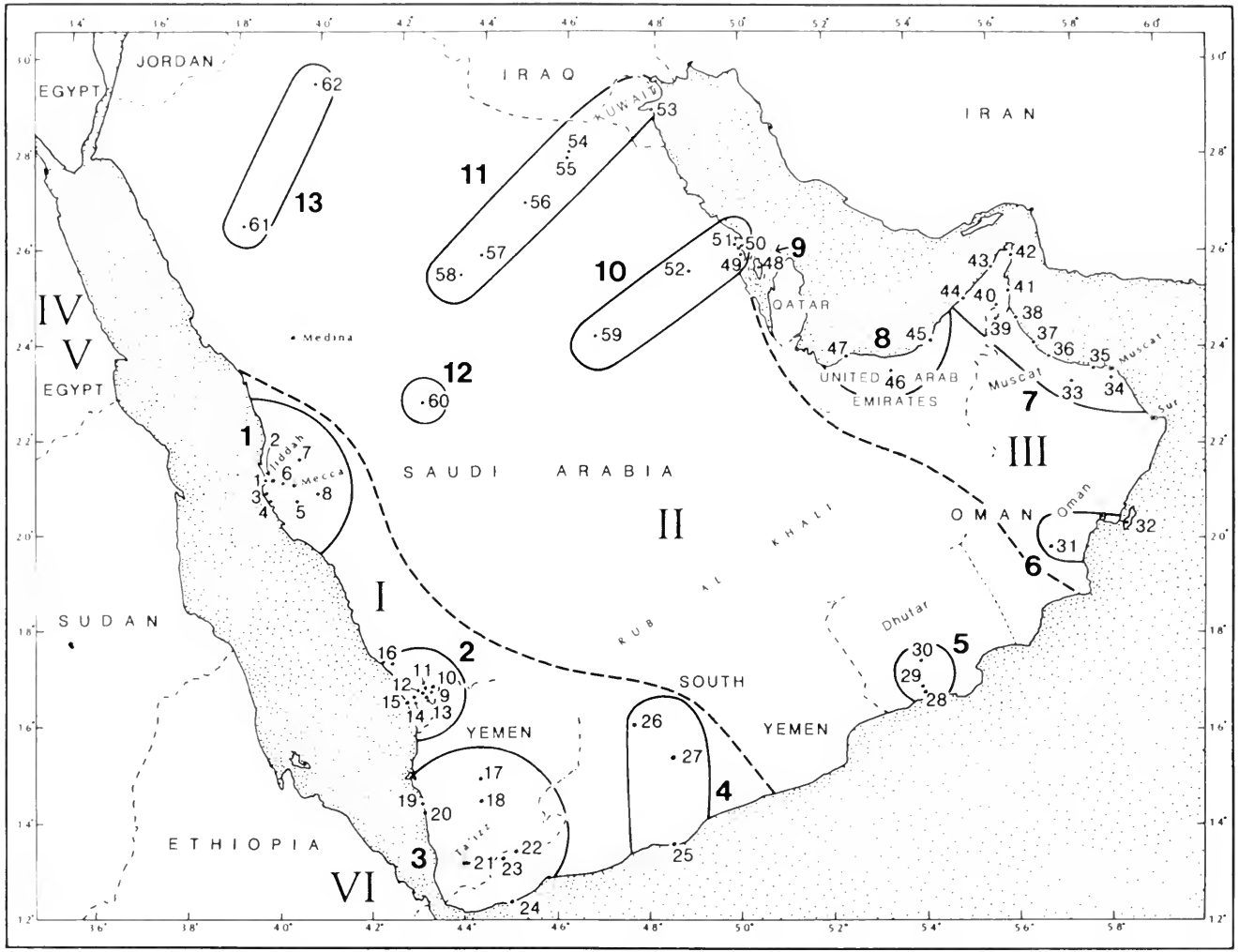

FIG. 1. Localities and regions of distribution of *Psammophis schokari* in Arabia plus adjacent areas. Also *P. sibilans* from Abu Rawash, Egypt (V). See list of localities for numerical coding on map (Appendix).

TABLE 2. Geographic variation of certain morphological characters of *Psammophis schokari* from Arabian Peninsula, Eritrea, Somaliland, and Abu Rawash, Egypt, and of *P. sibilans* from Abu Rawash, Egypt (see map for regional codes).

	Region								
	I Western Arabia (localities 1-27)			II Central Arabia (localities 28-30, 49-62)			III Eastern Arabia (localities 31-48)		
Characters	Range	(mean)	No.	Range	(mean)	No.	Range	(mean)	No.
Lateral stripe through eye	+	(100.0)	63	+	(100.0)	24	+	(100.0)	30
Mid-dorsal stripe	+	(77.4)	62	+	(87.5)	24	+	(16.7)	30
Lateral band	+	(72.6)	62	+	(91.7)	24	+	(40.0)	30
Dark midventral band	+	(50.8)	61	+	(95.8)	24	+	(83.3)	30
Black stripe near edge on ventrals	+	(19.7)	61	+	(95.8)	24	+	(66.7)	30
Scale rows, midbody	17	(100.0)	60	17	(100.0)	24	17	(100.0)	30
Ventrals, ♂	167–185	(177.0)	34	167–181	(174.0)	9	170–190	(175.4)	19
Ventrals, ♀	171–192	(180.7)	22	170–181	(176.2)	13	169–181	(174.4)	9
Subcaudals, ♂	133–156	(145.6)	19	109–130	(122.8)	6	110–138	(122.6)	10
Subcaudals, ♀	144–167	(151.5)	11	108–121	(114.4)	7	119–135	(127.6)	7
Supralabials*	8–10	(9.0)	126	8–9	(8.9)	48	8–10	(9.0)	60
Supralabials entering eye*	5–6	(94.4)	126	5–6	(91.7)	48	5–6	(88.3)	60
Infralabials*	10–12	(11.0)	126	8–11	(10.9)	48	10–11	(96.7)	60
Infralabials in contact with first pair of chinshields*	4–6	(4.97)	126	4–5	(4.96)	48	4–5	(4.95)	60
Preoculars*	1–2	(1.02)	126	1	(1.0)	48	1	(1.0)	60
Postoculars*	2–4	(2.2)	126	2–3	(2.1)	48	2	(2.0)	60
Temporals, anterior*	1–2	(1.99)	126	1–2	(1.98)	48	1–2	(1.98)	60
Temporals, posterior*	2–4	(2.5)	126	2–3	(2.5)	48	1–3	(2.48)	60
Total length, ♂ (mm)	326–1,386	(700.3)	19	523–1,033	(779.8)	4	289–969	(689.3)	10
Total length, ♀ (mm)	333–1,210	(675.7)	12	372–874	(657.7)	7	326–1,290	(763.7)	7
Tail length, relative, ♂	.248–.402	(.378)	19	.343–.367	(.354)	4	.314–.371	(.340)	10
Tail length, relative, ♀	.364–.403	(.382)	12	.318–.339	(.329)	7	.329–.376	(.353)	7

graphic variation within the Arabian Peninsula and the nearest populations to the northwest and southwest.

An interesting finding is the number of snakes with incomplete tails—50% of this Arabian sample. One tail character, number of subcaudals, is taxonomically important in its geographic distribution. Incomplete tails did limit the sample sizes for this character, but not so much as to preclude statistical significance. The reason for the lost ends of the tails is not known.

Methods

This analysis depends importantly on the procedures followed in data analysis. The procedures were dictated by the biology of *Psammophis*: these snakes are poorly represented in collections, have wide geographic distributions, and furthermore, exhibit variable morphologies. As a result, few museum specimens are available for study, and few series of specimens exist for any locality. This would pose no problem if individuals were proper objects of zoological classification; one could simply treat each individual as a perfect estimate of that *individual's morphology*. However, I fundamentally reject this typological position. Instead, individuals are useful in zoological systematics in defining the range of variation exhibited by *local populations*; it is populations that are recognized nomenclaturally as being distinct or not.

Therefore, as local populations of *Psammophis* cannot be collected and studied by conventional analyses (i.e., all specimens from a single collecting point constitute a single, nonsubjective local population), I have attempted to approximate this condition through my analytical treatment of snakes collected from different but nearby localities. The biology of *Psammophis* therefore demands an unconventional approach that is open

TABLE 2. *Continued.*

Characters	Region IV Abu Rawash, Egypt (*P. schokari*) Range (mean)	No.	Region V Abu Rawash, Egypt (*P. sibilans*) Range (mean)	No.	Region VI Somaliland and Eritrea Range (mean)	No.
Lateral stripe through eye	+ (100.0)	6	+ (0)	15	+ (100.0)	13
Mid-dorsal stripe	+ (33.3)	6	+ (86.7)	15	+ (15.4)	13
Lateral band	+ (16.7)	6	+ (73.3)	15	+ (7.7)	13
Dark midventral band	+ (100.0)	6	+ (60.0)	15	+ (15.4)	13
Black stripe near edge on ventrals	+ (100.0)	6	+ (6.7)	15	+ (15.4)	13
Scale rows, midbody	17 (100.0)	6	17 (100.0)	15	17 (100.0)	13
Ventrals, ♂	167–174 (170.0)	5	160–171 (165.0)	11	155–174 (165.3)	6
Ventrals, ♀	172 (172.0)	1	166–168 (167.0)	4	159–175 (166.0)	7
Subcaudals, ♂	112–117 (114.4)	5	100–116 (105.3)	8	88–115 (97.0)	5
Subcaudals, ♀	117 (117.0)	1	112 (112.0)	1	87–95 (91.5)	4
Supralabials*	8–9 (8.67)	12	8–9 (8.1)	30	8–9 (8.7)	26
Supralabials entering eye*	5–6 (66.7)	12	4–5 (90.0)	30	5–6 (65.4)	26
Infralabials*	11 (11.0)	12	11 (90.0)	30	11 (57.7)	26
Infralabials in contact with first pair of chinshields*	4–5 (4.67)	12	4–5 (4.87)	30	4–5 (4.8)	26
Preoculars*	1 (1.0)	12	1 (1.0)	30	1 (1.0)	26
Postoculars*	2 (2.0)	12	2–3 (2.1)	30	2 (2.0)	26
Temporals, anterior*	2 (2.0)	12	2 (2.0)	30	1–2 (1.9)	26
Temporals, posterior*	2–3 (2.5)	12	2–3 (2.4)	30	1–3 (2.3)	26
Total length, ♂ (mm)	717–911 (835.3)	4	596–992 (838.2)	10	305–703 (474.4)	5
Total length, ♀ (mm)	897 (897)	1	1,032 (1,032)	1	283–683 (388.3)	4
Tail length, relative, ♂	.330–.338 (.333)	4	.303–.333 (.318)	10	.289–.339 (.305)	5
Tail length, relative, ♀	.331 (.331)	1	.327 (.327)	1	.289–.314 (.297)	4

* Each side of head.

to subjectivity. Although the amalgamation procedure must be scrutinized for possible biasing effects, this approach is far preferable to one which fails to recognize that proper taxonomy is based on study of variation among populations, not individuals.

Amalgamation of Localities

With only 140 snakes representing no fewer than 65 localities, it was necessary to pool individual localities to create samples of sufficient size for statistical analysis. Several steps were taken, as follows:

1. Nearby localities (most lying within a 150-km radius) were automatically pooled together. Reference to a topographic map during this step ensured that specimens from different drainage basins of mountain ranges were not artificially juxtaposed.
2. Step 1 produced 13 samples on the Arabian Peninsula, with sample sizes ranging from two to 32; in addition, Egyptian samples of *P. schokari* (N = 8) and *P. sibilans* (N = 15), both from Abu Rawash and an Eritrean and Somaliland sample of *P. schokari* (*sensu lato*; N = 13) were also used. All statistical steps are originally based on these 16 samples.
3. Using the 13 samples from the Arabian Peninsula, analyses of variance (ANOVA) were conducted on all continuous variables: ventrals, subcaudals, total length, body length, and tail ratio. Only the test for number of subcaudals was statistically significant (F values = 14.43, $P < 0.001$, indicating significant differences among samples in subcaudals. Similar frequency tests of differences of discrete characters among samples

TABLE 3. Frequency distribution of number of subcaudals of *Psammophis schokari* and *P. sibilans*.

No. of subcaudals	Region											
	I Western Arabia		II Central Arabia		III Eastern Arabia		IV Abu Rawash, Egypt (*P. schokari*)		V Abu Rawash, Egypt (*P. sibilans*)		VI Somaliland and Eritrea	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
87	...	...	...	...	...	...	...	...	...	...	...	1
88	...	...	...	...	...	...	...	...	...	...	1	...
90	...	...	...	...	...	...	...	...	...	...	...	1
92	...	...	...	...	...	...	...	...	...	...	1	...
94	...	...	...	...	...	...	...	...	...	...	...	1
95	...	...	...	...	...	...	...	...	...	...	2	1
100	...	...	...	...	...	...	...	...	1	...	...	...
101	...	...	...	...	...	...	...	...	1	...	...	...
102	...	...	...	...	...	...	...	...	1	...	...	...
104	...	...	...	...	...	...	...	...	1	...	...	...
105	...	...	...	...	...	...	...	...	2	...	...	...
108	...	...	...	2	...	...	...	...	...	...	...	...
109	...	...	1	...	...	...	...	...	1	...	...	...
110	...	...	...	...	1	...	...	...	...	...	...	...
111	...	...	...	...	1	...	...	...	...	...	...	...
112	...	...	...	...	...	...	1	1	...	1	...	...
113	...	...	...	...	...	...	1	...	...	...	...	...
115	...	...	...	2	...	...	2	...	...	...	1	...
116	...	...	1	1	...	...	...	...	1	...	...	...
117	...	...	...	...	...	...	1	...	...	...	...	...
118	...	...	...	1	...	...	...	...	...	...	...	...
119	...	...	...	...	2	1	...	...	...	...	...	...
121	...	...	...	1	...	1	...	...	...	...	...	...
122	...	...	...	...	1	...	...	...	...	...	...	...
123	...	...	1	...	...	...	...	...	...	...	...	...
125	...	...	...	...	1	1	...	...	...	...	...	...
126	...	...	...	...	1	...	...	...	...	...	...	...
127	...	...	...	...	1	...	...	...	...	...	...	...
129	...	...	1	...	1	...	...	...	...	...	...	...
130	...	...	2	...	...	2	...	...	...	...	...	...
133	2	...	...	...	...	1	...	...	...	...	...	...
135	1	...	...	...	...	1	...	...	...	...	...	...
136	1	...	...	...	...	...	...	...	...	...	...	...
138	...	...	...	...	1	...	...	...	...	...	...	...
141	1	...	...	...	...	...	...	...	...	...	...	...
142	1	...	...	...	...	...	...	...	...	...	...	...
144	1	1	...	...	...	...	...	...	...	...	...	...
146	1	1	...	...	...	...	...	...	...	...	...	...
147	1	1	...	...	...	...	...	...	...	...	...	...
148	1	...	...	...	...	...	...	...	...	...	...	...
149	1	1	...	...	...	...	...	...	...	...	...	...
150	5	1	...	...	...	...	...	...	...	...	...	...
151	1	2	...	...	...	...	...	...	...	...	...	...
152	...	1	...	...	...	...	...	...	...	...	...	...
155	1	2	...	...	...	...	...	...	...	...	...	...
156	1	...	...	...	...	...	...	...	...	...	...	...
167	...	1	...	...	...	...	...	...	...	...	...	...
Totals (84)	19	11	6	7	10	7	5	1	8	1	5	4

were conducted, but these tests are unreliable because of small sample size. No significant differences were noted.

4. Given missing data for many specimens (especially in the critically diagnostic tail region), even this pooling was inadequate for many statistical tests of differences. Therefore, a variety of summary analyses, involv-

TABLE 4. Frequency distribution of combinations of stripe patterns in *Psammophis schokari* and *P. sibilans*.

Bands					Region					
					I Western Arabia	II Central Arabia	III Eastern Arabia	IV Abu Rawash, Egypt *P. schokari*	V Abu Rawash, Egypt *P. sibilans*	VI Somaliland and Eritrea
A	B	C	D	E						
+	0	+	+	0	...	...	4	...	...	...
+	0	+	+	+	...	1	3	...	...	...
+	0	0	+	+	...	2	16	6	...	...
+	+	+	+	+	5	20	2	1	...	...
+	+	+	+	0	24	...	2	...	...	...
+	0	0	0	0	10	...	4	...	...	10
+	+	+	0	0	8	1	...	...	...	...
+	+	+	0	+	3	...	1	...	...	1
+	+	0	0	0	3	...	...	...	...	...
+	0	0	0	+	3	...	...	...	...	...
+	0	+	0	+	1	...	...	...	...	...
+	0	0	+	0	1	...	...	...	...	1
+	+	0	+	+	...	...	...	1	...	1
0	0	0	0	0	...	...	...	...	1	...
0	+	+	+	0	...	...	...	...	10	...
0	+	+	0	0	...	...	...	...	1	...
0	+	0	0	0	...	...	...	...	2	...
0	0	0	+	0	...	...	...	...	1	...
Totals					58	24	32	8	15	13

A = Lateral stripe through eye; B = mid-dorsal stripe; C = lateral band; D = black midventral band; E = black stripe near edge of ventrals.

ing frequency tables for discrete characters and plots for continuous characters, were conducted. Results of these analyses identified groups of samples which were internally homogeneous and which could be pooled together. Examples of these summary screening procedures are as follows:

a. Frequencies of five striping patterns among individuals of different samples
b. Frequencies of overall pattern (different combinations of these five stripes) among the 16 samples
c. Frequencies of discrete character states for each other qualitative character among the 16 samples
d. Plots of continuous characters (number of ventrals, subcaudals, total length, body length, and ratio of tail length to body length) across samples

5. This screening procedure allowed the identification of adjacent samples which were similar and which were different. Samples which were similar were grouped into "regions" (I–VI) which were then subjected to statistical testing procedures.

Statistical Testing

Statistics was used to evaluate differences existing among the six regions. First, chi-square tests of homogeneity were used to ensure that each region was composed of similar samples, that is, that the pooling procedure did not amalgamate statistically distinguishable individuals.

Next, evidence was sought for sexual dimorphism, plotting frequencies of discrete characters and plotting states for continuous characters with the sexes separated. Although males tend to be larger than females, these differences were insignificant across all localities. This was shown by ANOVA on subcaudals. Number of subcaudals varies significantly among regions of the Arabian Peninsula for males ($F = 24.66$, $P < 0.001$); Duncan's multiple range test shows that males from region I differ significantly from those of regions II and III, but that the last two do not differ from each other. Females also show significant differences in subcaudals ($F = 102.37$; $P < 0.001$); in contrast to males, females of each region differ significantly from each other. When regional differences are taken into account, however, there is little evi-

dence for sexual dimorphism. An ANOVA employing region, sex, and their interaction yielded significant overall region and interaction terms, but no significant term for sex (table 5).

Multivariate analyses were undertaken using those characters shown (by univariate analyses) to differ significantly within the study area. First, the composition of samples in each region was evaluated using a nonparametric discriminant analysis

TABLE 5. Analysis of variance in number of subcaudals among Arabian *Psammophis schokari*.

Source	*d.f.*	Sum of squares	*F* value	*P*
Model	3	10,329.68	52.21	0.0001
Sex	1	4.33	0.07	0.7988
Zone	1	9,877.76	149.79	0.0001
Zone × sex	1	447.60	6.79	0.0116

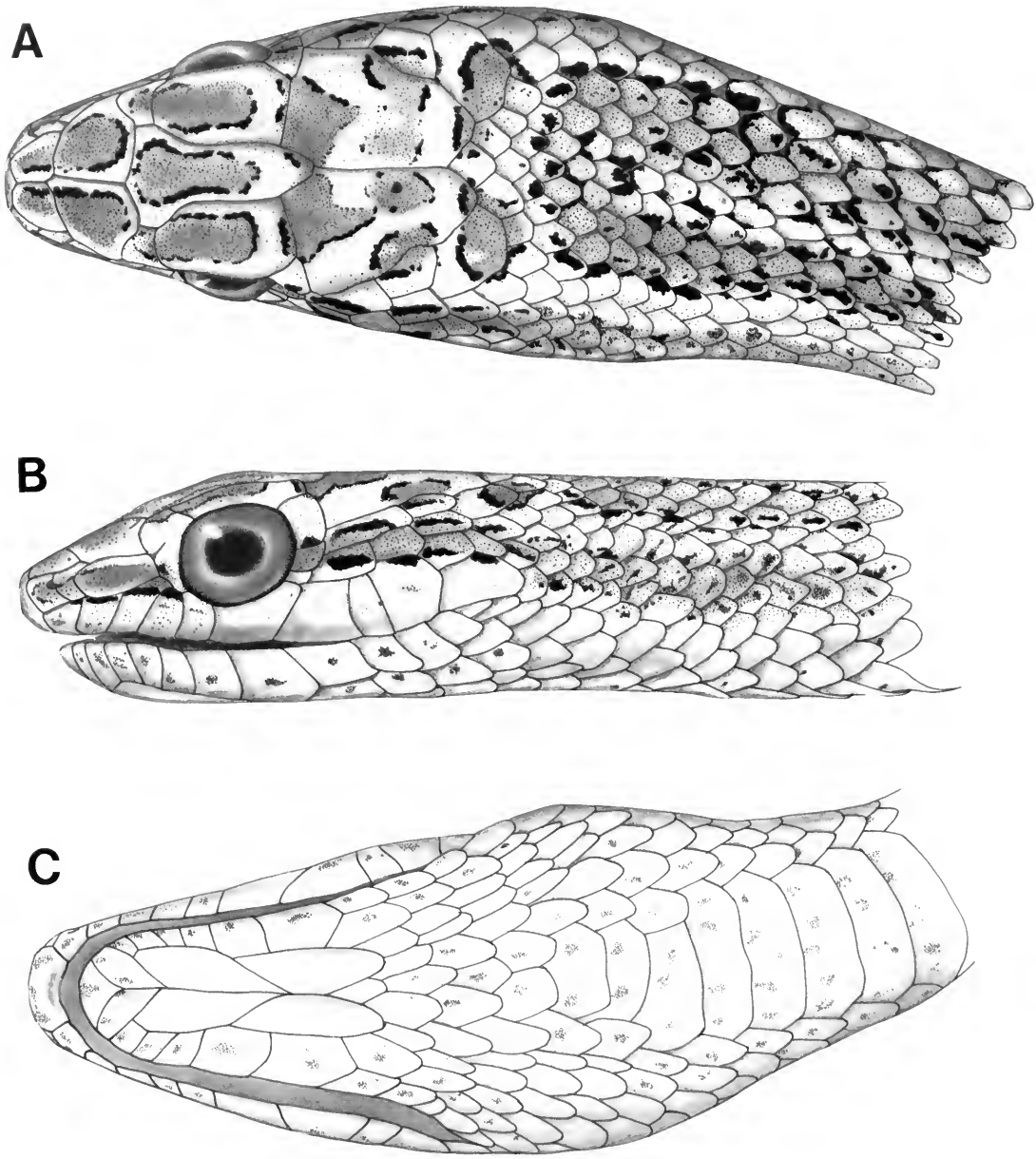

FIG. 2. Head views of neotype of *Psammophis schokari*.

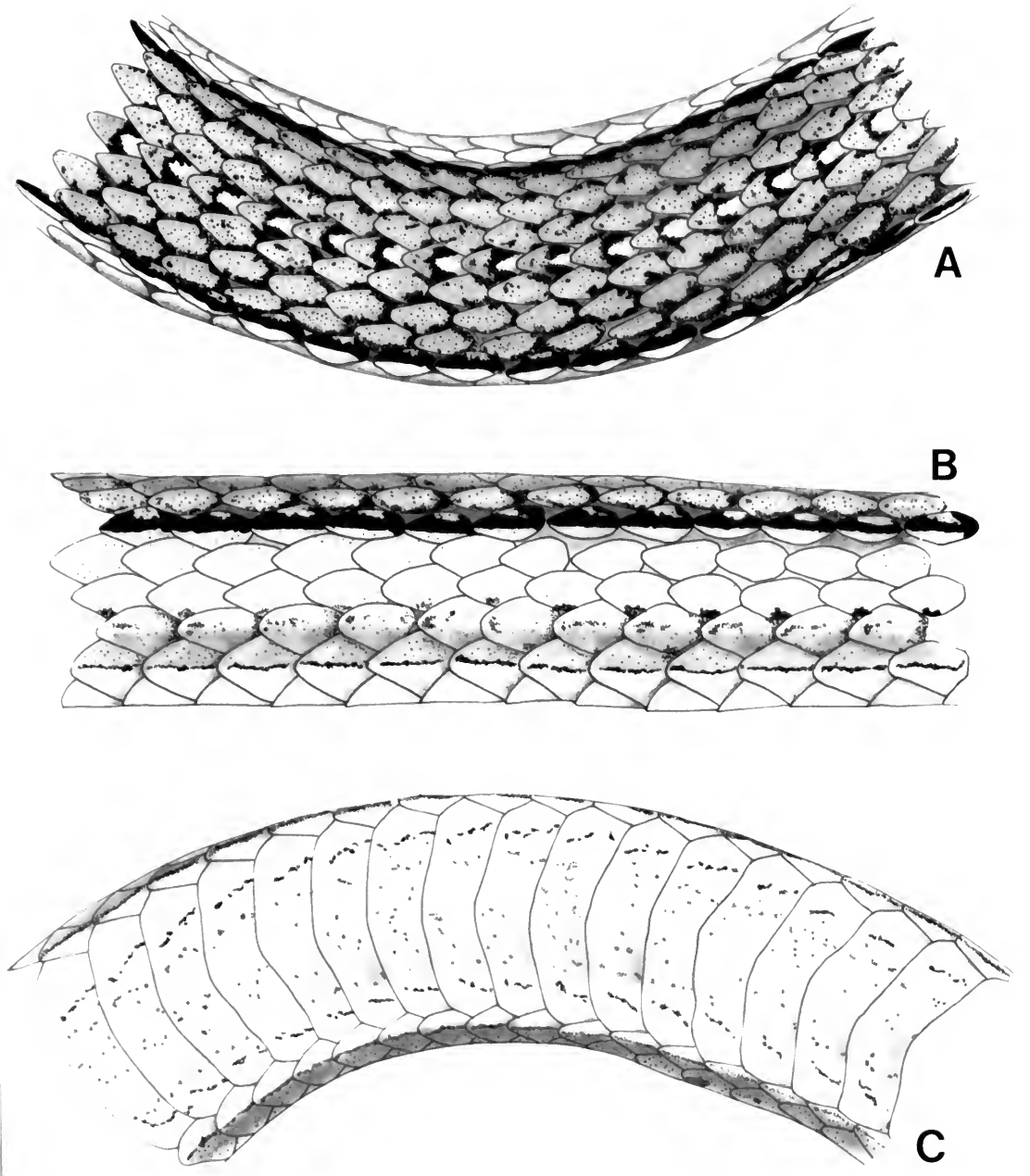

FIG. 3. Midbody views of neotype of *Psammophis schokari*.

(PROC NEIGHBOR of SAS). This analysis employed one reference sample from each region and used differences among these in striping patterns and number of subcaudals to identify regional affinities of all other specimens. Of the 121 specimens having complete data, 41 represented the six reference populations, while 80 were classified by the program. This analysis suggested the close phenetic relation of *P. schokari* from Egypt with those from the eastern Arabian Peninsula. Repetitions of this analysis using other samples to serve as "reference populations" allowed an evaluation of the modality of each sample.

The striping and subcaudal data were subjected

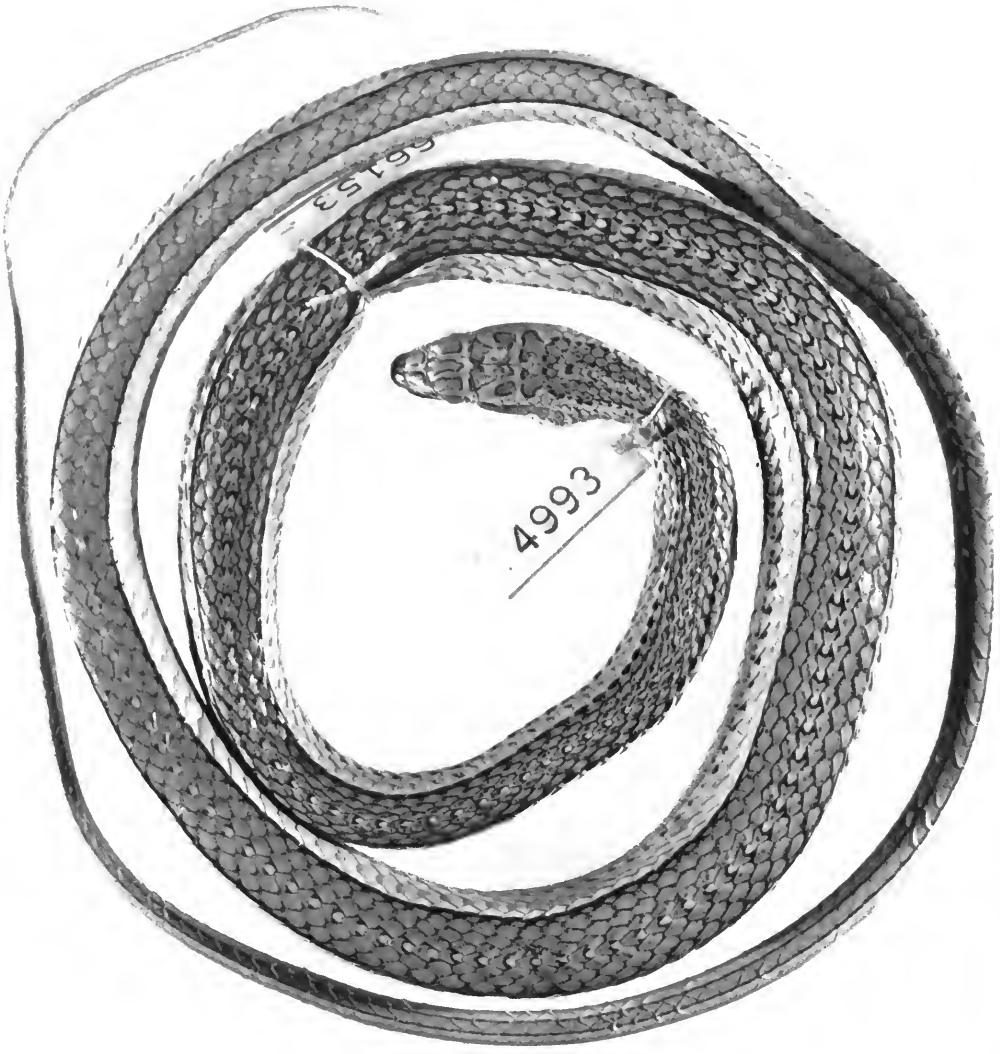

FIG. 4. Dorsal view of neotype of *Psammophis schokari*.

to a cluster analysis, using all 16 samples to ensure that the amalgamation procedure had not unduly affected the results. Using the average linkage clustering algorithm on squared euclidean distance data, I found the same results disclosed by discriminant analysis: Egyptian *P. schokari* clustered more closely with those from eastern Arabian localities than they did with others from that region; Eritrean *P. schokari* differs more from Arabian and Egyptian *P. schokari* than any of these do from each other; and Egyptian *P. sibilans* forms an outgroup for all the *P. schokari* analyzed.

Conclusion

The cluster analysis provides support for the summary statistics presented (i.e., that there are three Arabian groups that should be considered separately) and for the amalgamation procedure used. Other cluster analyses (e.g., using different characters and different clustering algorithms) were used to evaluate the robustness of the results.

The relations of *P. schokari* from region III (eastern Arabia) and those from region IV (Egypt) are not known. Whether they are a continuous

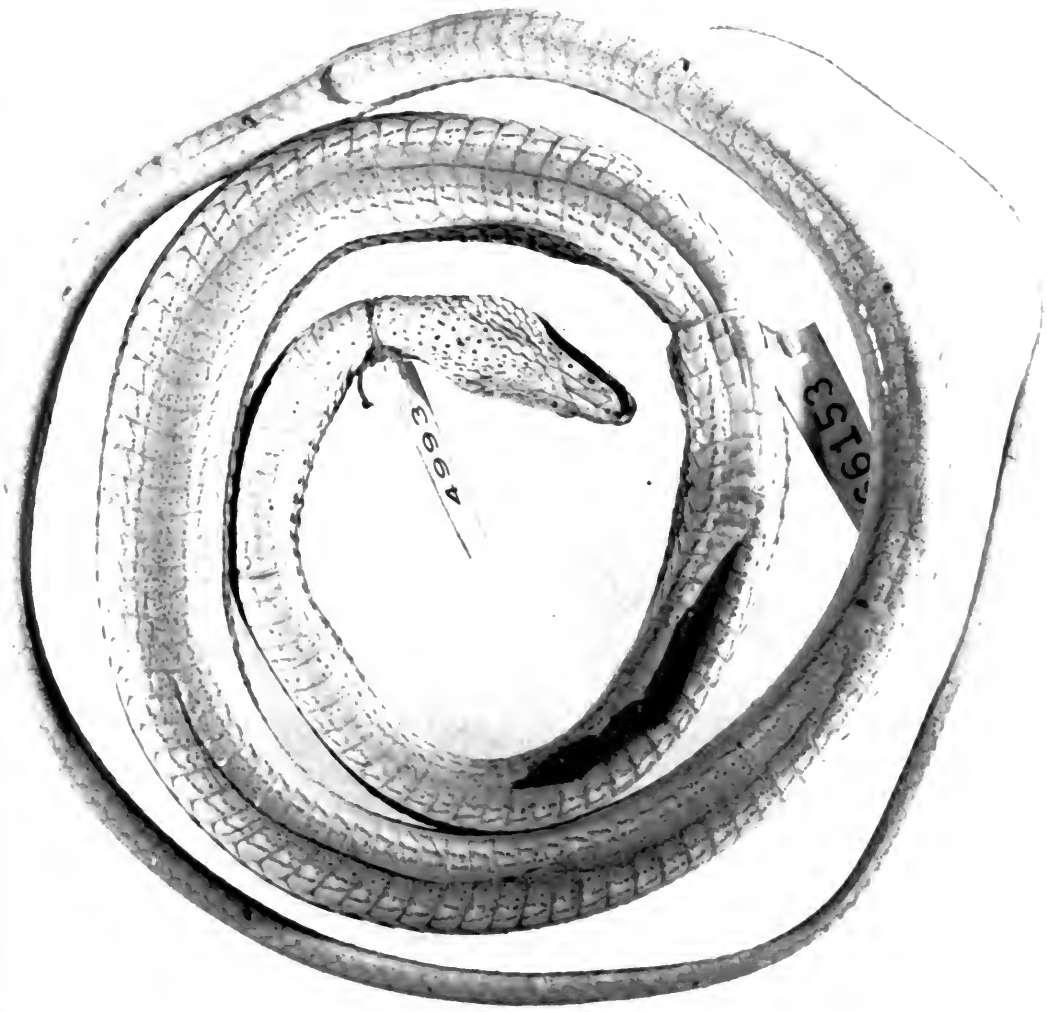

FIG. 5. Ventral view of neotype of *Psammophis schokari*.

genetic population, are disjunct parallel phenotypes, or are a formerly continuous population which has been disjuncted by other unrelated stocks is not clear. Additional collecting from other adjacent northern areas (Iran, Iraq, Syria, Jordan, and Israel) may resolve this question.

Neotype

F. W. Braestrup of the Universitetets Zoologiske Museum, Copenhagen, informed me that the two cotypes of *Coluber schokari* described by Forskål (1775) unfortunately have been lost (pers. comm.). Forskål (1775) reported that these specimens were from Yemen. I had the opportunity to examine eight animals with specific locality data from southwestern Yemen. More than 50% of the collected Arabian specimens of *P. schokari* have incomplete tails, and the number of subcaudals varies significantly across the range of the species (table 3). Fortunately one specimen of the eight from Yemen has a complete tail, and this animal I designate as the neotype of the species.

Psammophis schokari (Forskål) 1775

NEOTYPE (FIGURES 2–5)—Field Museum of Natural History No. 66153, a male from Hodeida

(= Al Hudaydah), Yemen, collected by Harry Hoogstraal and Robert Kuntz 27 January 1951. The snake was collected at sea level under boards in the town.

DESCRIPTION (TWO COTYPES OF FORSKÅL GIVEN IN BRACKETS)—A male with 1 preocular; 3 postoculars; 2 anterior temporals; 3 posterior temporals; 10 supralabials, 5th and 6th entering orbit; 12 infralabials, first 6 on left side and 5 on right side in contact with the anterior pair of chinshields; 17 scale rows at midbody; 175 ventrals [180; 183; sex unknown]; anal plate divided; subcaudals 150 [144; 114 incomplete].

Total length 763 mm; body length 464 mm; tail complete with terminal scute 299 mm, 0.392 of total length.

COLOR (IN ALCOHOL)—A dark narrow longitudinal band running from snout, through eye, onto cheeks. Dorsum light tan with a broad, black, middorsal band and a thin, broken, black stripe near edge of dorsals. Ventrum with a faint but distinct broad belly band and a lateral interrupted stripe.

Acknowledgments

I wish to acknowledge the consultation of my colleague, Bruce D. Patterson, on the statistical analysis; his generosity is fully appreciated. I also express appreciation to various curators from the following museums who made available the specimens used in this study (Appendix): British Museum (Natural History) (BMNH); California Academy of Sciences (CAS); Hebrew University, Jerusalem (HUJ); Museum National d'Histoire Naturelle, Paris (MNHP). I extend my thanks to E. N. Arnold, F. W. Braestrup, and D. G. Broadley for pertinent information. The illustrations of the neotype represent the skills of Marlene Hill-Werner, and the map was constructed by Clara Richardson. Ron Testa took the photographs. Molly Ozaki typed the manuscript.

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Appendix

Arabian localities of *Psammophis schokari* cited on map (fig. 1).

Map No.	Locality	Latitude/longitude	Material examined
	SAUDI ARABIA (coastal west-central)		
1	Jiddah	21°30′N 39°10′E	BMNH 5, CAS 4
1	Wadi Usfah, near Jiddah	...	CAS 1
1	±10 km N of Jiddah	21°31.5′N 39°7.5′E	CAS 1
2	Burayman	21°39′N 39°13′E	BMNH 2
3	30 km S of Jiddah	...	CAS 1
4	Ras as Shara	21°05′N 39°10′E	CAS 1
5	Km 110 and 115 Mecca	21°13′ & 15′N 39°55′E	BMNH 2
6	Hadda	21°26′N 39°35′E	BMNH 1
7	Madrakah	21°59′N 39°59′E	CAS 1
8	Near Ta'izz	21°16′N 40°24′E	CAS 1
	SAUDI ARABIA (southwestern)		
9	Wadi Dahan	ca. 17°N 43°¼′E	CAS 2
10	Hakimah	17°01′N 42°50′E	CAS 7
11	Khasawiyah	17°00′N 42°40′E	CAS 4
12	El Kuba	16°48′N 43°14′E	BMNH 2
13	Jowa	ca. 17°N 43°01′E	CAS 1
14	Abu Arish-Sabya Road	17°03′N 42°43′E	CAS 1
15	Ras al Bourge, Jizan	16°53′N 42°32′E	CAS 2
16	Ad Darb	17°43′N 42°15′E	CAS 1
	YEMEN		
17	San'a	15°24′N 44°14′E	BMNH 1
18	Mabar, Wadi Mal-el-Ghail	14°52′N 44°17′E	FMNH 1
19	Al Hudaydah (= Hodeida) [type locality]	14°50′N 42°58′E	BMNH 1, FMNH 2
20	Al-Manzer, 30 km S of Al Hudaydah	...	BMNH 1
21	Ta'izz	13°35′N 44°02′E	FMNH 1
	SOUTH YEMEN		
22	Jebel Harir	13°45′N 44°54′E	BMNH 1
23	Ad Dali	13°42′N 44°44′E	BMNH 1
24	Aden	12°47′N 45°03′E	BMNH 1
25	Bir Ali	14°00′N 48°20′E	BMNH 1
26	Hadramaut: Jol, near Zamakh	16°30′N 47°37′E	BMNH 1
27	Hadramaut: Al Qatan Qam Mts. 2500 ft	15°53′N 48°28′E	BMNH 1
...	Hadramaut	...	BMNH 1
...	Aden Protectorate	...	BMNH 5
	OMAN (Dhofar Province)		
28	Qara Mts., Fuzul	...	BMNH 2
29	Jabal Qara	17°20′N 54°04′E	BMNH 1, HUJ 1
30	Near Thamarit	17°38′N 54°02′E	BMNH 1
30	Thamarit	17°42′N 53°59′E	BMNH 1
...	Hatab	...	BMNH 1
	OMAN (Oman Province)		
31	Yalooni, Jiddat al Harasis	15°55′N 57°06′E	BMNH 1
32	Masirah Island; RAF camp northern area near North Point	20°41′N 58°53′E	BMNH 8
	OMAN (Muscat Province)		
33	Wadi Mistal	23°22′N 57°39′E	BMNH 1
34	Near Qurm, near Muscat	23°36′N 58°39′E	BMNH 1
35	Batinah, near Sib	23°40′N 58°12′E	BMNH 2
36	Batinah, near Al Khabura	23°58′N 57°06′E	BMNH 2
37	Batinah, between Sahan and Sohar	24°15′N 56°50′E	BMNH 1
38	Batinah, near Shinas	24°45′N 56°26′E	BMNH 1
39	Jabel Fayah (camp)	25°06′N 55°50′E	BMNH 1

APPENDIX. *Continued.*

Map No.	Locality	Latitude/longitude	Material examined
42	Ghazira	26°07′N 56°25′E	BMNH 1
?	"Muscat"	...	BMNH 2
	UNITED ARAB EMIRATES		
40	Siji	25°15′N 56°05′E	BMNH 1
41	Khor Fakkan	25°20′N 56°20′E	BMNH 1
43	Dig Dagga, near Ra's al Khaymah	25°48′N 55°56′E	BMNH 1
44	3 miles E of Dubai	25°14′N 55°17′E	BMNH 1
	ABU DHABI		
45	Al Hamra	...	BMNH 1
46	Camp 3, Habshan	23°50′N 53°37′E	BMNH 1
47	At or near Jebel Dhanna	24°11′N 52°36′E	BMNH 1
	BAHRAIN		
48	W of Ras Zuwayid	26°05′N 50°37′E	BMNH 1
48	Near Janabiya, W coast	26°11′N 50°28′E	BMNH 1
48	Bahrain	26°00′N 50°30′E	BMNH 2
	SAUDI ARABIA (eastern-coastal)		
49	Dhahran	26°18′N 50°05′E	FMNH 1
50	Ad Dammam	26°25′N 50°06′E	BMNH 2
51	Qatif	26°48′N 49°54′E	CAS 1
52	Urayirah	25°57′N 48°53′E	CAS 1
52	Nata	±26°N 59°E	CAS 1
	KUWAIT		
53	Arabian Gulf	29°20′N 48°00′E	BMNH 1
	SAUDI ARABIA (central and north-central)		
54	25 km SW of Hafar al Batin	28°29′N 46°00′E	BMNH 1
55	...	28°30′N 46°00′E	BMNH 1
56	...	27°35′N 44°55′E	BMNH 1
57	Quseida, near Burcida	26°20′N 43°59′E	BMNH 1
58	Rass, Qarim dist., 2500 ft	25°54′N 43°30′E	BMNH 1
59	Riyadh	24°39′N 46°46′E	BMNH 1
59	Riyadh, 25 km E	...	CAS 1
59	Khurais, 50 km W of Riyadh	25°06′N 48°04′E	BMNH 1
60	Rumaihiya	23°25′N 42°41′E	BMNH 1
61	Madaen Sahek	26°45′N 38°115′E	BMNH 1
62	Al Jauf	29°50′N 39°50′E	CAS 1
	GENERAL LOCALITY		
...	Saudi Arabia: Rub al Khali desert	...	BMNH 1
	ADDITIONAL MATERIAL EXAMINED		
	Psammophis schokari		
...	Egypt: Abu Rawash	...	FMNH 8
...	Somaliland: Guban, 150–3500 ft	10°11′N 42°43′E	BMNH 8
...	Somaliland: Buraw, 3100 ft	10°13′N 48°46′E	BMNH 1
...	Somaliland: 600 ft	11°05′N 49°E	BMNH 1
...	Somaliland: Golis Mts.	...	BMNH 1
...	Eritrea: Gulbub	16°33′N 39°07′E	BMNH 1
...	Eritrea: near Jabel Ghedem	...	BMNH 1
	Psammophis sibilans		
...	Egypt: Abu Rawash	...	FMNH 15

Field Museum of Natural History
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