

## THE STATUS OF THE TAIWAN SNAKES OF THE COLUBRID GENUS *ZAOCCYS*<sup>1</sup>

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### ABSTRACT

The color pattern of the Taiwan rat snake is strikingly similar to that of the mainland *Zaocys dhumnades*, not to *Zaocys nigromarginatus*; the black stripes are never as black as those of *Z. nigromarginatus* and their edges conform closely to the borders of the scales. The hemipenis of the Taiwan *Zaocys* is forked, one lobe is very large, bulbous, and the other small, stubby. Although the island and mainland specimen of *Z. dhumnades* (including two subspecies—*Z. dhumnades dhumnades* and *Z. dhumnades montanus*) closely resemble each other in appearance, they differ in following characteristics: (1) Subcaudals 141-153, mean, 143.0 in the island form; 109-124, mean 114.1 in *d. dhumnades*; 131+—137, mean 134.5 in *d. montanus*; showing the island form to have a higher number of subcaudals. (2) Median scale rows keeled: 6, 8, 10 or 12 at mid-body, 6, 7, 8, 10, 11 or 12 at one head-length before the vent in the island form; 2 or 4 at mid-body or one head-length before the vent in *d. dhumnades*; 2 at mid-body, 2 or 4 at one head-length before the vent in *d. montanus*. The island form is thus shown to have more keeled rows. The frequent presence of 1 or 2 keeled rows on the neck may also be recognized as a characteristic of the island population. The morphological evidence here presented supports the contention that the island form is subspecifically distinct from the mainland *Zaocys dhumnades*, and the name *Zaocys dhumnades oshimai* Stejneger, has correctly been applied to it by Pope.

Stejneger (1) included Taiwan in the range of *Zaocys dhumnades* of China. Oshima (2) believed the Taiwan species to be the same as that of the adjacent mainland. Because Taiwan specimens have higher subcaudal counts and a yellow vertebral stripe on the anterior half of the body, Stejneger (3) later separated the Taiwan population from the mainland form, naming it *Zaocys oshimai*. Maki (4)

classified the island form as a subspecies of *Zaocys nigromarginatus*. Maki thought that the subcaudal counts for *Z. oshimai* (140-144) and *Z. nigromarginatus* (117-137), recorded by Stejneger (3), were matched by the subcaudals of his three Taiwan specimens (138, 139 and 140). Pope (5) maintained that the Taiwan population should be classified as *Z. dhumnades oshimai* (Taiwan rat snake), since it has a higher average subcaudal count and more keeled median scale rows than the mainland *Z. dhumnades*. Moreover, he showed that the pattern of the black stripes in

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these two populations is exactly the same, but quite different from that of *Z. nigro-marginatus*. Other authorities like Okada (6) and Wang and Wang (7) adopted Maki's classification, but Chen (8) preferred Pope's. Recently Kuntz (9) recognized the island form as *Z. dhumnades*.

#### MATERIAL EXAMINED

A total of 41 (33♂, 8♀) specimens was collected from May, 1960 to April, 1965. Three were taken from Wulai, a mountain village, 25 kilometers south of Taipei; 10 from Hua Lien Hsien (eastern Taiwan); 2 from Tai Pein Shan, I-Lan Hsien (northeastern Taiwan); 26 from Puli, a small town at the foot of the Central Mountain Range in Nan Tou Hsien (central Taiwan).

#### SCALE CHARACTERISTICS AND MEASUREMENTS

Upper labials 8, rarely 9, usually the 4th and 5th bordering the eye, rarely the 5th and 6th; lower labials 10, rarely 9, 5 anterior lower labials in contact with the anterior chinshields, which are shorter than the posterior pair; preoculars 2, very rarely 1; postoculars 2, very rarely 3; loreal invariably 1; temporals 2+2, frequently the anterior upper or the posterior lower one on each side may be divided

transversely; anal divided; dorsal scales in 16-16-14 rows, with two rather large apical pits.

The ventral and subcaudal counts and measurements are shown in TABLE I.

#### COLOR PATTERN

The upper head is olive, dark olive or blackish, and the upper labials are usually yellowish white. The posterior one-half to two-thirds of the upper body is dark olive or slaty black; occasionally the upper body may be slaty black throughout, in which case the black is more intense posteriorly. A conspicuous olive-yellow vertebral stripe, covering two median scale rows, starts on the neck and extends posteriorly to merge with the uniform color of the posterior body. The vertebral stripe is bordered on each side by a prominent black stripe, two scale rows wide, the edges conforming with those of the scales. Posteriorly, the black stripes merge with the black of the body. The scales below the black stripes are bordered with black and their centers are olive with a bluish tint. Some distance posterior to the head, the scales of the third row lose their light centers, forming a narrow black stripe, which soon merges with the uniform color posteriorly. The chin, throat and a short section of the anterior portion of the belly are whitish,

TABLE I  
*Ventral and subcaudal counts and measurements of Taiwan rat snakes*

	Sex	No. of specimens	Range	Mean
Ventrals	♂	33	190+*-205	198.0
	♀	8	192-200	196.0
Subcaudals	♂	3	141-153	147.0
	♀	1	139	139.0
Total length	♂	3	163.7 cm-179.6 cm	171.6 cm
	♀	1	153.5 cm	153.5 cm
Tail Total length	♂	3	0.33-0.34	0.335
	♀	1	0.33	0.330

\* + means a half ventral, but recognized as a complete one.

occasionally with dusky blue spots; the rest of the belly may be uniformly grayish or dusky blue. The lateral tips of the ventrals are dark.

### HEMIPENIS

*Shape*—The hemipenis is forked. When the organ is retracted, the lateral external wall bears two deep longitudinal fissures, which begin at about the middle of the organ and merge distally (*Fig. 1*). When the organ is split along the median line of the medial surface and spread flat, it is clearly seen that the distal portion of the organ is divided into two, the two parts are united by a very thin layer of connective tissue (*Fig. 2*). In the fully everted hemipenis, one lobe is extremely large, bulbous, and the other is small and much reduced. *Fig. 4* shows the two lobes, the major lobe possesses a large white area, which is the insertion of the larger slip of the *M. retractor penis magnus*. The minor lobe is represented by the small white area, the insertion of the smaller slip of the same muscle.

*Length*—The hemipenis (*in situ*) generally extends to the 10th or 11th subcaudal plate, very rarely to 9th, 12th or 13th. The average termination being opposite the 11th subcaudal plate.

*Sulcus spermaticus*—This structure is single and short (about  $\frac{1}{2}$  the organ length). In the everted organ it extends to and ends at the base of the fork of the two lobes (*Fig. 4*). The lips are somewhat raised, smooth basally, calyculate in the calyculate area of the organ.

*Ornamentation*—The hemipenis is spinous proximally and calyculate distally. Two large basal hooks, adjacent to each other, a slight distance to one side of the sulcus, are followed distally by a spinous area.

Most of the spines are short, thick and approximately uniform in size, a few small spines usually present among the large ones. Each spine is laterally compressed, sharply pointed, recurved and set in a fleshy lobe. The spinous area is

sharply defined from the distal calyculate area. The calyces are deep and their lips edged with tiny spinules (fringed). The entire calyculate area presents a founce-like appearance. The calyces are largest basally reducing in size distally on each lobe of the organ. The dividing septa appear to reduce or be lost distally on the organ thus forming small founce-like structures. The calyces also are reduced to the inner surface of the lobes, which appear smooth (*Figs. 3, 4 and 5*).

*Musculature*—The *M. retractor penis magnus* usually originates at the 36th or 37th subcaudal plate, rarely the 34th, 35th or 38th, very rarely the 32nd, 33rd or 39th subcaudal. The muscle generally forks opposite the 13th plate, rarely the 12th or 14th, very rarely the 11th or 17th. The smaller slip branches from side of the major slip of the muscle and each extends to the tip of smaller and larger lobes, respectively. (*Figs. 2 and 3*).

### NUMBERS OF MEDIAN KEELED ROWS IN THE TAIWAN RAT SNAKE

The number of the median keeled rows in local specimens examined is shown in TABLE II. The keeled rows on the tail generally extend  $\frac{1}{3}$  or  $\frac{1}{2}$  the length of the tail; they may reach a point only a short distance from the tail's end.

### HABITS AND HABITAT

All of my specimens were collected in the mountains from 100 to 550 meters above sea level, often a short distance from mountain brooks. When they became aware of my presence, they attempted escape with great swiftness. Two females (Nos. 639 and 641) from Puli contain 11 and 9 eggs not well developed. Nothing was found in the stomachs of the above females and the other two Puli males (Nos. 636 and 643). Captive specimens fed on frogs and white mice.

TABLE II  
Keel rows in Taiwan rat snakes

Localization		Sex	No. of specimens	No. of keeled rows
Neck	just behind head	♂	10	1 or 2
		♀	—	—
	½ head-length posterior to head	♂	9	1 or 2
		♀	—	—
	1 head-length posterior to head	♂	10	1 or 2
		♀	1	2
	1½ head-lengths posterior to head	♂	1	2
		♀	4	2
	2 head-lengths posterior to head	♂	3	2
		♀	3	2
Mid-body	♂	33	6, 8, 10 or 12	
	♀	8	6 or 8	
Head-length anterior to vent	♂	33	7, 8, 10, 11 or 12	
	♀	8	6, 8 or 10	

## DISTRIBUTION

Data from the literature and from the present collections show that this snake is widely distributed in the mountain areas from northern Taiwan to the southern tip of the island.

The type specimen is now in U. S. National Museum (No. 52267; Collector Baker; November 18, 1914). It was taken from Urai (now named Wulai, in Taipei Hsien), northern Taiwan.

For comparison, I examined 9 specimens of *Zaocys* from the mainland of China, borrowed from the American Museum of Natural History, New York (AMNH) and the Chicago Natural History Museum (CNHM). These are:

1. *Zaocys dhumnades dhumnades* (CNHM 7071 ♂).
2. *Zaocys dhumnades montanus* (CNHM 24840 ♂, 24841 ♂; AMNH 34331 ♂, 34332 ♂).
3. *Zaocys nigromarginatus* (CNHM 7057 ♂; AMNH 21002 ♂, 23503 ♂, 62654 ♂).

## DISCUSSION

*Zaocys* comprises a small genus of snakes distributed from Nepal eastward through southern China, south through the peninsula of southeastern Asia and on into the Malay Archipelago and the Philippine Islands. These snakes are distinguished by their even scale row counts, a most unusual characteristic. The type species of *Zaocys* is the common Chinese *Z. dhumnades* (type locality, Chusan Islands, Chekiang Province). The only other species that concerns us here is *Z. nigromarginatus*, a Himalayan species, which ranges eastward to western China. These two species are readily confused.

Though the known range of *Z. nigromarginatus* is remote from Taiwan, there is a zoogeographic possibility that it occurs here; various forms known from extreme western China and the adjacent highlands to the west, occur in the mountains of Taiwan, apparently being absent or unknown from the intervening terri-

TABLE III  
Subcaudal counts in *Zaocys dhumnades*

Subspecies	Sex	Subcaudal counts		
		Range	Mean	Mean for sexes combined
<i>Zaocys dhumnades oshimai</i>	♂	141-153 (3)	147.0	143.0
	♀	139 (1)	139.0	
<i>Z. dhumnades dhumnades</i> *	♂	109-119 (6)	113.2	114.1
	♀	108-124 (12)	115.0	
<i>Z. dhumnades montanus</i> *	♂	131+ (1)	—	134.5
	♀	137 (1)	—	

\* The figures for *d. dhumnades* and *d. montanus* are cited from Pope (5).

tory. A population of *Zaocys* is known from the highlands of the mainland adjacent to Taiwan and has been identified by Pope (5) as *Z. dhumnades montanus*, not *Z. nigromarginatus*.

The most reliable character distinguishing *nigromarginatus* from *dhumnades* is coloration. The differences are more evident in the young than in the adult. Pope (5) has recorded these differences in detail and I find that my local specimens conform closely to his description of *dhumnades* and differ noticeably from *nigromarginatus*. Therefore I shall eliminate *nigromarginatus* from the determination of the identity of the Taiwan population, mentioning it only in the section on taxonomic history. Much confusion has been introduced by workers who paid too little attention to color patterns.

The scale characteristics, except the subcaudal counts, and color pattern of the

local specimens are strikingly similar to those of the mainland *Zaocys dhumnades*. *Zaocys dhumnades* is divided into two subspecies by Pope (5)—*Zaocys dhumnades dhumnades* and *Z. dhumnades montanus*, on the basis of their subcaudal counts and habitat. For comparison, the subcaudal counts in the mainland and island forms are shown in TABLE III. The figures in parentheses indicate the number of specimens counted.

In my series (33♂, 8♀), there are only 3 males and 1 female with perfect tails, and most of the specimens with a perfect tail are comparatively smaller (153.5-179.6 cm). Pope (5) has already pointed out that *Zaocys* often suffers injury to tail long before maturity. He found only 1 individual in 12 *d. montanus* from Chungan Hsien (mainland) with a perfect tail. He believed that the subcaudal count in that series would certainly aver-

TABLE IV  
Variation of keeled rows in *Z. dhumnades*

Subspecies	Variation of keeled rows		
	Head-length posterior to head	Mid-body	Head-length anterior to vent
<i>Zaocys d. oshimai</i>	1 or 2 (11)	6, 8, 10 or 12 (41)	6, 7, 8, 10, 11 or 12 (41)
<i>Z. d. dhumnades</i> *	—	2 or 4 (18)	2 or 4 (18)
<i>Z. d. montanus</i> *	—	2 (11)	2 or 4 (11)

\* The figures for *d. dhumnades* and *d. montanus* are cited from Pope (5).

age more than 130, if undamaged. TABLE III clearly shows that the island population (*Zaocys d. oshimai*) has higher subcaudal counts.

TABLE IV shows the variation in the number of keeled mid-dorsal scale rows, at three points on the body, in the

mainland and island forms.

The Taiwan form bears more keeled rows at mid-body and a head-length before the vent than either of the mainland forms. In each form, mainland and island, the keeled rows are variable, and especially in the Taiwan specimens.

TABLE V  
No. of spines in spinous area in *Z. dhumnades*

Subspecies	Catalog number	Hemipenis	No. of spines in spinous area		
			Variation	Range	Mean
<i>Zaocys dhumnades oshimai</i>	480	Right	—	33-46	39.5
		Left	46		
	620	Right	—		
		Left	39		
	634	Right	33		
		Left	—		
	635	Right	39		
Left		—			
636	Right	39			
	Left	39			
643	Right	37			
	Left	—			
644	Right	—			
	Left	36			
<i>Z. d. dhumnades</i>	7071(CNHM)	Right	43	34-43	38.5
		Left	34		
<i>Z. d. montanus</i>	34332(AMNH)	Right	35	32-35	33.5
		Left	32		

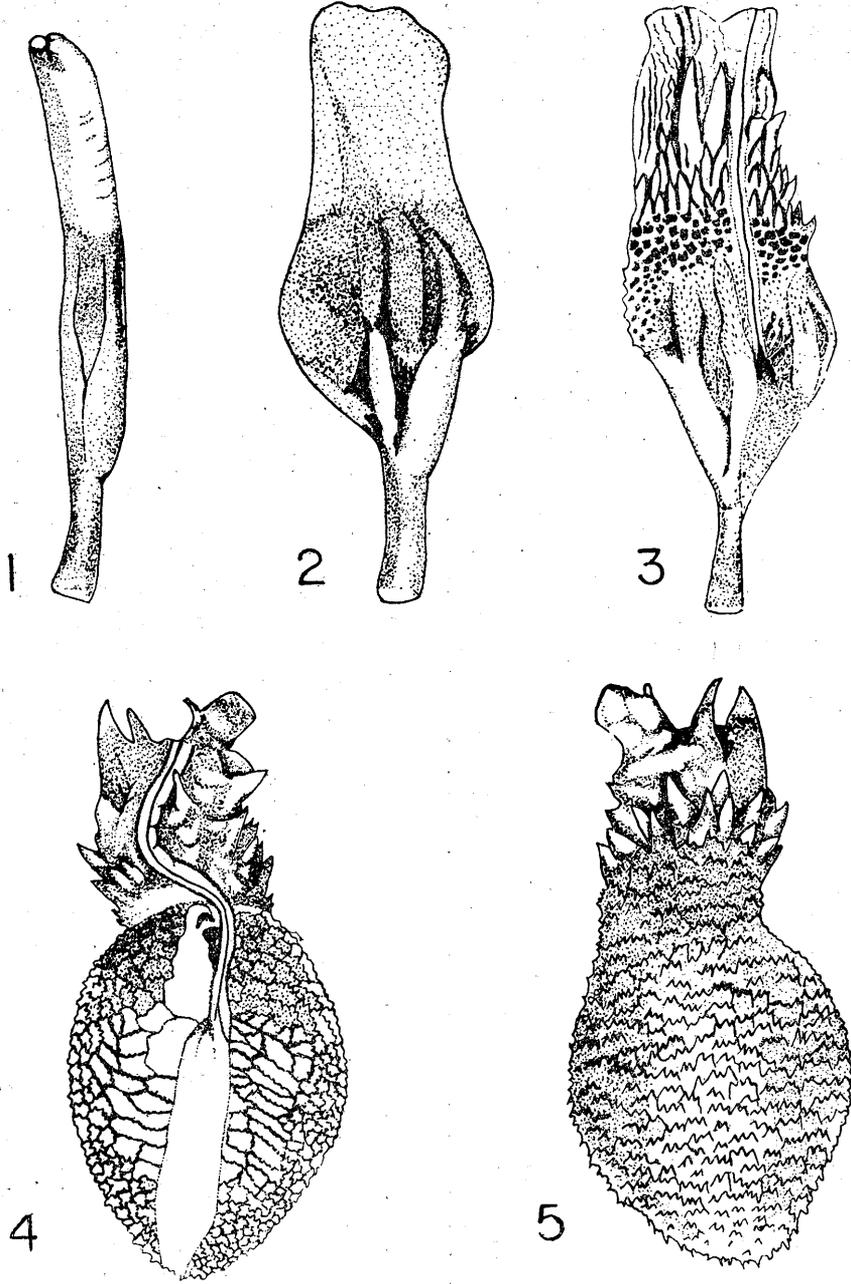
Fig. 1. Left hemipenis, retracted, showing two longitudinal fissures on its external wall (No. 620). Nat. size.

Fig. 2. Left hemipenis, split along the median line of the medial surface and spread flat, showing the major and minor lobes and bifurcation of *M. retractor penis magnus* (No. 620). Nat. size.

Fig. 3. Same as Fig. 2, showing the internal structures (No. 620). Nat. size.

Fig. 4. Left hemipenis, everted, showing the internal structures on the medial surface. The major lobe very large, bulbous, with a large white area (insertion of the major slip), the minor lobe represented by the small white area (insertion of the minor slip) (No. 644). Nat. size.

Fig. 5. Same as Fig. 4, showing the internal structures on the lateral surface of the major lobe (No. 644). Nat. size.



The hemipenis of *d. oshimai* is forked, one lobe is extremely large, the other much reduced. This condition is similar to the hemipenial structure found in the African natricine snake of the genus *Natriciteres*. The number of the spines, except the two basal hooks, in the spinous area of the hemipenis of the three forms examined are tabulated in TABLE V.

The counts made indicate that the number of hemipenial spines in *Zaocys* is variable. Owing to the lack of available mainland specimens the means may not be reliable. The mean of 39.5 for Taiwan specimens, however, is meaningful. The Taiwan population (*oshimai*) thus seem to possess more spines.

No comparison can be made here for the level of origin of *M. retractor penis magnus*, since in some of the mainland specimens borrowed from the States, the *M. retractor penis magnus* was cut short.

The color pattern of the Taiwan specimens is exactly like that of the mainland *Z. dhumnades*. In the present series, a few of the smaller ones (Nos. 052 ♀, 640 ♂, 641 ♀; 114.5–168.3 cm) bear distinct stripes throughout and the large ones usually become black posteriorly or throughout. If black throughout, the shade is generally darker posteriorly. Pope (5) is correct in stating that *Z. dhumnades* loses the pattern posteriorly, in advance of anteriorly, during ontogeny.

The island form appears to be more closely allied to the mainland *d. montanus*. The number of subcaudals in the island form is higher than in *d. montanus*, but much more so than in *d. dhumnades*. In addition, both the island form and *montanus* are mountain inhabitants, and *d. dhumnades*, according to Pope (5), is a lowland dweller. Pope (5) stated that *montanus* occurs in the Sanchiang mountains (3500 feet above sea level) of Chungan Hsien, Fukien, which is almost opposite this island. It is highly probably that *montanus* had migrated to Taiwan when this island was still connected with Fukien. The data from literature and present collections show that all Taiwan specimens were obtained in comparatively

low mountains. Inferentially, it seems quite possible that the Taiwan form also may be found in the high mountains.

Taiwan specimens possess a higher average subcaudal count and a greater number of keeled median scale rows. Further, their color pattern agrees entirely with that of the mainland *Z. dhumnades*. It is, therefore, reasonable to classify the Taiwan form as *Z. dhumnades oshimai*, a subspecies closely related to *Z. dhumnades montanus*.

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