Bull. Inst. Zool., Academia Sinica **2:** 55-56 (1963)

VARIATION IN COLOR PATTERN AND HOOD MARKING OF TAIWAN COBRAS[1]

SHOU-HSIAN MAO[2]

Received for publication November 24, 1963

ABSTRACT

The scale characteristics of Taiwan cobras are similar to those described by the other authors and the hemipenis also well agrees with Pope's description. Therefore, the Taiwan cobra is here refered to the subspecies *Naja naja atra.*

The color pattern of the local specimens manifests no uniformity. This is no surprise, since Pope has stated that the Asiatic cobras nearly everywhere exhibit a variability in color pattern.

The mask pattern also varies considerably. The common pattern in the population of Taiwan cobras is the full mask (21%); the monocellate type is extremely rare. In looking over the variations in each series, it is immediately apparent that various designs of mask really aberrant deviations, in which colorations, configurations, *etc.* have failed to develop or have not developed completely.

It has long been the general belief that there is only one subspecies of cobra in Taiwan as well as on the mainland of China. The Chinese cobra has been classified as *Naja naja atra* by several herpetologists (1-5), but Deraniyagala (6,7) using color pattern, hood marking and other characters, recognized the Chinese cobra as belonging to *Naja kaouthia atra.* Kaouthia refers to the monocellate or "O" shaped hood marking.

Pope, Romer and Deraniyagala (3, 5, 6, 7) briefly mention in their writings the variations in color pattern and hood marking of the cobras existing in Chinese mainland. This paper attempts to depict in detail the variations in color pattern and hood marking of Taiwan cobras, because the types of mask variations found in the author's collection are more marked than those described by the above-mentioned writers. Another noteworthy fact is the rarity of the monocellate marking in Taiwan cobras.

It is hoped that this study may be utilized later for finalizing the taxonomic status of the Chinese cobra, which as of this date, is not entirely clear.

MATERIALS

The mask variations depicted in this paper are based upon 86 specimens, some of which were bought from a Taipei whole-sale snake dealer. They had been collected in Pin-Tung Hsien (south Taiwan), Tai-Chung Hsien (central Taiwan), Tamsui (north Taiwan), and I-Lan Hsien (north-east Taiwan).

COLOR PATTERN VARIATIONS

Of the 86 specimens, 76 are dark brown above, 4 dusky brown, and 6 black. Most of the specimens of the first two groups bear a number of narrow pale cross-bands and scattered pale spots. In some specimens, the cross-bands are more or less connected by the scattered pale

1 This stndy was supported partly by the Institute of Zoology, Academia Sinica and China Medical Board of New York, Inc.

2 Assistant professor, Department of Biomorphics, National Defense Medical Center, Taipei, Taiwan.

spots, forming a somewhat diffuse marking. Frequently, 2 of these cross-bands lie very close to each other and, occasionally, may be merged on one side, while remaining separate on the other. Often 2 bands are either connected at mid-dorsum and separated on both sides, or merged on both sides and separated at the middle portion of the dorsum. Very rarely the specimens bear a number of short longitudinal pale lines, some of which may be more or less arranged in cross-bands. In one of my specimens (No. 325) there is only 1 cross-band behind the hood and in 3 others (Nos. 358, 360, and 401) the cross-bands are entirely absent.

From 10 to 15 anterior ventrals are pale yellow with a pair of lateral black spots on the 7th-8th in 9 specimens; the 8th-9th in 24; the 8th-10th in 1; the 9th-10th in 5; the 10th-11th in 2; the 7th in only 1; the 8th in 4, and the 9th in 2 specimens; inothers the black spots are more variable and not symmetrical. For instance No. 331 325 bears the left spot on the 8th-9th and the right spot on the 9th-10th; in No. 328 the left spot is on the 8th, the right spot on the 8th-9th; in No. the left spot is divided into 2: 1 on the 8th and 1 on the 9th, with the right spot on the 8th-9th; in No. 388 there are 2 pairs and a single spot: the 1st pair on the 5th, the 2nd pair on the 8th-9th and the single spot on the right end of the 12th. Generally the black spots are accompained by dark or dusky blotches. Anterior ventrals not bearing the black spots may be mottled with dark or dusky brown laterally or mesially. Most frequently the 4 ventrals (31 specimens) following the anterior pale-yellow ones are black or blackish. Occasionally 3 ventrals (12 specimens), rarely 5 (3 specimens), and very rarely 6 or 2 (1 specimen each) are black. Sometimes, a plate in front of the black ventrals is blackened on each side, with the middle portion pale yellow or a plate following the last one is black on the right half or twothirds. Other ventrals are yellow or greyish yellow with dark brown laterally and darker blotches mesially, sometimes with the latter much reduced; occasionally the ventrals may be dotted or dusted with black mesially. Subcaudals are yellowish, edged with dark brown laterally, rarely margined with dark brown posteriorly.

The dorsal color of the remaining 6 specimens is much darker (blackish) than that of the others, their cross-bands are yellowish and margined with black. Their number is apparently fewer than those of the specimens described above. On the ventral surface, the anterior pale-yellow ventrals, the paired lateral black spots and the black ventrals following the pale-yellow ones are similar to those of the dark brown specimens. Generally a few ventrals behind the black ones are yellow, clouded with black; other ventrals and subcaudals may be uniformly black or only the ventrals are black with several groups of distant yellow ventrals clouded or dotted with black. The subcaudals may or may not be dotted with darker spots in the middle portion but all are edged with black or dark brown laterally. In one specimen (No. 357) the ventrals behind the black ones are grayish yellow, clouded with dark brown blotches in the middle portion, edged with dark brown laterally. The subcaudals are yellowish, edged with dusky brown laterally.

MASK VARIATIONS

The dorsal design of the hood in Chinese cobras is called the "mask" by Pops (3). The complete or full mask of Pope is really a wide transverse, black-margined white band, suggesting a mask, extending across the hood and joining the light area of the throat. The mesial portion of this band enclosing a large central and two small lateral black spots is much wider than lateral portions. When the narrow lateral portions of the white band are interrupted by the dorsal ground color Pope designates it as an isolated mask. He also points out some other variations. The most primitive and simple design of the mask consists of 2 white spots in the center of the hood, corresponding to the mesial portion of the full mask. Such a feature is described by Pope as an imperfect mask.

Deraniyagala (6,7) defines the type of mask variation possessing only the large central black spot encircled by a white ring as monocellate, and that with two primitive white spots, each bearing a small lateral black spot, joining posteriorly, with the large central spot of the ground color, as binocellate.

The pictures of the mask variations shown in the Plate were photographed during the full extension of the hoods. They may be grouped into 7 series: Series A including figs. 1-7; Series B, 8-10; Series C, 11-15; Series D, 16-20; Series E, 21-24; Series F, 25-26; Series G, 27 only. Because some of the specimens died, a few other variations were not photographed.

1 Imperfect mask, indistinctly margined with black; with large black spot and a white stripe on right hood margin, in 1 specimen.

2 Mask isolated, margined with black; the medial black margins of the two mesial white spots merge into one forming the large central black spot, in 3.

3 Mask isolated, margined with black; large black spot joined to anterior and posterior borders; with two small black spots, in 1,

4 Mask joining the light area of throat, margined with black; large black spot joined to anterior and posterior borders; with 2 small black spots, in 2.

5 Mask joining the light area of throat, margined with black; large black spot joined to anterior border; with 2 small black spots, in 13.

6 Mask joining the light area of throat, margined with black; large black spot joined to posterior border; with 2 small black spots, in 1.

7 Full mask in 18 (4 ♀, 14 ♂).

8 Incompletely developed binocellate mask, margined with black; large spot in ground color joined the ground color of the hood anteriorly and posteriorly; with a trace of white on hood margin of both sides, in 1.

9 Mask binocellate, large spot in ground color joined to the ground color of the hood anteriorly; with white stripe on hood margin of both sides, in 4.

10 Mask isolated on left side, margined with black; large black spot joined to anterior border; with 2 small black spots, in 5.

11 Mask joining the light area of throat, margined with black; large black spot joined to anterior and posterior borders; with left small black spot, in 1.

12 Mask joining the light area of throat, margined with black; large black spot joined to anterior border, a thin white line between the posterior ends of the mesial portions; with right small black spot, in 1.

13 Mask joining the light area of throat, margined with black; large black spot joined to anterior border; with right small black spot in 2.

14 Mask joining the light area of throat, margined with black; large black spot joined to anterior border; with left small black spot, in 2.

15 Imperfect full mask with large and left small black spots, in 1.

16 Mask isolated on left side, without black margin; large spot in ground color joined to ground color of hood anteriorly and posteriorly, in 2.

17 Mask isolated on right side, without lateral portion on left side, margined with black; large spot in ground color joined to the ground color of hood anteriorly, in 1.

18 Mask isolated on left side, without black margin; large black spot joined to ground color of hood anteriorly, in 4.

19 Mask joining the light area of throat, margined with black; large black spot joined to anterior border, in 6.

20 Mask monocellate, joining th light area of throat, margined with black, in 2.

21 Mask joining the light area of throat, margined with black; large black spot joined to anterior and posterior borders; 2 small black spots, one on each hood margin, in 1.

22 Mask joining the light area of throat, without black margin; large spot in ground color joined to ground color of hood anteriorly and posteriorly; each half of mask with 2 small black spots, in 1.

23 Mask joining the light area of throat, without black margin; large spot in ground color joined to ground color of hood anteriorly and posteriorly; with 1 small black spot on left half, 3 on right half, in 1.

24 Mask joining the light area of throat, margined with black; large spot in ground color joined to ground color of hood anteriorly and posteriorly; small black spots merged into one on left half, 2 merged spots on right half, in 1.

25 Mask isolated, margined with black; mesial portions joined at middle; no spot, in 1

26 Mask joining the light area of throat, margined with black; 2 halves joined at middle; no spot, in 1.

27 Mask possessing only the lateral portion on each hood margin, in 1.

28 Six variations not photographed, in 7.

SCALE CHARACTERISTICS

The scale characteristics of the present collection agree well with the descriptions published by the authors cited at the beginning. Upper labials 7, very rarely 6 or 8, 3rd and 4th entering the eye; lower labials 8, occasionally, 7, very rarely 6, usually anterior 4 in contact with anterior chin-shields; preocular invariably 1; postoculars 2 or 3, very rarely 1; anterior temporals 2, occasionally 1; posterior temporals 2 or 3, rarely 1; scale smooth, in 23 rows (45 specimens), 24 (27 specimens), 25 (11 specimens) and 26 or 21 (1 specimen each) on the neck, 21 occasionally 19, at mid-body, and 15 before the vent. Other details are as follows:

	Sex	No. of specimens	Exteremes	Average
Ventrals	♂	44	157-171	164
	♀	41	165-176	171
Subcaudals	♂	35	44-52	48
	♀	36	43-50	47
Ventrals + subcaudals	♂	35	206-222	214
	♀	36	212-222	217
Total length	♂	35	65.9-118.6cm	92.3cm
	♀	36	75.2-115.6cm	95.4cm
Tail/Total length	♂	35	0.15-0.17	0.16
	♀	36	0.14-0.16	0.15

THE HEMIPENIS

The hemipenis usually extends to the 10th or 11th subcaudal plate, occasionally to the 9th or 12th, and is generally forked opposite 8th, occasionally the 7th or 9th. Its structures is similar in every detail to that described by Pope (3). The transverse smooth area between the anterior larger and posterior smaller spinous areas is constricted as a narrow ring if the hemipenis is injected out of the tail.

DISCUSSION

Pope (3) states that nearly all Asiatic cobras exhibit a variability in color pattern, therefore the lack of uniformity of pattern in Taiwan cobras is to be expected.

The percentage of the full mask (21%) in my collection is higher than other designs of the hood marking, therefore it may be considered to be the normal one. Various other types of mask are indisputable the individual variations, in which colorations, configurations, *etc.*, have failed to develop or have not developed completely. The variations in each series do not represent the various stages in the development of the final type of the marking, even through they look as if they do. It is impossible to make deductions on development of designs unless there has been an opportunity to study variations within a "limited community", or to study so-called litter mates to get an idea of the genetics involved. It seems that we need more precise data which would enable us to speculate on the evolution and development of the mask as Pope suggests.

On close inspection, I find that all of the hemipenis are deeply forked. This is further evidence to indicate that Taiwan cobras belong to *Naja naja atra.*

Acknowledgements Greatful acknowledgement is given to Dr. H. M. Liang, Director of the Instute of Zoology, Academia Sinica, for his encouragement of my study of Taiwan snakes, and sincere thanks are also due to Dr. R. E. Kuntz, Chief of Parasitology, NAMRU-2, Taipei, Dr. Y. H. M. Wang, Chairman of the Department of Zoology, National Taiwan University, and Dr. C. H. Pope a world-wide known herpetologist, for their valuable comments.

REFERENCES

1. STEJNEGER, L. 1907. Herpetology of Japan and Adjacent Territory. *Bull. U. S. Natl. Hist. Mus., Washington.* **58:** 394-396.
2. MAKI, M. 1931. *Monograph of the Snakes in Japan.* Dai-Ichi Schobo, Tokyo. pp 156-158.
3. POPE, C. H. 1935. *The Reptiles of China.* Amer. Mus. Nat. Hist., N. Y. pp 348-354.
4. WANG, C. H. and Y. H. M. WANG. 1956. The Reptiles of Taiwan. *Quart. J. Taiwan Mus.* **9:** 67-68.
5. ROMER, J. D. 1959. *Aid to the Recognition of Venomous Snakes in Hong Kong with Recommendations for First Aid Treatment of Bites.* Govt. Press, HK. 4.
6. DERANIYAGALA, P. E. P. 1960. The Taxonomy of the Cobras of South Eastern Asia —Part 1. *Spolica Zeylanica, Natl. Mus. of Ceylon* **29**: 41-63.
7. DERANIYAGALA, P. E. P. 1961. The Taxonomy of the Cobras of South Eastern Asia —Part 2. *Spolica Zeylanica, Natl. Mus. of Ceylon* **29**: 205-232.

1 No. 321 ♀

2 No. 330 ♂

3 No. 327 ♀

4 No. 322 ♂

5 No. 319 ♂

6 No. 326 ♂

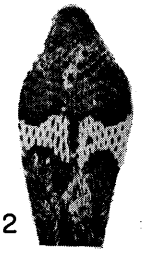
7 No. 339 ♂

8 No. 394 ♀

9 No. 345 ♂

10 No. 409 ♂

11 No. 404 ♂



12 No. 407 ♂

13 No. 358 ♂

14 No. 414 ♂

15 No. 410 ♂

16 No. 406 ♀

17 No. 359 ♀

18 No. 346 ♂

19 No. 408 ♀

20 No. 323 ♂

21 No. 310 ♀

22 No. 412 ♀

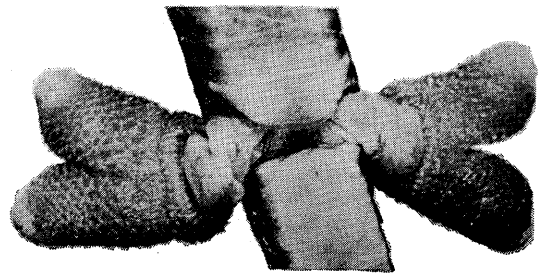
23 No. 411 ♀

24 No. 343 ♂

25 No. 413 ♂

26 No. 360 ♀

27 No. 405 ♂



HEMIPENIS