



Revision of the diagnostic characters of *Opisthotropis maculosa* Stuart and Chuaynkern, 2007 with notes on its distribution and variation, and a key to the genus *Opisthotropis* (Squamata: Natricidae)

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Abstract

Opisthotropis maculosa was described based on a single specimen collected from northeastern Thailand in 2007. We collected three specimens from Guangxi and Guangdong, China. These additional specimens provide the first information on morphological variation in this species, including sex-related differences. Based on the new information, we revise the diagnostic characteristics of this species and provide a key to the currently recognized species of *Opisthotropis*.

Key word: China, diagnosis, herpetology, morphology, sexual dimorphism, snakes

Introduction

The oriental snakes of the genus *Opisthotropis* (Günther 1872), currently containing ca. 20 species, are distributed across southern China and mainland Southeast Asia extending to Sumatra (Indonesia), the Philippines and northward to the Ryukyu Archipelago of Japan (Zhao & Adler 1993; Orlov *et al.* 2000; Stuart 2006; Stuart & Chuaynkern 2007; Murphy *et al.* 2008; Ziegler *et al.* 2008). Fascinatingly, most of the species are known only from very few specimens or described based on single specimens (see Stuart & Chuaynkern 2007 and Ziegler *et al.* 2008 for examples and references). These natricid snakes, normally inhabiting hill streams and nearby terrestrial habitats, have been known to forage on juvenile crabs (Ota, 2004), and earthworms, fishes, tadpoles, frogs, and shrimps (as reviewed by Ziegler *et al.* 2008). Probably due to their secretive nocturnal lives in stream habitats, the diversity of this genus is likely still not fully revealed, and two species were described in the last few years when field efforts were enhanced (Stuart & Chuaynkern 2007; Ziegler *et al.* 2008).

In 2004, Kadoorie Farm and Botanic Garden (KFBG 2004) reported an unidentified species of *Opisthotropis* from a hill stream in Dawuling Nature Reserve (collected in July 2002), western Guangdong Province, China and noted it was probably an undescribed species. In July 2009, while conducting a survey of amphibians and reptiles in southern Guangxi Zhuang Autonomous Region, China, we collected two adult natricid specimens in riparian habitats of subtropical forests. The morphological characters of these three specimens agreed with Smith's (1943) definition of the genus *Opisthotropis*. We identified these three specimens as *O. maculosa*, a species described originally from Thailand, based on the combination of the following characters: all scales smooth; 15 dorsal scale rows; glossy black dorsum with single yellow spot on each scale (Stuart & Chuaynkern 2007). The three specimens, two males and one female, represent not only the second to fourth known reports of the species but also a new record for China.

Opisthotropis maculosa (originally *O. maculosus*) was described on the basis of a single male specimen (Stuart & Chuaynkern 2007) collected in Thailand and hence morphological variations could not be given. Here we use the Chinese specimens to supplement the original description of the species and provide data on morphological variation, including sexual dimorphism. The diagnostic characters of this species are also revised accordingly.

Material and methods

Two specimens (SYS r0537 and SYS r0538) were collected from Shiwanshan Mountain (21° 53' 39.9" N, 107° 54' 16.0" E, 493 m asl, coll. Qing Du and Jian-Huan Yang, 10 July 2009) and Wuhuangling Mountain (22° 08' 57.7" N, 109° 20' 58.8" E, 355 m asl, coll. Qing Du and Run-Lin Li, 14 July 2009), Guangxi, China, respectively. They are preserved in 80% ethanol and deposited in The Museum of Biology, Sun Yat-sen University, Guangzhou, China (SYS). Specimen KFBG 2002.01 was collected from Dawuling Mountain (1150 m asl, coll. Xiao Zhi, 2 July 2002). It is preserved in 80% ethanol and deposited in Kadoorie Farm and Botanic Garden, Hong Kong SAR, China (KFBG).

Dorsal scale rows were counted at one head's length behind the head, mid-body (halfway between rear of head and cloaca) and one head's length in front of the cloaca. Ventral scales were counted following Dowling (1951). Measurements were made on preserved specimens with a soft measuring tape to the nearest 1 mm. Sex was determined by dissection or by the presence of everted hemipenes. Abbreviations are as follows: Total length (TL) from the tip of snout to the tip of tail; snout-vent length (SVL) from tip of snout to anterior margin of cloaca; tail length (TaL) from posterior margin of cloaca to tip of tail. Data for the holotype (National Science Museum, Bangkok, Thailand: THNHM 05343) of *Opisthotropis maculosa* in Table 1 are based on Stuart & Chuaynkern (2007). Data for other species of the genus *Opisthotropis*, and for *Paratapanophis praemaxillaris* and *Parahelicops annamensis* were obtained from literature (Boulenger 1888; Boulenger 1914; Pope 1935; Zhao *et al.* 1998; Stuart 2006; Zhao 2006; Stuart & Chuaynkern 2007; Murphy *et al.* 2008; Ziegler *et al.* 2008) and from examined *Opisthotropis* specimens stored in SYS and KFBG (Appendix).

Results

Description of the Chinese specimens (Fig. 1). Head small, indistinct from neck, body round in cross section and slender; eye small, pupil round; nostril directed dorsally. Rostral broader than high, visible from above; nasal divided, surrounded by the first two supralabials, rostral, internasal, prefrontal and loreal; two internasals, in contact with rostral anteriorly; one prefrontal, about twice as width as length, pentagonal and tapering anteriorly; one frontal, width about 1.2 times length, about equal to its distance from snout tip, five-sided and tapering posteriorly; one pair of parietals, about 1.9 times longer than frontal; one loreal, not in contact with internasals and eye, surrounded by 2nd and 3rd supralabials, nasal, prefrontal and preocular; one preocular, in contact with frontal; one postocular in SYS r0538 and KFBG 2002.01, two in SYS r0537; one supraocular, small, not in contact with prefrontal; frontal touching eye in SYS r0537, not in other two specimens; subocular absent; seven supralabials (3-2-2) on both sides, fourth and fifth touching eye in SYS r0538 and KFBG 2002.01, eight supralabials (3-1-4) on both sides, only fourth touching eye in SYS r0537; 1+1 temporals on both sides; eight infralabials on both sides in SYS r0538 and KFBG 2002.01, nine infralabials on left side and eight on right side in SYS r0537, first touching each other behind mental; two pairs of chin shields, posterior shorter than anterior in SYS r0538 and KFBG 2002.01, reverse in SYS r0537; 15:15:15 dorsal scale rows; all scales glossy with apical pits. Hemipenes cylindrical, extending to level of 12th subcaudal in SYS r0538. Tail of two males (SYS r0538 and KFBG 2002.01) subcylindrical, relatively long, thin at base then thickened for short length before narrowing gradually to tail tip; tail of female (SYS r0537) subcylindrical, relatively short, narrowing smoothly from base to tail. Measurements and some scale characters given in Table 1.

Color in life. Eye black; scales on top of head glossy black with scattered yellow flecking; labials of holotype and SYS r0537 yellow edged with black, versus labials of SYS r0538 and KFBG 2002.01 black with scattered yellow flecking; chin shields yellow with scattered black flecking; body and tail glossy black with iridescence above, with single yellow spot on each scale, yellow spots becoming larger on sides of body; ventrals yellow with black lateral margins; subcaudals yellow with black anterior and lateral margins.



FIGURE 1. New Chinese specimens of *Opisthotropis maculosa*. Specimen SYS r0538 (male): **(A)** General aspect in life; **(B, C)** dorsal and ventral views of head; **(D)** dorsolateral view of anal region showing tail thinning at base and thickening posteriorly. Specimen SYS r0537 (female): **(E, F)** Dorsolateral and ventral views of head; **(G)** ventral view of anal region. Specimen KFBG 2002.01 (male): **(H)** hemipenes. Photographs by Jian-Huan Yang and Qing Du.

TABLE 1. Comparisons of morphological characters for the holotype (THNHM 05343; data from Stuart & Chuaynkern 2007) and new Chinese specimens (SYS r0537, SYS r0538 and KFBG 2002.01) of *Opisthotropis maculosa*.

Specimen	Holotype	SYS r0537	SYS r0538	KFBG 2002.01
Sex	Male	Female	Male	Male
SVL (mm)	410	398	358	373
TaL (mm)	110	109	123	110
TaL/TL ratio	0.21	0.21	0.26	0.23
Pre-ventrals	2	2	1	2
Ventrals	182	166	188	172
Paired subcaudals	67	75	97	83
Frontal touching eye (+) or not (-)	-	+	-	-
Prefrontal touching supraocular (+) or not (-)	+	-	-	-
Frontal touching preocular (+) or not (-)	-	+	+	+
Postoculars	2	2	1	1
Supralabials at eyes	4th	4th	4th and 5th	4th and 5th
Supralabials	8 (3-1-4)	8 (3-1-4)	7 (3-2-2)	7 (3-2-2)
Infralabials	8(L), 9(R)	9(L), 8(R)	8	8
Length of chin shields	Posterior > anterior	Posterior > anterior	Anterior > posterior	Anterior > on left, < on right
Infralabials touching anterior chin shields	1-5 on both sides	1-5 on left, 1-4 on right	1-3 on left, 1-4 on right	1-4 on both sides

Variation. Differences between the holotype and the three Chinese specimens in measurements and scalation are listed in Table 1. The three Chinese specimens largely resemble the holotype except that: SYS r0537 differs from holotype in having one supraocular very small, not in contact with preocular and prefrontal; frontal touching eye and preocular; nine infralabials on left, eight on right; anterior chin shield in contact with first five infralabials on left, first four on right; 166 ventrals, last one divided; 75 paired subcaudals, first one undivided. SYS r0538 differs from holotype in having supraocular small, not in contact with prefrontal; frontal touching preocular; one postocular; seven supralabials, 4th and 5th in contact with eye; eight infralabials on both sides; anterior chin shield in contact with first three infralabials on left, first four on right; anterior pair of chin shields longer than posterior pair; 188 ventrals; 97 paired subcaudals. KFBG 2002.01 differs from holotype in having supraocular small, not in contact with prefrontal; frontal touching preocular; one postocular; seven supralabials, 4th and 5th in contact with eye; eight infralabials on both sides; anterior chin shield in contact with first four infralabials on both sides; anterior chin shield longer than posterior on left side, shorter on right side; 172 ventrals, last one divided; 83 paired subcaudals.

Revision of diagnostic characters. Due to the variations observed in the additional Chinese specimens, the diagnostic characters need to be revised accordingly. *Opisthotropis maculosa* differs from other species in the genus by the combination of: all scales smooth; dorsal scale rows 15:15:15; internasal not in contact with loreal; glossy black with iridescent dorsum with single yellow spot on each scale, yellow spots becoming larger on sides of body.

Distribution, ecology and behavior. *Opisthotropis maculosa* is currently known only from four localities (Fig. 2): the type locality in the Phu Wua Wildlife Sanctuary (18° 14' 31.0" N, 103° 57' 44.5" E, 190 m asl.) on the Khorat Plateau of Thailand, near the Mekong River and border with Laos; Shiwanshan National Forest Park, Shangsi County, Guangxi, China; Wuhuangling Forest Park, Pubei County, Guangxi, China; Dawuling Nature Reserve, southwestern Guangdong, China (See Materials and Methods for coordinates of Chinese specimens). *Opisthotropis maculosa* is an aquatic snake living in hill streams from low to mid altitudes (190–1,150 m asl.). As with the holotype (Stuart & Chuaynkern, 2007), the Chinese specimens were collected from rocky streams running

through well-preserved, dense deciduous forests. The streams flow through rocky outcrops or large boulders with a substrate of gravel, stone and rock. The stream at the Shiwanshan National Forest Park is about 8 m wide and 0.3 m deep at the collecting site, the one at Wuhuangling Forest Park 4 m wide and 0.4 m deep, and that at Dawuling Nature Reserve about 2 m wide and 0.4 m deep. The former two specimens were spotted swimming at night and swiftly hid themselves under stones when disturbed. The specimen at Dawuling was seen at daytime during a heavy rainshower. It was swimming in a stream pool with another similar sized individual that escaped. They struggled fiercely when restrained in hand (as reported for the holotype). No other congeners were found syntopically. The biology of this species remains almost entirely unknown.

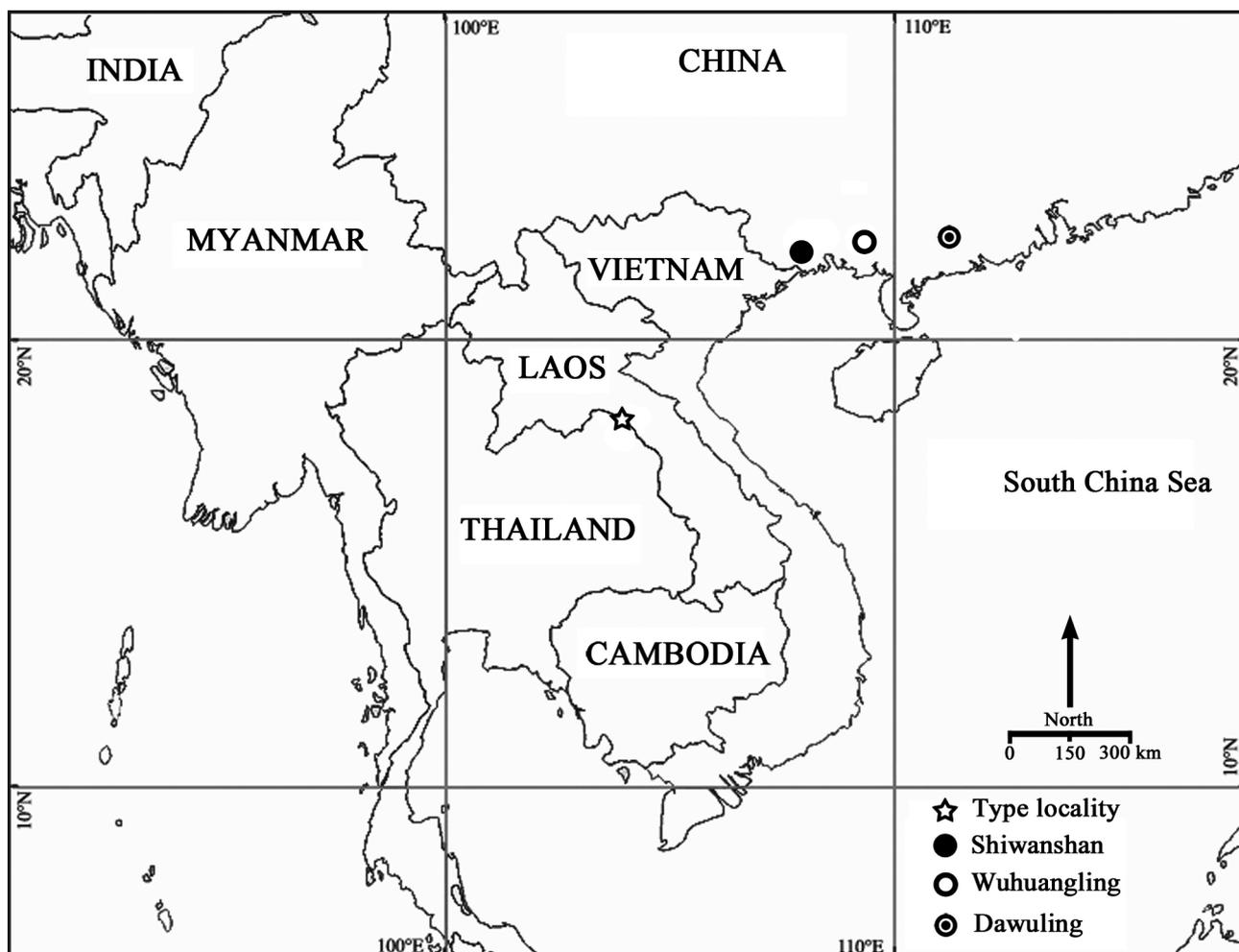


FIGURE 2. Map of Indochina and southern China showing localities for *Opisthotropis maculosa*: Phu Wua Wildlife Sanctuary, Nong Khai Province, Thailand; Shiwanshan Mountain and Wuhuangling Mountain, Guangxi, China; Dawuling Mountain, Guangdong, China.

Key to the species of *Opisthotropis*

With reference to the literature (see Zhao *et al.* 1998; Stuart 2006; Stuart and Chuanynkern 2007; Murphy *et al.* 2008; Ziegler *et al.* 2008) and the information from the additional specimens outlined in this paper, we provide a key to the species of *Opisthotropis* plus the similar species *Parahelicops annamensis* and *Paratapinophis praemaxillaris*. Pope (1935) placed *Paratapinophis* in the synonymy of *Opisthotropis* and it remained there until Murphy *et al.* (2008), without phylogenetic analysis, removed it based on its morphological distinctiveness. Smith (1943) placed *Parahelicops* in the synonymy of *Opisthotropis* and most authors have since followed that as recently as Stuart & Chuanynkern (2007) although some do recognize *Parahelicops* (Orlov 1995; Orlov *et al.* 2003, for example). Ziegler *et al.* (2008) were uncertain about *Parahelicops* and use both generic names for *annamensis*. The key is as follows:

1	Midbody scales in 15 rows	2
-	Midbody scales in 17 or 19 rows	6
2	All scale smooth	3
-	Posterior dorsal scales keeled	5
3	Temporal scales 1+2, subcaudals 51–58	<i>O. guangxiensis</i>
-	Temporal scales 1+1, subcaudals 60–97	4
4	Uniformly glossy dark above; internasals in contact with loreals	<i>O. jacobi</i>
-	Glossy black dorsum with a distinctly yellow spot on each dorsal scale; internasals not touching loreals	<i>O. maculosa</i>
5	Supralabials 6, subcaudals 58–89, ventral scales 176–198	<i>O. kikuzatoi</i>
-	Supralabials 8–9, subcaudals 117–123, ventral scales 167–169	<i>Parahelicops annamensis</i>
6	Midbody scales in 17 rows	7
-	Midbody scales in 19 rows	16
7	Anterior body scales in 17 rows	8
-	Anterior body scales in 19 rows	14
8	Internasals in contact with loreals	9
-	Internasals not touching loreals	10
9	Subcaudals 39–47	<i>O. daovantieni</i>
-	Subcaudals 55–89	<i>O. spenceri</i>
10	Preoculars absent; loreals in contact with eyes	11
-	Preoculars present; loreals not touching eyes	12
11	Olive dorsum with light yellow crossbars	<i>O. cheni</i>
-	Dorsum with black and yellow striped pattern	<i>O. latouchii</i>
12	Presence of a dark lateral stripe that sharply separates the dark dorsal from the pale ventral coloration; supralabials 10 (rarely 9 or 11)	<i>O. lateralis</i>
-	Dark lateral stripes absent; supralabials 7–9	13
13	Olive-black above, each scale edged with white margin; dorsal scales feebly keeled above 2nd scale row from the nape to the tail; supralabials 8 (rarely 9)	<i>O. andersonii</i>
-	Blackish-brown above, each scale with uniform color; dorsal scales smooth on nape, feebly keeled on body, strongly keeled towards the tail; supralabials 7 (rarely 6 or 8)	<i>O. maxwelli</i>
14	Anterior temporal scales one	15
-	Anterior temporal scales two	<i>O. tamdaoensis</i>
15	With single prefrontal scale	<i>O. ater</i>
-	With divided prefrontal scales	<i>O. rugosa</i>
16	Anterior body scale 21 rows	<i>O. alcalai</i>
-	Anterior body scale 19 rows	17
17	Posterior body scale 17 rows	18
-	Posterior body scale 19 rows	<i>O. kuantunensis</i>
18	Dorsal scales smooth (female) or slightly keeled (male)	<i>Paratapinophis praemaxillaris</i>
-	Dorsal scales strongly keeled	19
19	Suboculars two	20
-	Suboculars absent	<i>O. balteata</i>
20	Internasal in contact with loreal, preocular two, supralabials 11–12	<i>O. typica</i>
-	Internasal not in contact with loreal, preocular one, supralabials 9	<i>O. boonsongi</i>

Discussion

Stuart & Chuaynkern (2007) described *Opisthotropis maculosa* on the basis of a single male specimen. They stressed that, of the known *Opisthotropis* species, *O. maculosa* and *O. jacobi* are very similar in morphology and both can be easily differentiated from all other species in having dorsal scales in 15:15:15 rows and all scales smooth. To distinguish their new species from *O. jacobi*, Stuart & Chuaynkern (2007) gave four discriminating characters in *O. maculosa*: 1) distinct yellow-spotted dorsum (uniformly dark in *jacobi*), 2) two postoculars (one in *jacobi*), 3) the fourth supralabials in contact with eye (both fourth and fifth in *jacobi*), and 4) posterior pair of chin shields longer than anterior (reverse condition in *jacobi*). Additionally, according to Murphy *et al.* (2008), *O. maculosa* differs from *O. jacobi* in having internasal scales not in contact with loreals (reverse condition in *jacobi*). The Chinese *O. maculosa* specimens match the distinctive coloration of the holotype of *O. maculosa* as well as in the internasal scales not contacting the loreal. However, other diagnostic characters provided by Stuart & Chuaynkern (2007) are variable (Table 1). The most significant is that the posterior pair of chin shields are shorter than anterior pair in all our specimens, and only one postocular is present in two specimens.

There is only one known female specimen of *O. maculosa*, so it is not possible to document sexual dimorphism thoroughly; but it is worth noting that the female specimen has fewer ventrals than the males (Table 1), and there are additional potential sex-related differences in the length and shape of the tail: 1) tail in males (TaL/TL ratios: 0.21–0.26) is longer than in female (TaL/TL ratio: 0.21); 2) narrow at base, then thickening short distance posteriorly and narrowing smoothly to the end of the male tail, versus narrowing smoothly from the base to the end of the female tail. On the other hand, the Chinese male specimens distinctly differ from the Thailand male specimen in having many more subcaudals (83–97 versus 67) and a relatively longer tail (TaL/TL ratio: 0.23–0.26 versus 0.21), and a smaller supraocular not in contact with preocular and prefrontal (Table 1). These geographical variations are remarkable, but the number of subcaudal scales seems to be strikingly variable in certain species, i.e., 58–89 in *O. kikuzatoi*, 39–47 in *O. daovantieni*, 55–89 in *O. spenceri*, and 117–123 in *Parahelicops annamensis* (see key above).

The aquatic *Opisthotropis maculosa* is probably nocturnal and active during heavy rain in daytime. The type was also collected during heavy rain at night (Stuart & Chuaynkern 2007). This snake is secretive and therefore not frequently encountered. As the four known specimens were scattered across southern Guangxi and southwestern Guangdong, China and the northeastern Thailand, *O. maculosa* is likely to be more widespread and perhaps occurs in tropical and sub-tropical hill streams extending from southwestern Guangdong, China to Thailand.

According to Zhao (2006), there are ten species of *Opisthotropis* recorded in China including *O. praemaxillaris* (Angel 1929), previously the type species of the genus *Paratapinophis*. Murphy *et al.* (2008) resurrected the genus *Paratapinophis*. Thus, the discovery of *O. maculosa* in China as reported in this paper brings the total number of *Opisthotropis* species to ten in this country, and they are mainly distributed in the South China zoogeographical region (Zhao & Adler 1993). Among these, *O. maculosa*, *O. andersonii*, *O. balteata*, *O. kuatunensis*, *O. lateralis*, *O. latouchii*, and *O. maxwelli* occur in the Fujian-Guangdong Coast Subregion of South China. Such an impressive diversity calls for the need for further ecological research into the natricid assemblages and their niche differentiation in their mountain stream habitats, which are under threat from the many small hydroelectric plants and associated catchwaters, and from logging.

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References

- Boulenger, G.A. (1888) Description of two new snakes from Hongkong and note on the dentition of *Hydrophis viperina*. *Annals and Magazine of Natural History*, (6), 2, 43–45.
- Boulenger, G.A. (1914) Descriptions of new species of snakes in the collection of the British Museum. *Annals and Magazine of Natural History*, (8), 14, 482–485.
- Dowling, H.G. (1951) A proposed standard system of counting ventrals in snakes. *British Journal of Herpetology*, 1, 97–99.
- Kadoorie Farm and Botanic Garden (2004) *Report of a Rapid Biodiversity Assessment at Dawuling Nature Reserve, Southwest Guangdong, China, June/July 2002*. South China Forest Biodiversity Survey Report Series: No. 38. KFBG, Hong Kong SAR. ii+19pp.
- Murphy, J.C., Chan-Ard, T., Mekchai, S., Cota, M. & Voris, H.K. (2008) The rediscovery of Angel's stream snake, *Paratapinophis praemaxillaris* Angel, 1929 (Reptilia: Serpentes: Natricidae). *The Natural History Journal of Chulalongkorn University*, 8, 169–183.
- Orlov, N.L. (1995) Rare snakes of the mountainous forests of northern Indochina. *Russian Journal of Herpetology*, 2, 179–183.
- Orlov, N.L., Murphy, R.W. & Papenfuss, T.J. (2000) List of snakes of Tam-dao mountain ridge (Tonkin, Vietnam). *Russian Journal of Herpetology*, 7, 69–80.
- Orlov, N.L., Ryabov, S.A., Sang, N.V. & Truong, N.Q. (2003) New records and data on the poorly known snakes of Vietnam. *Russian Journal of Herpetology*, 10, 217–240.
- Ota, H. (2004) Field observations on a highly endangered snake, *Opisthotropis kikuzatoi* (Squamata: Colubridae), endemic to Kumejima Island, Japan. *Current Herpetology*, 23, 73–80.

- Pope, C.H. (1935) *The Reptiles of China: Turtles, Crocodylians, Snakes, Lizards*. Natural History of Central Asia Vol. 10. The American Museum of Natural History, New York, 604 pp.
- Smith, M.A. (1943) *The Fauna of British India, Ceylon and Burma, including the Whole of the Indo-Chinese Sub-Region. Reptilia and Amphibia. Vol. III. Serpentes*. Taylor and Francis, London, 583 pp.
- Stuart, B.L. (2006) A second specimen of *Parahelicops annamensis* Bourret, 1934 (Serpentes: Colubridae: Natricinae). *Hamadryad*, 30, 167–171.
- Stuart, B.L. & Chuaynkern, Y. (2007) A new *Opisthotropis* (Serpentes: Colubridae: Natricinae) from northeastern Thailand. *Current Herpetology*, 26, 3–40.
- Yang, D.T., Su, C.Y. & Li, S.M. (1980) A preliminary study on reptiles in southern Yunnan. *Acta Zoologica Sinica*, 26, 262–265. (In Chinese, with English abstract)
- Zhao, E.M. (2006) *Snakes of China*. Anhui Science and Technology Publishing House, Hefei, texts 372 pp, photos 279 pp. (In Chinese)
- Zhao, E.M. & Adler, K. (1993) *Herpetology of China*. Society for the Study of Amphibians and Reptiles, Oxford, Ohio, 522 pp.
- Zhao, E.M., Huang, M.H. & Zong, Y. (1998) *Fauna Sinica: Reptilia Vol. 3 (Squamata, Serpentes)*. Science Press, Beijing, 522 pp. (In Chinese)
- Zheng, J. (1992) A note on the genus *Opisthotropis* in China. *Wuyi Science Journal*, 9, 370–372. (In Chinese, with English abstract)
- Ziegler, T., David, P. & Thana, V.N. (2008) A new natricine snake of the genus *Opisthotropis* from Tam Dao, Vinh Phuc Province, northern Vietnam (Squamata, Colubridae). *Zoosystematics and Evolution*, 84, 197–203.

APPENDIX. Specimens examined.

Institutional abbreviations: **SYS**, Sun Yat-sen University, Guangzhou, China; **KFBG**, Kadoorie Farm and Botanic Garden, Hong Kong SAR, China

Opisthotropis andersonii KFBG 1994.01 from Hong Kong, China

Opisthotropis cheni SYS r0007, SYS r0040, SYS r0045 and SYS r0050 from Nanling Nature Reserve, Guangdong, China

Opisthotropis kuatunensis SYS r0093 and SYS r0094 from Lianhuashan Nature Reserve, Guangdong, China

Opisthotropis lateralis SYS r0092 from Dawuling Nature Reserve, Guangdong, China

Opisthotropis latouchii SYS r0008, SYS r0010 and SYS r0049 from Nanling Nature Reserve, Guangdong, China