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NEW RECORDS OF POORLY KNOWN KUKRI SNAKES FROM SOUTHERN VIETNAM INCLUDING THE PROOF OF THE FIRST LIVING INDIVIDUAL OF *Oligodon moricei* (SQUAMATA: COLUBRIDAE)

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Based on a new collection from southern Vietnam, here we report five poorly known species of the genus *Oligodon* for the first time from Phu Yen Province. We herein provide morphological descriptions for *Oligodon cattienensis*, *O. cinereus pallidocinctus*, *O.deuvei*, *O. moricei*, and *O. saintgironsi*, including ecological notes for the newly recorded species. In the case of *Oligodon moricei*, our new finding is the second known individual and the first photograph of a living specimen of the species.

Keywords: distribution; kukri snakes; morphology; new records; Phu Yen Province

INTRODUCTION

The colubrid snake genus *Oligodon* Boie in Fitzinger, 1826 currently contains 85 species (Uetz et al., 2022), distributed throughout southern and south-eastern Asia (David et al., 2008a, 2008b; Green et al., 2010). In Vietnam, Nguyen et al. (2009) reported 14 species of the genus. Since then, six new *Oligodon* species have been described from the country, namely *O. nagao* David, Nguyen, Nguyen, Jiang, Chen, Teynié et Ziegler, 2012; *O. arenarius* Vassilieva, 2015; O. *cattienensis* Vassilieva, Geissler, Galoyan, Poyarkow, Van Devender et Böhme, 2013; *O. condaoensis* Nguyen, Nguyen, Le et Murphy, 2016; *O. culaochamensis* Nguyen, Nguyen, Nguyen, Phan, Jiang et Murphy, 2017; and *O. rostralis* Nguyen, Tran, Nguyen, Neang, Yushenko et Poyarkov, 2020. Two species, *O. albocinctus* (Cantor, 1839) and *O. mouhoti*

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(Boulenger, 1914), were excluded from the fauna of Vietnam by David et al. (2008b, 2012). At present, a total of 21 species of the genus *Oligodon* are recognized in Vietnam, of which seven species are endemic to the country.

During our field work from 2015 to 2017, a series of snakes was collected from Tay Hoa and Song Cau districts and Tuy Hoa City of Phu Yen Province. From this province, previously only a single kukri snake species was documented, namely *Oligodon ocellatus* (David et al., 2008a). Based on morphological examination, we herein report five new records of poorly known kukri snakes of the genus *Oligodon* from Phu Yen Province, southern Vietnam.

MATERIAL AND METHODS

Field surveys were conducted in the forests of Tay Hoa and Song Cau districts as well as in Tuy Hoa City, Phu Yen Province by the first author in 2015 – 2017 (Fig. 1). Specimens were collected by hand and snake hook. After taking photographs, specimens were anaesthetized and euthanized in a closed vessel with a piece of cotton wool containing ethyl acetate (Simmons, 2002), fixed in 90% ethanol for 8 h, and then later transferred to 70% ethanol for permanent storage. Preserved specimens were deposited in the collection of Phu Yen University (PYU), Vietnam.

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Fig. 1. Map showing the studied site in Phu Yen Province (black square), southern Vietnam.

Abbreviations are as follows: SVL: snout-vent length, from tip of snout to cloaca; TaL, tail length, from cloaca to tip of tail; TL, total length (SVL + TaL); TaL/TL, ratio tail length/total length; ASR, number of dorsal scale rows at neck; MSR: number of dorsal scales at midbody; PSR, number of dorsal scale rows before vent; VEN, ventral scales; SC, subcaudal scales; SL, supralabial scales; SL-Eye, number of supralabials entering orbit; PreSubOc, number of presuboculars scale; IL, infralabial scales; a.s.l., above sea level. Bilateral scale counts were given as left/right.

Taxonomic identifications were based on the following literature: Smith (1943), Nguyen (2007), David et al. (2008a, 2008b), Das (2010), Vassilieva et al. (2016), and Pauwels et al. (2017).

RESULTS

Oligodon cattienensis Vassilieva, Geissler, Galoyan, Poyarkov, Devender et Böhme, 2013 Cattien Kukri Snake / Rán kiếm cát tiên (Fig. 2)

Specimens examined (n = 3). Two adult males, PYU DTD.609 (SVL 439 mm, TaL 74 mm) and PYU



Fig. 2. Oligodon cattienensis (PYU DTD.610, adult male): *a*, dorsolateral view; *b*, ventral view.

DTD.610 (SVL 451 mm, TaL 74 mm), collected on 19 April 2016, in Hoa Kien Commune, Tuy Hoa City (13°9'9.7" N 109°14'40.4" E; at an elevation of 120 m a.s.l.) and one adult female, PYU DTD.771 (SVL 591 mm, TaL 100 mm), collected on 15 September 2017 in Hoa Thinh Commune, Tay Hoa District (12°52'8.4" N 109°14'11.3" E; at an elevation of 310 m a.s.l.).

Morphological characters. Body cylindrical and robust; head faintly distinct from neck; eye rather large, pupil round; rostral large, wider than high; internasals 2; prefrontal shorter than frontal; parietal longer than wide; nasal undivided; loreal 1/1, not entering the orbit; preocular 1/1; postoculars 2/2; presuboculars absent; anterior temporal 1/1; posterior temporals 2/2; supralabials 8/8, fourth and fifth entering orbit, sixth largest; infralabials 8/8, first pair in contact with each other and with mental, first to fourth in contact with anterior chin shields; dorsal scale rows 17 - 17 - 15, smooth; ventrals 170 and 173 in males (n = 2), 168 in the female (n = 1),

Characters	O. cattienensis		O. deuvei		O. moricei		O. saintgironsi	
	Phu Yen	Vassilieva et al., 2013	Phu Yen	David et al., 2008b	Phu Yen	David et al., 2008b	Phu Yen	David et al., 2008a
SVL, mm	439 - 590.6	362	166 - 177	275 - 460	161	384	442	425 - 567
TLmax, mm	690	415	210	530	183	443	560	676
TaL/TL	0.141 - 0.144	0.11 - 0.13	0.157 - 0.162	0.132 - 0.172	0.120	0.133	0.211	0.161 - 0.203
ASR	17	17	17	17	17	17	19	19
MSR	17	17	17	17	17	17	17	17 - 18
PSR	15	15	15	15	15	15	15	15
VEN	168 - 173	167 - 178	143 - 145	140 - 155	166	175	167	166 - 184
SC	37 - 43	31 - 35	39	31 - 47	36	41	61	53 - 59
SL	8	8	7	7(8)	7 - 8	8	8	8
SL-Eye	4 – 5	4 - 5	3 - 4	3 - 4(4 - 5)	3 - 4(4 - 5)	4 - 5	4 - 5	4 - 5
PreSubOc	0	0	0	0(1)	0	0	1	1
IL	8	7 - 8	8-9	8-9	7	9	8	9

TABLE 1. Morphological Comparisons Between Newly Collected Specimens from Phu Yen and Original Descriptions of four Recently Described

 Species of Oligodon from Southern Vietnam

Note. SVL, snout-vent length; TL, total length; TaL/TL, ratio tail length/total length; ASR, number of dorsal scale rows at neck; MSR, number of dorsal scales at midbody; PSR, number of dorsal scale rows before vent; VEN, ventral scales; SC, subcaudal scales; SL, supralabial scales; SL-Eye, number of supralabials entering orbit; PreSubOc, number of presuboculars scale; IL, infralabial scales. Data obtained from original descriptions of David et al. (2008a, 2008b) and Vassilieva et al. (2013).

slightly angulated; cloacal plate undivided; subcaudals 37 and 43 in males (n = 2), 39 in the female (n = 1), divided. Hemipenes bifurcated, deeply forked, without spines, reaching subcaudals 7 - 11.

Coloration in life. Dorsal surface of head with four streaks, one transverse band across the snout, one round blotch on the frontal scale, two behind the orbit, and one broad arrow shaped blotch on the neck; dorsal surface of body and tail dull brownish gray or brown with a discontinuous yellow-orange to yellowish-brown vertebral stripe, extending from the occiput to the tip of the tail, 24 - 28 butterfly-shaped blotches on trunk and five on tail; venter white gray, ventral pattern varies from few squarish dark-gray spots on lateral edges of some ventrals to almost continuous dark gray spotting on most posterior ventrals (identification after Vassilieva et al., 2013).

Ecological notes. The specimens were found from 8:00 to 10:00 on the ground. The surrounding habitat was evergreen secondary forest of small woods and shrubs.

Distribution. This species was previously known only from the type locality in Dong Nai Province, Vietnam (Vassilieva et al., 2013).

Remarks. The specimens from Phu Yen differ from the type series by having a greater maximum SVL (590.6 mm vs. 362 mm) and more subcaudals (37 - 43 vs. 31 - 35) (see Table 1 and Vassilieva et al., 2013).

Oligodon cinereus pallidocinctus (Bourret, 1934) Günther's Kukri Snake / Rắn kiếm xám (Fig. 3)

Specimens examined (n = 2). Two adult males, PYU DTD.206 (SVL 435 mm, TaL 67 mm), collected on 31 March 2016 and PYU DTD.742 (SVL 405 mm, TaL 60 mm) collected on 7 March 2017 on Chop Chai Mountain, Tuy Hoa City (13°6'49.5" N 109°16'23.7" E; at an elevation of 300 m a.s.l.).

Morphological characters. Body robust and cylindrical; head indistinct from neck; eye rather large, pupil round; rostral distinctly broader than high, visible from above; internasals 2; prefrontal shorter than frontal; parietals longer than wide; nasal undivided; loreal 1/1, not entering the orbit; preocular 1/1; postoculars 2/2; presuboculars absent; anterior temporal 1/1; posterior temporals 2/2; supralabials 8/8 or 8/7, fourth and fifth entering orbit, sixth and seventh largest; infralabials 8/8 or 7/7, first pair in contact with each other, first to fourth in contact with anterior chin shields; dorsal scale rows 17 - 17 - 15, smooth; ventrals 158 and 168; cloacal plate undivided; subcaudals 35 and 36 in males (n = 2), divided. Hemipenes not bifurcated, without spines, stretching to subcaudals 10.

Coloration in life. Dorsal surface of head reddish with a gray chevron; dorsal surface of body reddish or reddish brown with 33 or 34 yellow, black-edged bands, five on tail; head without temporal streak; ventral surface

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Fig. 3. Oligodon cinereus pallidocinctus (PYU DTD.742, adult male): *a*, dorsolateral view; *b*, ventral view.

uniform cream with small dark spots (identification after Smith, 1943; Nguyen, 2007; Nguyen et al., 2014).

Ecological notes. The specimens were found on the bank of rocky streams. The surrounding habitat was secondary forest composed of medium and small hardwoods and shrub.

Distribution. In Vietnam, the species has been recorded from Lai Chau and Dien Bien provinces in the North southwards to An Giang and Kien Giang provinces (Nguyen et al., 2009, 2014; Geissler et al., 2011; Luu et al., 2013). Elsewhere, this species is known from India, Bangladesh, China, Myanmar, Laos, Thailand, and Cambodia (Nguyen et al., 2009).

Remarks. *O. cinereus pallidocinctus* is morphologically similar to *O. albocinctus* and *O. kampucheaensis*, but it differs from *O. albocinctus* by having fewer dorsal scale rows (17 - 17 - 15 vs. 19 - 19 - 17), fewer ventrals (158 - 168 vs. 177 - 210), fewer subcaudals (35 - 36 vs. 42 - 69) and the fourth and fifth supralabials entering the eye (vs. third and fourth SL) (Hasan et al., 2013); from *O. kampucheaensis* by having more dorsal scale rows



Fig. 4. *Oligodon deuvei* (PYU DTD.790, subadult female): *a*, dorsolateral view; *b*, ventral view.

(17 - 17 - 15 vs. 15 - 15 - 15), hemipenes not bifurcated (vs. deeply bifurcated) (Neang et al., 2012).

Oligodon deuvei David, Govel et Rooijen, 2008 Deuve's Kuri Snake / Rắn kiếm deu-vo (Fig. 4)

Specimens examined (n = 2). Two subadult females, PYU DTD.601 (SVL 166 mm, TaL 32 mm), collected on 5 January 2016, in Xuan Phuong Commune, Song Cau District, Phu Yen Province (13°26'0.9" N 109°16'10.2" E; at an elevation of 20 m a.s.l.); PYU DTD.790 (SVL 177 mm, TaL 33 mm), collected on 18 October 2017, in Hoa Kien Commune, Tuy Hoa City (13°8'9.5" N 109°13'10.4" E; at an elevation of 100 m a.s.l.).

Morphological characters. Body cylindrical; head indistinct from neck; eye rather large, pupil round; rostral distinctly broader than high, visible from above; internasals 2; prefrontal shorter than frontal; parietals longer than wide; nasal undivided; loreal 1/1, not entering the orbit; preocular 1/1; postoculars 2/2; presuboculars absent; anterior temporal 1/1; posterior temporals 2/2; supralabials 7/7, third to fourth entering orbit, sixth largest; infralabials 8/8, first pair in contact with each other,

Ecological notes. The specimens were found at 9:00 on the ground. The surrounding habitat was forest consisting of small woods and shrubs.

Distribution. In Vietnam, this species has been recorded from Dong Nai Province and Ho Chi Minh City (Nguyen et al., 2009). Elsewhere, this species is known from Laos, Cambodia, and Thailand (David et al., 2008b; Nguyen et al., 2009; Das, 2010; Pauwels et al., 2017).

Remarks. The specimens from Phu Yen differ from the type series by the presence of a presubocular on the right side (see Table 1 and David et al., 2008b).

Oligodon moricei David, Govel et Rooijen, 2008 Morice's Kuri Snake / Rån kiêm mo ri o (Fig. 5)

Specimen examined (n = 1). One subadult female, PYU DTD.712 (SVL 161.0 mm, TaL 22 mm), collected on 22 October 2016, in Hoa Kien Commune, Tuy Hoa City (13°09'30.9" N 109°13'10.2" E; at an elevation of 150 m a.s.l.).

Morphological characters. Body cylindrical; head indistinct from neck; eve rather large, pupil round; rostral distinctly broader than high, visible from above; internasals 2; prefrontal shorter than frontal; parietals longer than wide; nasal divided; loreal 1/1, not entering the orbit; preocular 1/1; postoculars 2/2; presubocular 1/1; anterior temporal 1/1. posterior temporals 2/2; supralabials 8/8, fourth and fifth entering orbit, sixth largest; infralabials 7/7, first pair in contact with each other, first to fourth in contact with anterior chin shields; dorsal scale rows 17 - 17 - 15, smooth; ventrals 166, slightly angulated; cloacal plate undivided; subcaudals 36, divided.

Coloration in life. Dorsal surface of head brownish gray with dark defined large marks and interrupted temporal streak; dorsal surface of head, body and tail reddish brown; a broad rusty brown vertebral stripe, with vertebral and black paravertebral stripes broad, very conspicuous; ventral surface reddish white anteriorly and reddish brown posteriorly (identification after David et al., 2008b).

Ecological notes. The specimen was found at 10:00 on the forest floor. The surrounding habitat was evergreen secondary forest of small woods and shrubs.

Distribution. This species was previously known only from the type locality in Khanh Hoa Province, Vietnam (David et al., 2008b).

Remarks. The specimen from Phu Yen differs from the type specimen in the description of David et al. (2008) by having fewer ventrals (166 vs. 175), fewer subcaudals (36 vs. 41), and fewer infralabials (7 vs. 9).

Fig. 5. Oligodon moricei (PYU DTD.712, subadult female): a, dorsolateral view; b, ventral view.

first to fourth in contact with anterior chin shields; dorsal scale rows 17 - 17 - 15, smooth; ventrals 143 and 145, slightly angulated; cloacal plate undivided; subcaudals 39 in females (n = 2), divided.

Coloration in life. Dorsal surface of head brownish gray with five well defined large marks; dorsal surface of body and tail brown with a pale yellow vertebral stripe, edged by two darker faint paravertebral stripes and small black blotches; ventral surfaces red orange with irregularly distributed black rectangular blotches (identification after David et al., 2008b; Das, 2010; Geissler et al., 2011; Pauwels et al., 2017).

b



Oligodon saintgironsi David, Govel et Pauwels, 2008 Saint Gironns' Kukri Snake/ Rắn kiếm xanh-gi-ron-x (Fig. 6)

Specimen examined (n = 1). One adult female, PYU DTD.643 (SVL 442 mm, TaL 118 mm), collected on 15 April 2016, near Hoa Thinh Commune, Tay Hoa District, (12°51′18.4″ N 109°13′15.1″ E, at an elevation of 310 m a.s.l.).

Morphological characters. Body cylindrical and stout; head ovoid, short, indistinct from neck; eye large, pupil round; internasals 2, shorter than prefontals; prefontals wider than long; nasal divided; frontal longer than prefrontal and shorter than parietal; parietals longer than wide; loreal 1/1, square; preocular 1/1; subpreocular 1/1; postoculars 2/2; anterior temporals 2/2, posterior temporals 2/(1 + 1/1); supralabials 8/8, second and third in contact with loreal, fourth and fifth entering orbit, sixth and seventh largest; infralabials 9/9, first to fourth bordering chin shields; dorsal scale rows 19 - 17 - 15, smooth; ventrals 167; cloacal plate entire; subcaudals 61, divided.

Coloration in life. Dorsal surface of head grayish-brown with two streaks, one transverse band across the snout, one arrow shaped band on head extends to the posterior of the neck; dorsal surface body dark grayish brown with a pale yellowish-tan vertebral stripe, more distinct in anterior part but indistinct in the posterior half of the body, 11 butterfly-shaped vertebral blotches; venter white-cream with a small brown-red blotch rectangular in the anterior half of body, then progressively larger in the posterior half; lower surface of tail white-cream with 4 butterfly-shaped blotches (identification after David et al., 2008a; and Vassilieva et al., 2016).

Ecological notes. The specimen was collected at 9:00 on the forest floor. The surrounding habitat was evergreen forest of large hardwoods.

Distribution. In Vietnam, the species has been recorded from Dong Nai Province and Ho Chi Minh City (David et al., 2008a). Elsewhere, this species is known from Cambodia (David et al., 2008a).

Remarks. The specimen from Phu Yen differs from the type series by having more subcaudals (61 vs. 53 – 59) and fewer infralabials (8 vs. 9) (see Table 1 and Vassilieva et al., 2013).

DISCUSSION

Oligodon cattienensis was originally described from Cat Tien National Park in Dong Nai Province by Vassilieva et al. (2013) and our new record in Phu Yen Province is approximately 400 km distant in the northeast



Fig. 6. *Oligodon saintgironsi* (PYU DTD.643, adult female): *a*, dorso-lateral view; *b*, ventral view.

from the type locality. *Oligodon deuvei* and *O. saintgironsi*, were originally described based on type series from Bien Hoa, Dong Nai Province (David et al., 2008a, b) and our new records in Phu Yen Province extend the distribution range of these species ca. 400 km to the northeast. In addition, the first repated living specimen of *Oligodon moricei* shows a reddish brown color at the underside of the tail. The new record in Phu Yen Province is approximately 100 km northwards of the type locality of this species in Nha Trang, Khanh Hoa Province (David et al., 2008b). Further field work is required to explore the snake diversity in southern Vietnam, particularly the poorly studied kukri snakes of the genus *Oligodon*.

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