



A new species of *Rhinophis* Hemprich, 1820 (Reptilia: Serpentes: Uropeltidae) from Rakwana massif, Sri Lanka

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Abstract

A new species of *Rhinophis*, *Rhinophis erangaviraji* sp. nov. is described, the tenth species of the genus known from Sri Lanka. The new species is readily distinguished from all other congeners by its colour pattern and scalation. Morphometric analysis supports the distinction of the new species from the superficially similar *R. blythii*. The new species is known only from the Rakwana massif, where it has been collected in shady areas, within loose soil.

Key words: new species, *Rhinophis*, *Rhinophis erangaviraji* sp. nov., shieldtail, snakes, Sri Lanka, taxonomy, Uropeltidae

Sinhala abstract

රක්වාන ප්‍රදේශයේ සොයා ගත් *Rhinophis erangaviraji* ලෙස නම් කෙරුණ නව සර්ප විශේෂයක් පිළිබඳව මෙම විද්‍යාත්මක පත්‍රිකාවෙන් පැහැදිලි කරන අතර “වරාණ විරාජ්‍යේ තුඩුල්ල” ලෙස සිංහලෙන් හඳුන්වන මෙම විශේෂයත් සමග ශ්‍රී ලංකාවේ හමුවන තුඩුල්ලන් සංඛ්‍යාව දැනගනී. නව විශේෂය වීම ගනුදෙනු අනෙකුත් සමාජිකයන්ගෙන් පහසුවෙන් වෙන් කර ගැනීමට හැකි ලක්ෂණ ලෙස ශරීරයේ වර්ණ රටාව හා කොරළු අගයන් බොහෝ සෙයින් උපකාරී වේ. තරමක් දුරට මෙම නව විශේෂයට රූපීයව සමාන වන *Rhinophis blythii* (ගෝමර තුඩුල්ල) ගෙන් වෙන් කර ගැනීම සඳහා සංසන්දනාත්මක ලෙස ගනු ලැබූ දත්ත විශ්ලේෂණය මගින්ද නව විශේෂයේ වෙනස්කම් මෙම ලිපියෙන් හඳුන්වා කර පෙන්වා දී ඇත. මෙම නව තුඩුල්ලන් විශේෂය රක්වාන කඳවලට පමණක් සීමා වී සිටින අතර මුරුල් පස් සහිත ප්‍රදේශ තුළදී හිරික්ෂණය කර ගත හැකි බව අප පර්යේෂණ මගින් සනාථ කර ඇත.

Introduction

There are currently twelve recognized species of the uropeltid snake genus *Rhinophis* Hemprich, of which nine are endemic to Sri Lanka and three to India (Das, 2001; McDiarmid *et al.*, 1999). Of the Sri Lankan species, *R. dorsimaculatus* Deraniyagala, 1941, *R. oxyrhynchus* (Schneider, 1801), *R. porrectus* Wall, 1921, *R. punctatus* Müller, 1832, and *R. oxyrhynchus* are found in the Dry Zone (Deraniyagala, 1955, 1975; de Silva, 1980; de Silva, 1990). *R. porrectus* Wall, 1921 has variably been treated as a junior synonym of *R. punctatus* (Smith, 1943; Deraniyagala, 1955; Gans, 1966) or a distinct, valid species (Wall, 1921; Taylor, 1950; de Silva, 1980; Mahendra, 1984; McDiarmid *et al.*, 1999; de Silva, 2006; Somaweera, 2006). *R. dorsimaculatus*, is known only from the original material, although a picture of a specimen closely resembling this species has recently been published by Somaweera (2006).

Rhinophis blythii Kelaart, 1853, *R. drummondhayi* Wall, 1921, *R. homolepis* (Hemprich, 1820), *R. philippinus* (Cuvier, 1829) and *R. tricoloratus* Deraniyagala, 1975, are found in the wet zone and the central

hills (also found in the Intermediate Zone, except *R. tricoloratus*) of Sri Lanka (Deraniyagala, 1955; de Silva, 1980). Here we describe a new Wet Zone species of *Rhinophis* from the Rakwana massif.

Material and methods

Five unidentified *Rhinophis* specimens were collected from Enselwatte estate, Sinharaja Division, Rakwana hills (Army Camp Forest), Matara District, Southern Province (Fig. 1). The specimens were photographed in life and the entire series was fixed and preserved in 15% formalin and subsequently transferred to 75% ethyl alcohol after one day. Fifty measurements were taken with a Mitutoya digital Vernier caliper (to the nearest 0.01 mm) each measurement was taken three times and their means recorded, and snout-vent length (SVL) was measured to the nearest 1 mm, using a flexible measuring tape. Observations were made through a Leica Wild M3Z microscope. Collection localities were recorded with a Garmin E-trex venture GPS. The new material was compared with preserved specimens (Appendix 1) of other species of Sri Lankan *Rhinophis* in the Colombo National Museum of Sri Lanka (NMSL), and with data from the literature (Boulenger, 1890; Wall, 1921; Smith, 1943; Taylor, 1950; Deraniyagala, 1955; de Silva, 1980; Whitaker and Captain, 2004; de Silva, 2005).

Ventral scale counts were taken according to the method described by Gower and Ablett (2006). Costal scale row counts were taken at three points along the body, at the 20th and 75th ventral scale, and 20th scale in front of the anal.

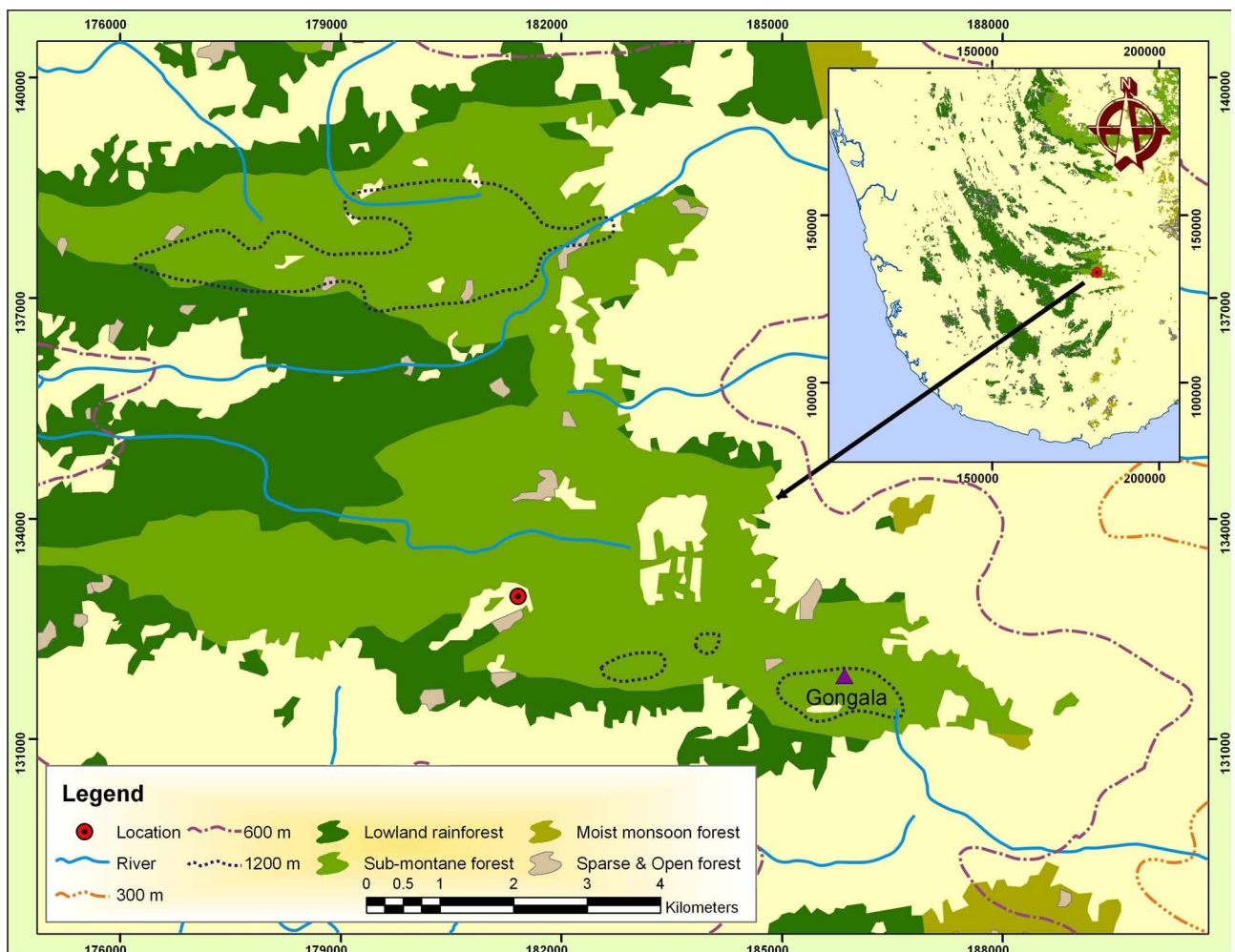


FIGURE 1. Map showing the type locality of *Rhinophis erangaviraji* sp. nov.

Principal components and cluster analyses were performed using PC-ORD 4.17 for Windows (MjM software, Glenden Beach, Oregon, USA). A preliminary univariate analysis showed 48 variables to be potentially taxonomically important, and these were used for definitive analyses. The statistics of the univariate comparisons are summarized in Table 1. The external anatomical characters measured for morphometric analysis and abbreviated in the text are listed in Appendix 2, and some are illustrated in Fig. 2. All morphometric data were normalized to RL, and the corresponding mean values were used in the analysis. The small paratype was not included in morphometric analysis.

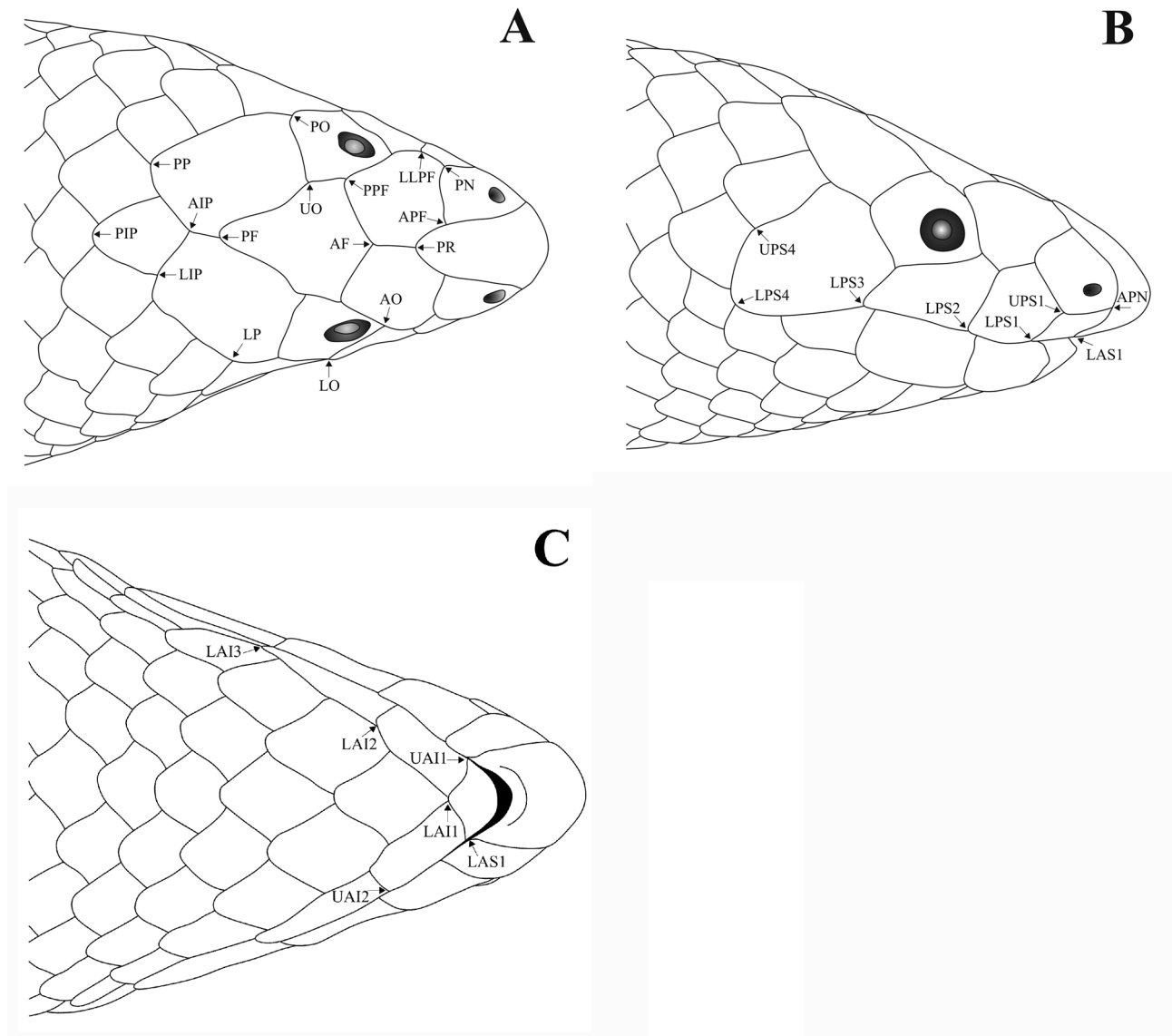


FIGURE 2. Landmarks on head scales of *Rhinophis erangaviraji* sp. nov. used in morphometric analyses. **A.** Dorsal view: AF-anteriormost tip of frontal, AIP-anterior tip of interparietal, AO-anterior tip of ocular, APF-anterior tip of prefrontal, LIP-lateral tip of interparietal, LLPF-lower lateral tip of prefrontal, LO-lower tip of ocular, LP-lateral tip of parietal, PF-posterior tip of frontal, PIP-posterior tip of interparietal, PN-posterior tip of nasal, PO-posterior tip of ocular, PP-posterior tip of parietal, PPF-posterior tip of prefrontal, PR-posterior tip of rostral, UO-upper tip of ocular. **B.** Lateral view: APN-anterior tip of nasal, LAS1-lower anterior tip of 1st supralabial, LPS1-lower posterior tip of 1st supralabial, LPS2-lower posterior tip of 2nd supralabial, LPS3-lower posterior tip of 3rd supralabial, LPS4-lower posterior tip of 2nd supralabial, UPS1-upper posterior tip of 1st supralabial, UPS4-upper posterior tip of 4th supralabial. **C.** Ventral view: LAI1-lower anterior tip of 1st infralabial, LAI2-lower anterior tip of 2nd infralabial, LAI3-lower anterior tip of 3rd infralabial, LAS1-lower anterior tip of 1st supralabial, UAI1-upper anterior tip of 1st infralabial, UAI2-upper anterior point of 2nd infralabial. See Appendix 2 for explanation of abbreviations.

TABLE 1. The morphometric measurements (mm) of the type series of *Rhinophis erangviraji* and *Rhinophis blythii*, normalized to the rostral length (RL).

	<i>Rhinophis erangviraji</i>										<i>Rhinophis blythii</i>												
	Holotype		Paratype01		Paratype02		Paratype03		Range		Mean		SD		Range		Mean		SD				
	20080601	20080602	20080602	20080602	20080603	20080604	20080604	20080604	Mean	SD	20081501	20081502	20081503	20081504	Mean	SD	20081501	20081502	20081503	20081504			
AF-LLPF	0.91	0.80	0.91	0.91	0.91	0.79	0.85	0.07	0.07	0.79 - 0.91	0.74	0.71	0.66	0.73	0.71	0.04	0.79 - 0.91	0.74	0.66	0.73	0.71	0.04	0.66 - 0.74
AF-PPF	0.64	0.54	0.61	0.61	0.61	0.61	0.60	0.04	0.04	0.54 - 0.64	0.40	0.46	0.50	0.49	0.46	0.04	0.54 - 0.64	0.40	0.50	0.49	0.46	0.04	0.40 - 0.50
AIPE	1.45	1.26	1.48	1.48	1.48	1.36	1.39	0.10	0.10	1.26 - 1.48	1.13	1.10	1.24	1.11	1.15	0.06	1.26 - 1.48	1.13	1.24	1.11	1.15	0.06	1.10 - 1.24
AOW	0.87	0.74	0.90	0.90	0.90	0.79	0.83	0.07	0.07	0.74 - 0.90	0.67	0.67	0.70	0.62	0.67	0.03	0.74 - 0.90	0.67	0.70	0.62	0.67	0.03	0.62 - 0.70
APF-PR	0.37	0.35	0.36	0.36	0.36	0.33	0.35	0.02	0.02	0.33 - 0.37	0.20	0.22	0.24	0.24	0.23	0.02	0.33 - 0.37	0.20	0.24	0.24	0.23	0.02	0.20 - 0.24
AW	2.16	2.21	2.07	2.07	2.07	2.28	2.18	0.09	0.09	2.07 - 2.28	1.87	1.92	1.67	1.43	1.72	0.22	2.07 - 2.28	1.87	1.67	1.43	1.72	0.22	1.43 - 1.92
BD	3.86	3.70	3.60	3.60	3.60	3.31	3.62	0.23	0.23	3.31 - 3.86	2.33	2.28	2.45	2.16	2.31	0.12	3.31 - 3.86	2.33	2.45	2.16	2.31	0.12	2.16 - 2.45
BW	3.94	3.83	3.80	3.80	3.80	3.51	3.77	0.18	0.18	3.51 - 3.94	2.70	2.69	2.88	2.69	2.74	0.09	3.51 - 3.94	2.70	2.88	2.69	2.74	0.09	2.69 - 2.88
FL	1.19	1.08	1.29	1.29	1.29	1.33	1.22	0.11	0.11	1.08 - 1.33	0.88	0.82	1.00	0.89	0.90	0.07	1.08 - 1.33	0.88	1.00	0.89	0.90	0.07	0.82 - 1.00
FW2	0.87	0.75	0.91	0.91	0.91	0.90	0.86	0.07	0.07	0.75 - 0.91	0.68	0.68	0.63	0.66	0.66	0.02	0.75 - 0.91	0.68	0.63	0.66	0.66	0.02	0.63 - 0.68
HD	1.74	1.55	1.62	1.62	1.62	1.72	1.66	0.09	0.09	1.55 - 1.74	1.42	1.45	1.47	1.42	1.44	0.02	1.55 - 1.74	1.42	1.47	1.42	1.44	0.02	1.42 - 1.47
HL	3.18	2.79	3.01	3.01	3.01	2.81	2.95	0.18	0.18	2.79 - 3.18	2.42	2.71	2.46	2.40	2.50	0.14	2.79 - 3.18	2.42	2.46	2.40	2.50	0.14	2.40 - 2.71
HW	2.40	2.21	2.30	2.30	2.30	2.31	2.31	0.08	0.08	2.21 - 2.40	2.07	1.88	1.83	1.68	1.87	0.16	2.21 - 2.40	2.07	1.83	1.68	1.87	0.16	1.68 - 2.07
IN	0.69	0.63	0.68	0.68	0.68	0.65	0.66	0.03	0.03	0.63 - 0.69	0.56	0.57	0.48	0.55	0.54	0.04	0.63 - 0.69	0.56	0.48	0.55	0.54	0.04	0.48 - 0.57
IND	1.18	1.10	1.12	1.12	1.12	1.03	1.11	0.06	0.06	1.03 - 1.18	0.98	0.95	1.04	0.85	0.96	0.08	1.03 - 1.18	0.98	1.04	0.85	0.96	0.08	0.85 - 1.04
IPL	0.72	0.55	0.70	0.70	0.70	0.64	0.65	0.08	0.08	0.55 - 0.72	0.37	0.40	0.42	0.40	0.40	0.02	0.55 - 0.72	0.37	0.42	0.40	0.40	0.02	0.37 - 0.42
LASI-LASI'	0.44	0.47	0.44	0.44	0.44	0.41	0.44	0.02	0.02	0.41 - 0.47	0.34	0.33	0.35	0.33	0.34	0.01	0.41 - 0.47	0.34	0.35	0.33	0.34	0.01	0.33 - 0.35
LLPF-PN	0.24	0.21	0.23	0.23	0.23	0.24	0.23	0.01	0.01	0.21 - 0.24	0.30	0.32	0.32	0.32	0.32	0.01	0.21 - 0.24	0.30	0.32	0.32	0.32	0.01	0.30 - 0.32
LLSC	0.66	0.67	0.48	0.48	0.48	0.50	0.58	0.10	0.10	0.48 - 0.67	0.38	0.43	0.50	0.43	0.44	0.05	0.48 - 0.67	0.38	0.43	0.43	0.44	0.05	0.38 - 0.50
LO-AO	0.64	0.55	0.66	0.66	0.66	0.62	0.62	0.05	0.05	0.55 - 0.66	0.48	0.49	0.51	0.53	0.50	0.02	0.55 - 0.66	0.48	0.51	0.53	0.50	0.02	0.48 - 0.53
LO-LPS3	0.39	0.38	0.38	0.38	0.38	0.39	0.39	0.01	0.01	0.38 - 0.39	0.31	0.26	0.28	0.29	0.29	0.02	0.38 - 0.39	0.31	0.28	0.29	0.29	0.02	0.26 - 0.31
LO-UPS4	1.18	1.04	1.08	1.08	1.08	1.04	1.09	0.07	0.07	1.04 - 1.18	0.90	0.91	0.83	0.80	0.86	0.05	1.04 - 1.18	0.90	0.83	0.80	0.86	0.05	0.80 - 0.91
LPS3-LPS4	1.00	0.88	0.98	0.98	0.98	0.95	0.95	0.05	0.05	0.88 - 1.00	0.75	0.75	0.77	0.74	0.75	0.01	0.88 - 1.00	0.75	0.77	0.74	0.75	0.01	0.74 - 0.77
LP-UPS4	0.74	0.66	0.71	0.71	0.71	0.69	0.70	0.03	0.03	0.66 - 0.74	0.49	0.60	0.59	0.54	0.56	0.05	0.66 - 0.74	0.49	0.59	0.54	0.56	0.05	0.49 - 0.60

TABLE 1. (continued)

NL	0.76	0.65	0.64	0.71	0.69	0.06	0.64 - 0.76	0.54	0.57	0.59	0.54	0.56	0.02	0.54 - 0.59
NPF	2.00	1.76	2.06	1.89	1.93	0.13	1.76 - 2.06	1.62	1.65	1.71	1.64	1.66	0.04	1.62 - 1.71
NPP	2.48	2.24	2.23	2.15	2.28	0.14	2.15 - 2.48	1.74	1.85	1.78	1.88	1.81	0.06	1.74 - 1.88
PFE	1.28	1.10	1.32	1.28	1.25	0.10	1.10 - 1.32	1.01	0.97	1.06	1.00	1.01	0.04	0.97 - 1.06
PFL	0.60	0.52	0.54	0.53	0.55	0.04	0.52 - 0.60	0.31	0.32	0.30	0.31	0.31	0.01	0.30 - 0.32
PL1	1.04	0.86	0.95	0.84	0.92	0.09	0.84 - 1.04	0.63	0.72	0.57	0.60	0.63	0.06	0.57 - 0.72
PL2	1.26	1.05	1.19	0.98	1.12	0.13	0.98 - 1.26	0.73	0.82	0.71	0.75	0.75	0.05	0.71 - 0.82
PO-LO	0.51	0.44	0.51	0.47	0.48	0.03	0.44 - 0.51	0.39	0.38	0.37	0.40	0.39	0.01	0.37 - 0.40
PO-UPS4	1.12	0.96	1.00	1.00	1.02	0.07	0.96 - 1.12	0.79	0.80	0.81	0.66	0.77	0.07	0.66 - 0.81
PPF-AO	0.54	0.48	0.52	0.49	0.51	0.03	0.48 - 0.54	0.43	0.42	0.48	0.45	0.45	0.03	0.42 - 0.48
PP-LP	0.80	0.84	0.86	0.80	0.83	0.03	0.80 - 0.86	0.57	0.56	0.61	0.55	0.57	0.03	0.55 - 0.61
PR-LLPF	0.89	0.78	0.89	0.75	0.83	0.07	0.75 - 0.89	0.55	0.68	0.71	0.65	0.65	0.07	0.55 - 0.71
PR-PN	0.79	0.71	0.79	0.62	0.73	0.08	0.62 - 0.79	0.55	0.56	0.55	0.55	0.55	0.01	0.55 - 0.56
PRW	1.15	1.15	1.03	1.14	1.12	0.06	1.03 - 1.15	0.84	0.80	0.66	0.63	0.73	0.10	0.63 - 0.84
RW1	0.61	0.55	0.58	0.55	0.57	0.03	0.55 - 0.61	0.46	0.47	0.46	0.42	0.45	0.02	0.42 - 0.47
RW2	0.36	0.34	0.36	0.33	0.35	0.02	0.33 - 0.36	0.27	0.27	0.26	0.25	0.26	0.01	0.25 - 0.27
SHD	0.84	0.97	0.91	1.04	0.94	0.09	0.84 - 1.04	0.61	0.60	0.66	0.62	0.62	0.03	0.60 - 0.66
SHW2	1.46	1.46	1.38	1.67	1.49	0.12	1.38 - 1.67	1.11	1.07	1.09	1.08	1.09	0.02	1.11 - 1.09
SPP	3.04	2.69	2.64	2.64	2.75	0.19	2.64 - 3.04	2.28	2.41	2.28	2.18	2.29	0.09	2.18 - 2.41
SVL	85.60	97.65	80.63	92.34	89.06	7.47	80.63 - 97.65	70.59	106.47	79.67	75.26	83.00	16.08	70.59 - 106.47
TL	3.82	2.64	3.34	2.46	3.07	0.63	2.46 - 3.82	2.00	2.47	2.12	2.06	2.16	0.21	2.00 - 2.47
UA12-LA12	0.44	0.40	0.46	0.40	0.43	0.03	0.40 - 0.46	0.29	0.32	0.28	0.29	0.30	0.02	0.28 - 0.32
UO-PF	0.83	0.80	0.82	0.76	0.80	0.03	0.76 - 0.83	0.57	0.51	0.54	0.58	0.55	0.03	0.51 - 0.58
WRV1	0.70	0.62	0.61	0.64	0.64	0.04	0.61 - 0.70	0.55	0.53	0.43	0.43	0.49	0.06	0.43 - 0.55
WVA20	1.17	1.14	1.18	1.16	1.16	0.02	1.14 - 1.18	0.78	0.85	0.72	0.80	0.79	0.05	0.72 - 0.85

***Rhinophis erangaviraji* sp. nov.**

Figs. 3–12.

Holotype: NMSL20080601, adult male 214 mm SVL, Enselwatte Estate, Sinharaja Division (Army Camp Forest), Rakwana hills, Matara District, Southern Province (N 06° 23', E 080° 36'), 1042 m. Coll. Dulan Vidanapathirana, Nayanaka Ranwella and L. J. M. Wickramasinghe. 5 December, 2007.

Paratypes: NMSL20080602, adult female 291 mm SVL; NMSL20080603, adult male 204 mm SVL; NMSL20080604, adult female 241 mm SV; NMSL20080605, small male 103 mm SVL. Collection data as for holotype.

Diagnosis: The new species is distinguished morphologically from the congener it resembles most closely, *R. blythii*, by the following characters: 146–157 (vs 159–165) paravertebral scales; 142–154 (vs 155–162) ventral scales (Table 2); dorsal and lateral surface of head black (vs dark brown with dorsal yellow 'V', Fig 5 & 6); ventrally black zigzag pattern on yellow background (vs each ventral scale anterior blackish brown and posterior light brown, with brownish tint throughout ventrally, Fig 7); no ring-like pattern at the base of the tail (vs yellow ring at base of tail, Fig 8, 9); caudal shield with one axis of symmetry, narrower anteriorly (vs shield oval, with two axes of symmetry, Fig 10); anal region and under side of tail black (vs anal region whitish brown, underside of tail dark brown, Fig 11).

Rhinophis erangaviraji sp. nov. differs from, *R. dorsimaculatus*, *R. oxyrhynchus*, *R. porrectus* and, *R. punctatus* by having a smooth rostral (vs strongly ridged above); 142–154 ventrals (vs 238, 211–227, 281, and 236–246 ventrals, respectively); total length 300 mm (vs 350 mm, 573 mm, 350 mm, and 390 mm, respectively); moderate sized tail shield (vs large shield). Differs from *R. oxyrhynchus*, *R. porrectus*, and *R. punctatus* by having a shorter rostral, about one third (vs about one half) length of the dorsal head shield scales. Differs from *R. homolepis* and *R. tricoloratus* by smooth rostral (vs slightly ridged above); fewer ventrals (vs 180–204 and 163–175, respectively); moderate sized tail shield (vs large shield). Differs from *R. drummondhayi* by fewer ventrals (vs 173–191); moderate sized shield (vs small shield). Differs from *R. philippinus* by having generally fewer ventrals (vs 153–182 ventrals); moderate sized tail shield (vs large shield); and yellow markings (vs no yellow).

The three Indian species of *Rhinophis* differ from the new species as follows: *R. fergusonianus* has more ventrals (180), *R. sanguineus* has more ventrals (182–218) and 15 costal scale rows at midbody, and *R. travancoricus* has fewer ventrals (132–146) and lacks yellow markings on the body (confined to tail). As far as is known, no species of uropeltid snake occur in both India and Sri Lanka (Cadle *et al.*, 1990; McDiarmid *et al.*, 1999; Bossuyt *et al.*, 2004).

Description of holotype: Robust snake; snout-vent length (SVL) 214 mm; body elongate (SVL/BW ratio 21.70); head narrow; snout pointed; nostril small, smaller than the eye, situated at the anterior of nasal scale; eye small, diameter about one third of ocular shield; neck not obvious; tail short (SVL/TL 22.43). Rostral unkeeled, slightly compressed, shorter than frontal and parietal (FL/RL 1.19, PL2/RL 1.26), longer than nasals, prefrontals, and ocular (RL/NL 1.46, RL/PFL 1.80, RL/AOW 1.14), about one third length of head (HL/RL 3.18); nasals completely separated by rostral, larger than prefrontal, smaller than ocular, frontal and parietal (NL/PFL 1.23, AOW/NL 1.27, FL/NL 1.74, PL1/NL 1.53, PL2/NL 1.84), anterior, lower, posterior, and upper edges touching rostral, 1st and 2nd supralabial, and prefrontal respectively; prefrontals contact frontal, ocular, 2nd and 3rd supralabials; frontal long (FL/FW2 1.37), touching parietals and oculars; ocular as long as wide, longer than prefrontal (AOW/PFL 1.57), shorter than parietal lengths 1 and 2 (AOW/PL1 1.35, AOW/PL2 0.69); ocular contacts parietal, 3rd and 4th supralabials; parietal similar in length to frontal (FL/PL2 0.95), contacting 4th supralabial and interparietal; interparietal slightly longer than wide, similar in length to nasal (NL/IPL 0.95); four supralabials, in size order 1st < 2nd < 3rd < 4th, 4th four times as long as 1st; mental triangular, no mental groove, width greater than length, smaller than infralabials, touching 1st infralabial and postmental; postmental single, 1st pair of infralabial separated by postmental; three infralabials, second largest, third smallest; costals smooth, costal row counts 19, 17, 17; 155 paravertebral scales; 151 ventrals, each

approximately twice as wide as long; preanal wider than length, equal in size to ventrals (PRW/WVA20 0.98); anal divided/paired, larger than preanal (AW/PRW 1.88); nine subcaudals, all entire; caudal shield suboval, with one axis of symmetry, anterior narrower than posterior, conical and blunt tip, ten scales around shield. (Tables 1, 2).

TABLE 2. Scale count data for the type series of *Rhinophis erangaviraji*, and some *Rhinophis blythii*. See Appendix 2 for explanation of abbreviations. Specimens are deposited in NMSL.

	<i>Rhinophis erangaviraji</i>				<i>Rhinophis blythii</i>			
	Holotype 20080601	Paratype 20080602	Paratype 20080603	Paratype 20080604	20081501	20081502	20081503	20081504
PARA	154	156	146	155	158	163	160	165
SASH	10	13	12	12	11	10	9	12
SUBC	9	6	8	5	5	5	4	6
VEN	149	152	140	151	153	162	157	156

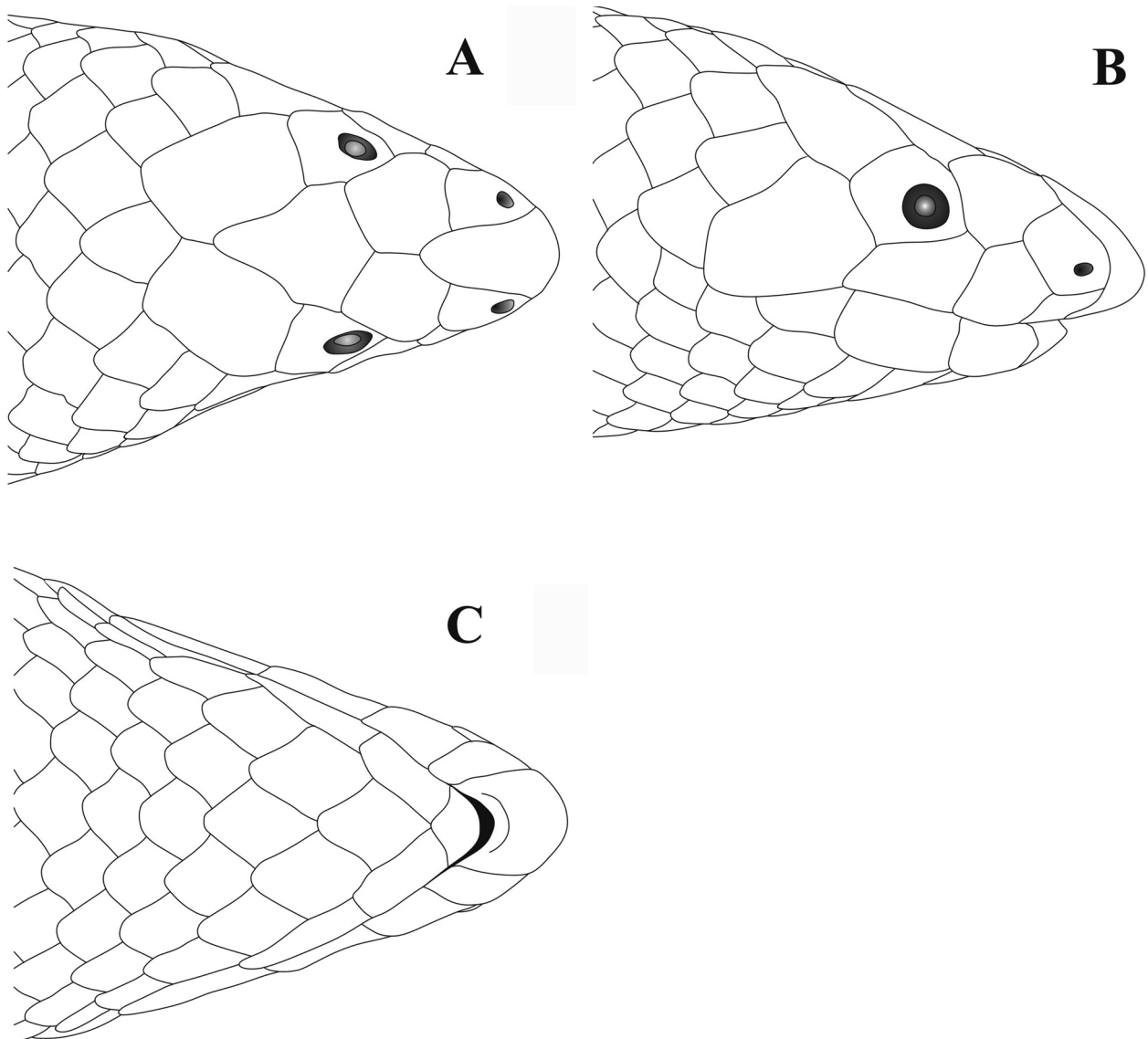


FIGURE 3. Head scalation of holotype of *Rhinophis erangaviraji* sp. nov., NMSL20080601. **A.** dorsal view, **B.** lateral view, **C.** ventral view.

Colour in life: Head black with yellow irregular spots. Lower margin of supralabials bright yellow. Eye black, rounded pupil not prominent. Dorsal body black, lower margins of costal scales with small irregular yellow spots. Lateral surface of body with canary yellow, scalloped stripe from gape to just behind anterior of tail shield. Scalloped nature prominent in first third of stripe, and close to vent, stripe less prominent on middle of body, ends in straight line on tail. Scalloping of lateral stripe extends onto ventral surface of body. Tail pitch except laterally. Shield black, with very small spines trapping small grains of sand and mud giving it a brownish tint.

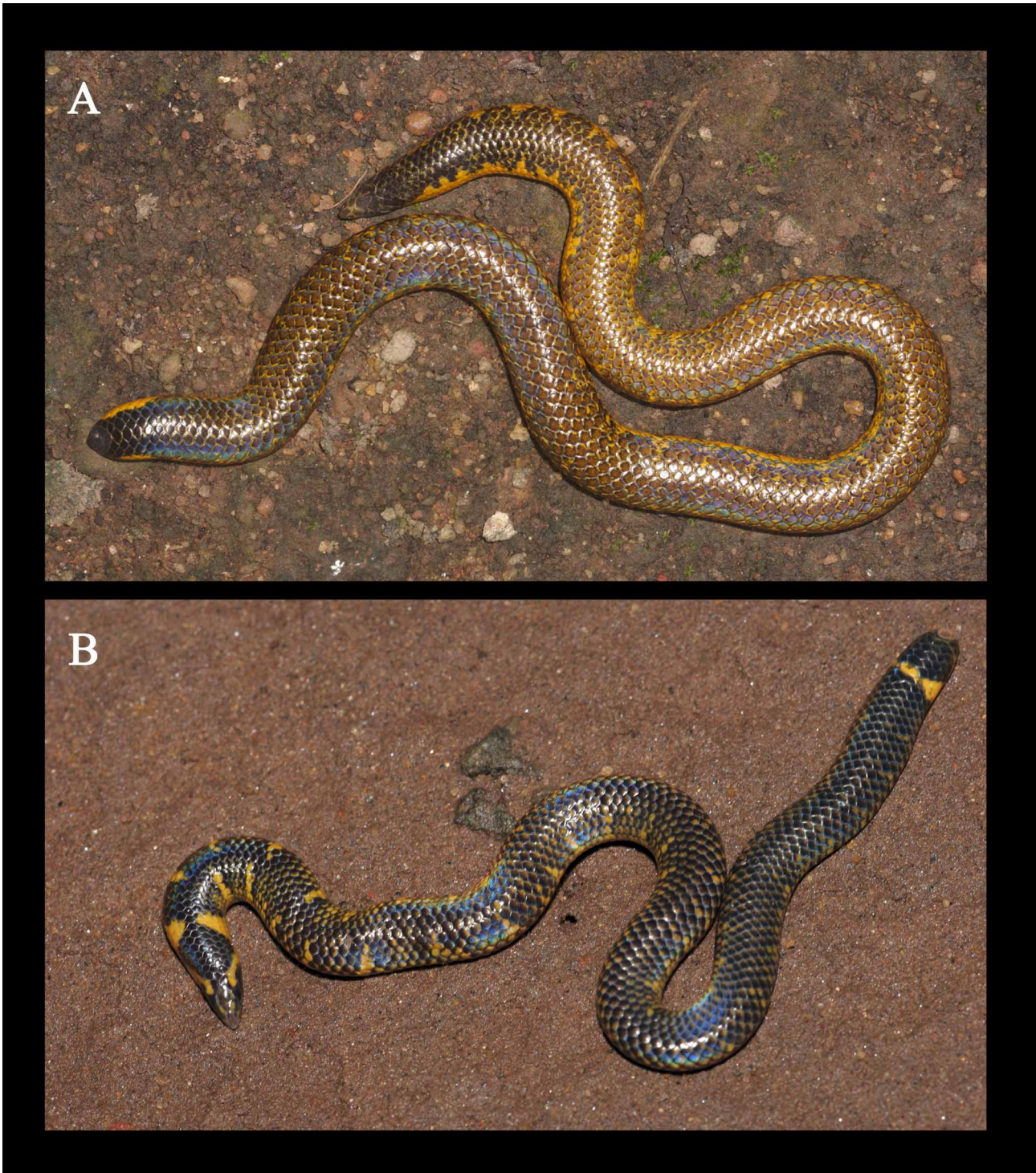


FIGURE 4. Dorsal view in life of **A.** holotype of *Rhinophis erangaviraji* **sp. nov.**, NMSL20080601, adult male, 214 mm SVL, **B.** *Rhinophis blythii*, NMSL 20081501, adult female, 204 mm SVL.



FIGURE 5. Dorsal view of head of **A.** holotype of *Rhinophis erangaviraji* **sp. nov.**, NMSL20080601, **B.** *Rhinophis blythii*, NMSL 20081501.

Colour in alcohol: Colour pattern remains unchanged. Pupil changes to yellowish white. Black on dorsum changes to dark brown, bright yellow to off white.

Paratypes and variations: Subcaudals divided in all paratypes. However, about 75% of nearly 40 other (living and dead) specimens examined had entire subcaudals. A summary of the morphological and

morphometric data of the paratypes is given in Table 1. Small *R. erangaviraji* have been found readily during October to January. The colour pattern of these younger animals is as in adults, with overall paler colours but a much darker head (Fig 12). Paratype NMSL20080604 has seven maxillary and seven mandibular teeth on each side.



FIGURE 6. Lateral view of head of **A.** holotype of *Rhinophis erangaviraji* sp. nov., NMSL20080601, **B.** *Rhinophis blythii*, NMSL 20081501.

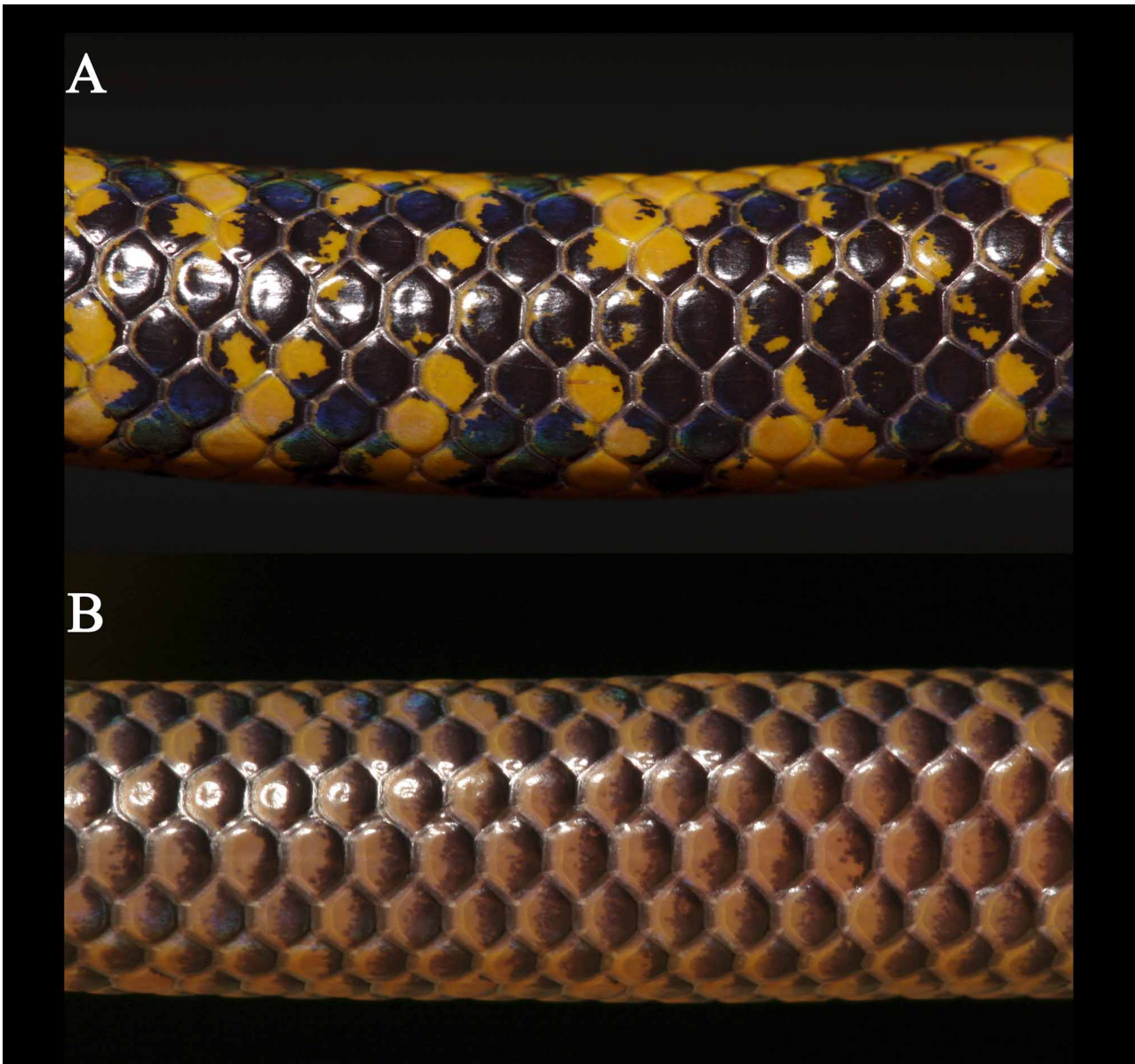


FIGURE 7. Ventral view of **A.** holotype of *Rhinophis erangaviraji* **sp. nov.**, NMSL20080601, **B.** *Rhinophis blythii*, NMSL 20081501.

Etymology: Named for the late Mr. Eranga Viraj Dayarathne, an Instructor of the Reptiles group of the Young Zoologists' Association of Sri Lanka, Department of National Zoological Gardens. A man who showed love and kindness to nature, and quiet yet effective service to Sri Lankan reptiles and their conservation. Suggested vernacular names: *Eranga Virajge thudulla*, *Eranga Virajvin nilakael pambu*, *Eranga Viraj's shieldtail snake* (or *Eranga Viraj's Rhinophis*) in Sinhala, Tamil, and English respectively.

Comparison: Apart from the listed diagnostic characters, *R. erangaviraji* can be distinguished further from all other Sri Lankan congeners in details of its colour pattern. *Rhinophis dorsimaculatus* has a broad orange, middorsal vertebral stripe (vs black dorsal body colour); *R. drummondhayi* has a dappled brown and white or pale yellow venter (vs black with yellow), a whitish (vs black) anal region and a yellow-white ring at the base of the tail (vs absent); *R. homolepis* has a white/yellow collar behind the head (vs dorsal surface of neck black), white/yellow triangular (apex pointed upwards) markings along body (vs scalloped yellow stripe), yellow anal (vs black), and pale yellow ring at base of tail (vs absent); *R. oxyrhynchus* has a uniformly brown dorsal colour (vs black), pale brown to yellow or whitish venter (vs black with yellow), and yellow

anal (vs black); *R. philippinus* has a purplish-black dorsum (vs black) and lateral and ventral surface of body (vs black with yellow markings); *R. porrectus* and *R. punctatus* have a whitish venter (vs black), and a narrow

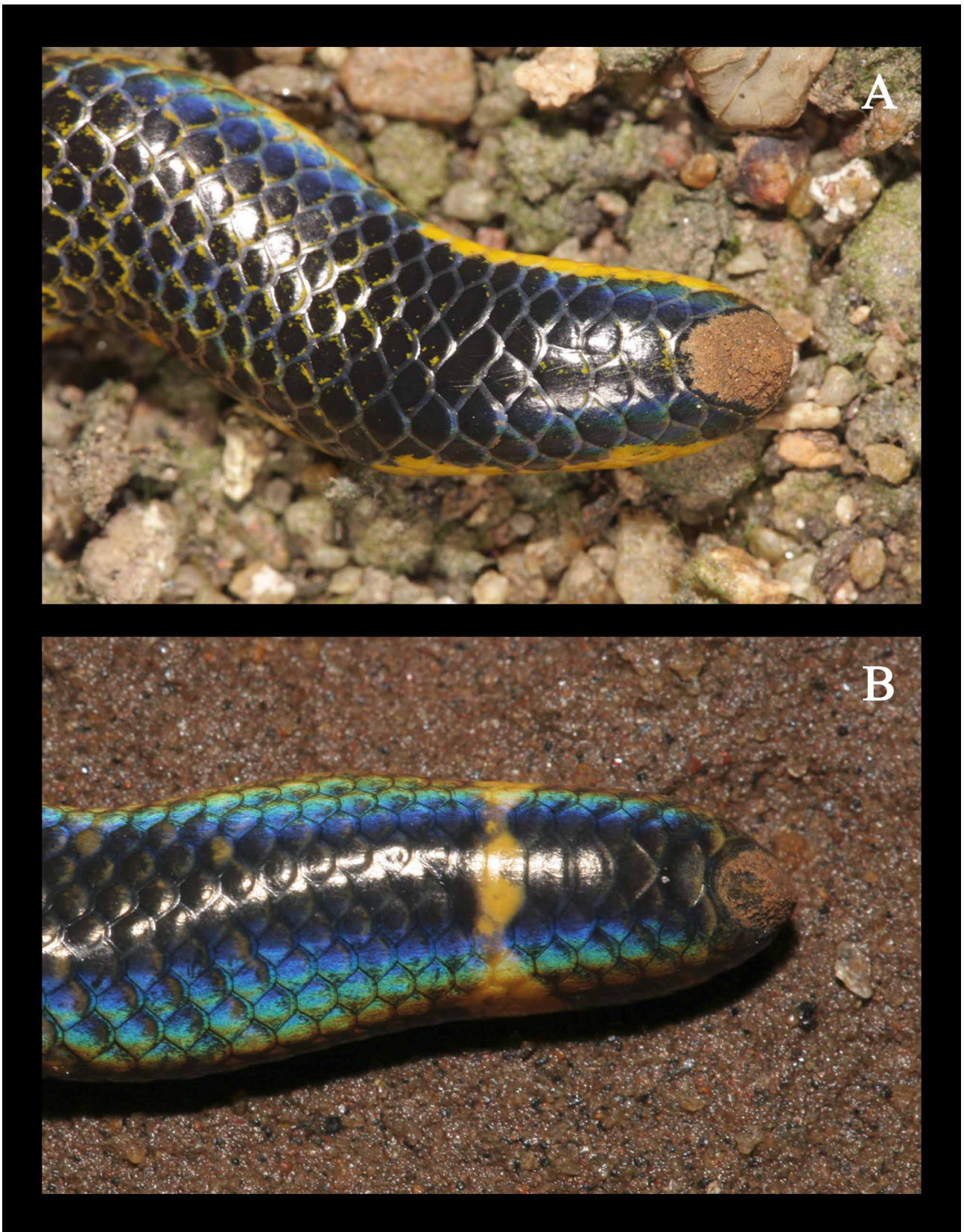


FIGURE 8. Dorsal view of tail of **A.** holotype of *Rhinophis erangaviraji* **sp. nov.**, NMSL20080601, **B.** *Rhinophis blythii*, NMSL 20081501.

dark dorsal stripe (vs no stripe); *R. tricoloratus* has a yellow to yellow-brown venter (vs black with yellow markings), gray to brown dorsum (vs black), yellow to whitish yellow anal (vs black), and a yellowish ring at base of tail (vs absent).

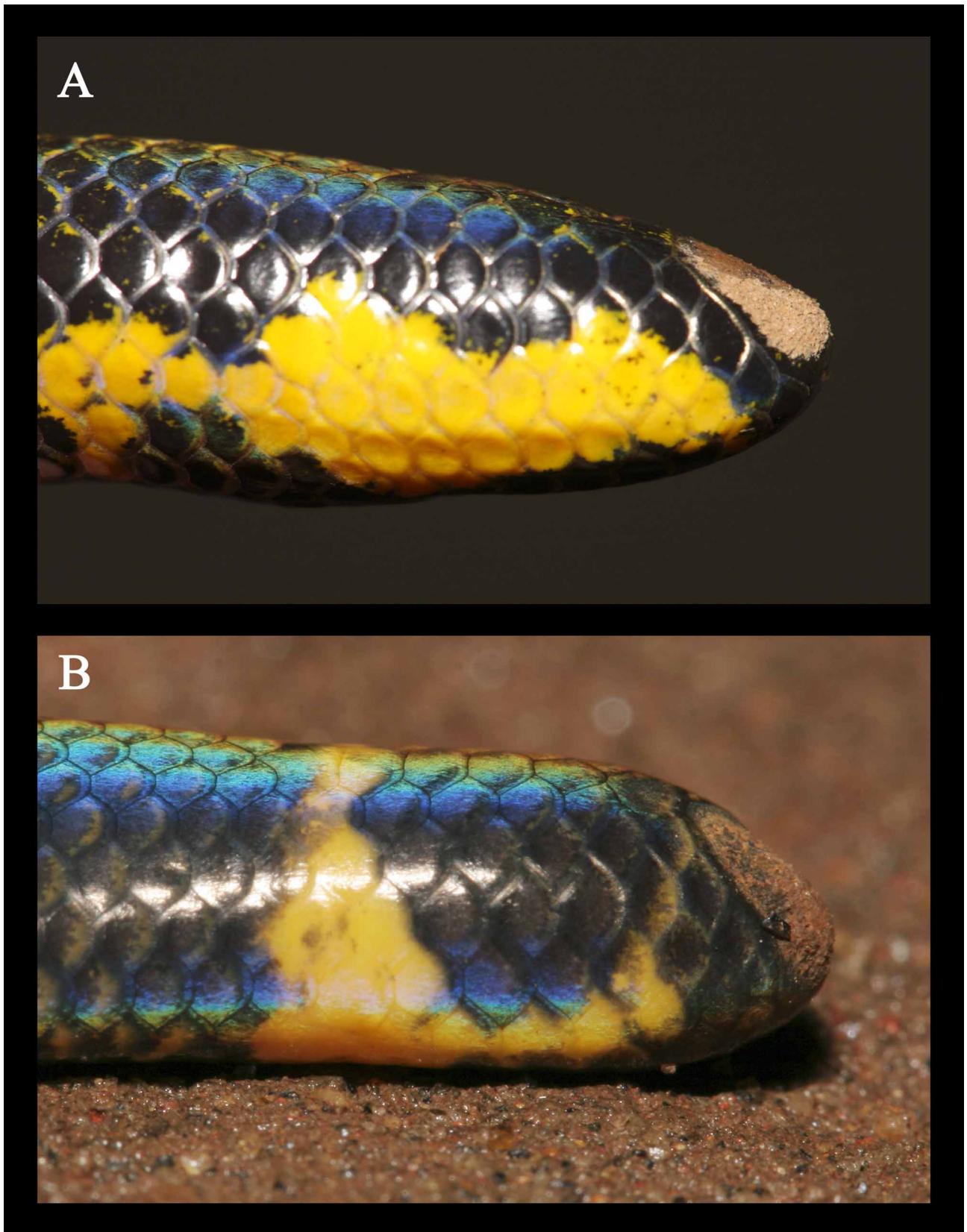


FIGURE 9. Lateral view of tail of **A.** holotype of *Rhinophis erangaviraji* sp. nov., NMSL20080601, **B.** *Rhinophis blythii*, NMSL 20081501.



FIGURE 10. Tail shield of **A.** holotype of *Rhinophis erangaviraji* **sp. nov.**, NMSL20080601, **B.** *Rhinophis blythii*, NMSL 20081501.



FIGURE 11. Ventral view of tail of **A.** holotype of *Rhinophis erangaviraji* sp. nov., **B.** *Rhinophis blythii*, NMSL 20081501.

Habitat, Ecology and Conservation: *Rhinophis erangaviraji* and *R. blythii* are allopatric, with the former known only from the Rakwana massif and the latter from the Central Hills, of Sri Lanka. *Rhinophis erangaviraji* can be found without difficulty in loose soil in shady areas, up to 1 m deep, under leaf litter in

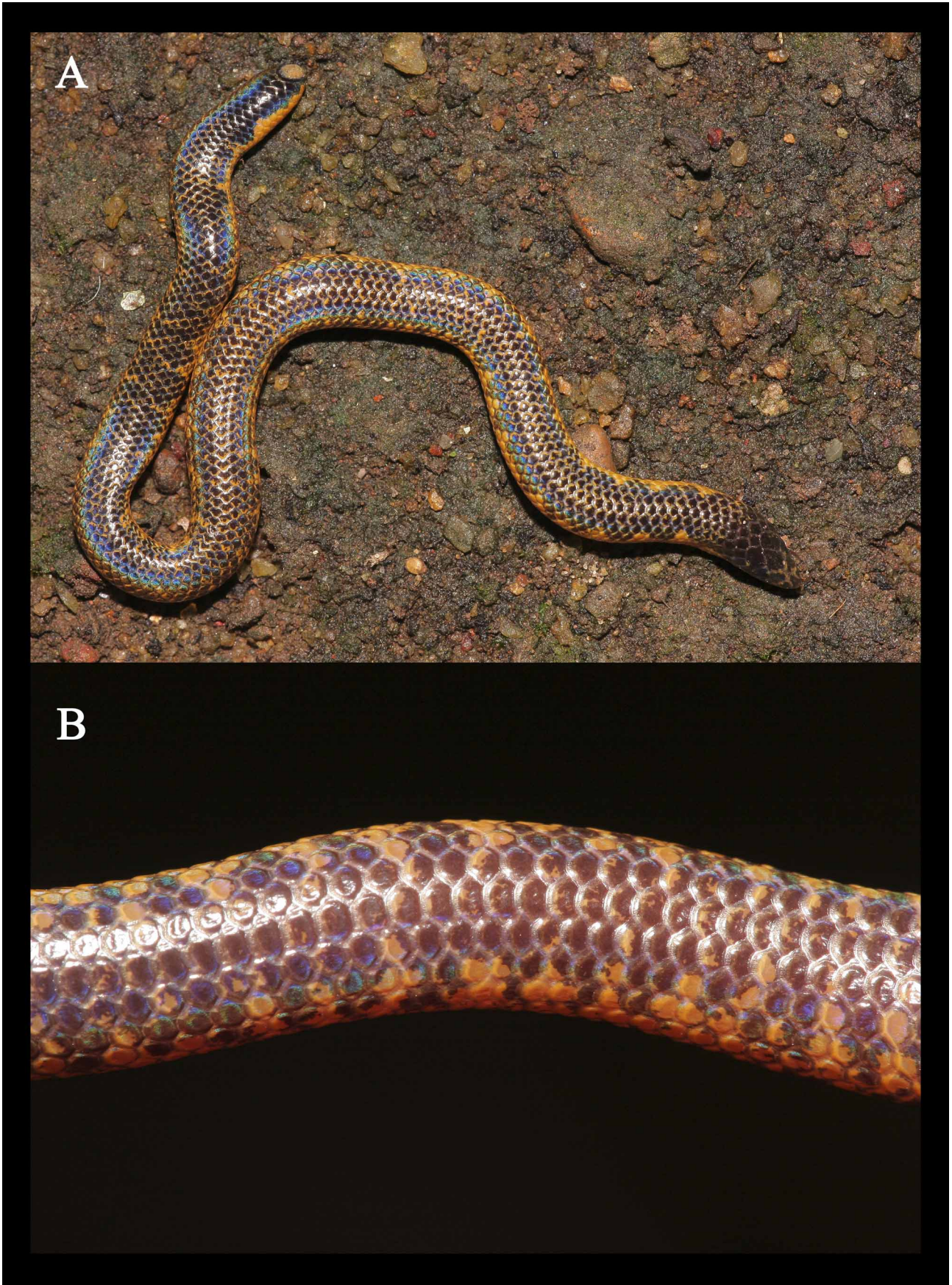


FIGURE 12. Small (103 mm SVL) male paratype of *Rhinophis erangaviraji* **sp. nov.**, NMSL20080605 in **A.** dorsal view, and **B.** ventral view of midbody.

drainage ditches in tea estates, home gardens, and grasslands, but is also relatively commonly seen within the natural forest habitat of Rakwana. At night these snakes can be seen in the leaf litter. Probable conservation threats to this species are habitat loss, and deterioration caused by agriculture (especially tea), including the use of agrochemicals. Forest fires started by humans during the dry season are another threat, as indicated by many dead specimens being found after these fires. Road kills have also been observed.

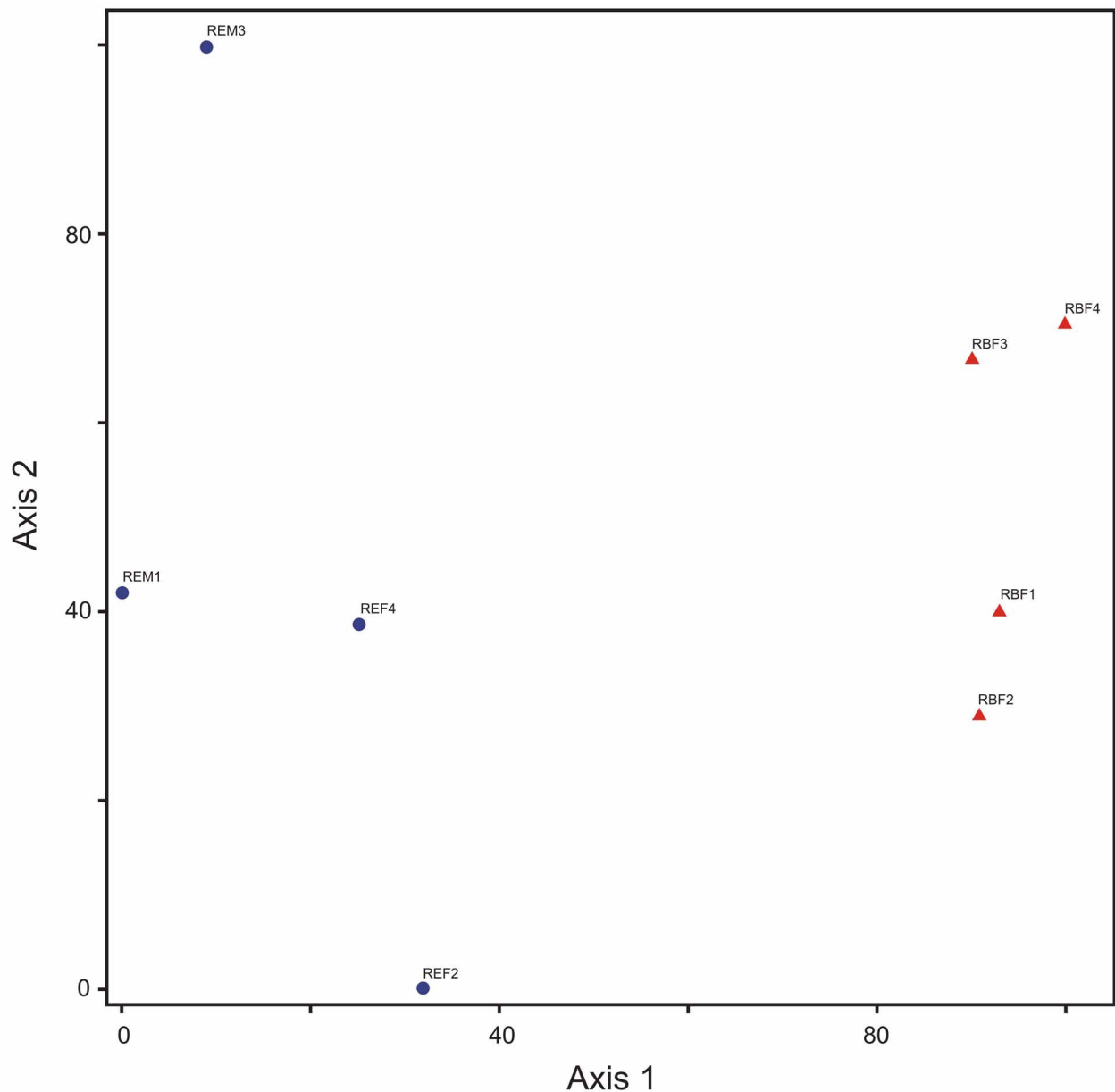


FIGURE 13. The results of Principal Component Analysis, showing first and second axes. REM1, 3 = *Rhinophis erangaviraji* males NMSL20080601, 603; REF2, 4 = *R. erangaviraji* females NMSL20080602, 604; RBF1, 2, 3, 4 = *Rhinophis blythii* females NMSL20081501, 502, 503, 504.

Results and discussion

Morphometric analysis: Morphological comparison indicated that *R. erangaviraji* is similar to *R. blythii* (Table 1). A preliminary univariate analysis indicated 48 variables (Appendix 2) to be taxonomically meaningful, so these were used in principal components analysis of *R. blythii* and *R. erangaviraji*, and the results are summarized in Table 3. The scree plot of initial eigen values from the principal component analysis

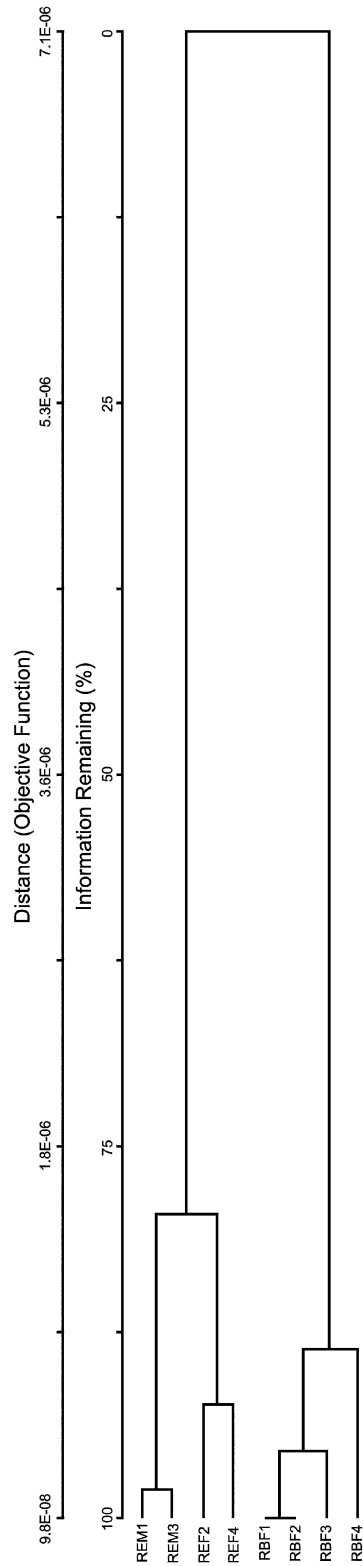


FIGURE 14. Dendrogram showing the results of Cluster Analysis. REM1, 3 = *Rhinophis erangaviraji* males NMSL20080601, 603; REF2, 4 = *R. erangaviraji* females NMSL20080602, 604; RBF1, 2, 3, 4 = *Rhinophis blythii* females NMSL20081501, 502, 503, 504.

TABLE 3A. Variance extracted from the first two principal components axes.

Axis	Eigenvalue	% of Variance	Cumulative %
1	41.757	85.217	85.217
2	2.197	4.485	89.702

TABLE 3B. Eigenvectors for first two principal components axes. See Appendix 2 for explanation of abbreviations.

Characters	Axis 1	Axis 2
AF-LLPF	-0.1402	0.1125
AF-PPF	-0.1410	0.1208
AIPE	-0.1441	0.2043
AOW	-0.1454	0.1745
APF-PR	-0.1498	-0.0043
AW	-0.1262	-0.2883
BD	-0.1509	-0.0901
BW	-0.1506	-0.0576
FL	-0.1379	0.1433
FW2	-0.1436	0.1042
HD	-0.1432	-0.0137
HL	-0.1433	-0.0151
HW	-0.1429	-0.1051
IN	-0.1422	-0.0335
IND	-0.1320	-0.0462
IPL	-0.1521	0.0983
LAS1-LAS	-0.1422	-0.1262
LLPF-PN	0.1417	0.1441
LLSC	-0.1083	-0.2837
LO-AO	-0.1423	0.2259
LO-LPS3	-0.1451	-0.0620
LO-UPS4	-0.1484	-0.1037
LPS3-LPS4	-0.1533	0.0626
LP-UPS4	-0.1442	0.0157
NL	-0.1399	-0.1137
NPF	-0.1442	0.2313
NPP	-0.1471	-0.0695
PARA	0.1282	-0.2278
PFE	-0.1435	0.1955
PFL	-0.1533	-0.0647
PL1	-0.1483	-0.0505
PL2	-0.1494	0.0122
PO-LO	-0.1483	0.1273
PO-UPS4	-0.1480	-0.0889
PPF-AO	-0.1356	0.1912
PP-LP	-0.1479	-0.0296

to be continued.

TABLE 3. (continued)

PR-LLPF	-0.1380	0.1358
PR-PN	-0.1440	0.0671
PRW	-0.1403	-0.2494
RW1	-0.1524	-0.0492
RW2	-0.1530	-0.0353
SHD	-0.1331	-0.1100
SHW2	-0.1352	-0.1497
SPP	-0.1433	-0.1592
UAI2-LAI2	-0.1512	0.0296
UO-PF	-0.1495	-0.0199
VEN	0.1151	-0.3628
WRV1	-0.1370	-0.2146
WVA20	-0.1490	-0.0768

indicated that 95% of variance is represented by four axis components, of which the initial two are responsible for more than 90% of the variance (Table 3A). The first two axes (Table 3B) of the analysis are plotted in Fig. 13, which shows an obvious overlap on axis 2, but clear separation (> 60% variance) on axis 1. Of the 48 variables, the following contributed most to the separation of the two species in the two axes (Table 3B): Eigenvector 1: BD, BW, IPL, LPS3-LPS4, PFL, RW1, RW2, and UAI2-LAI2; Eigenvector 2: AIPE, AOW, AW, LLSC, and LO-AO. However, the values (especially for axis 1) are all small and very similar, suggesting that no particular characters stand out as especially important. The new species is also separated by about 80% from *R. blythii* in cluster analysis data represented by the dendrogram in Fig. 14.

Other observations: According to our observations, the type specimen of *R. tricoloratus* has 19 costal scale rows around the neck and 17 at midbody *contra* the 21 and 19 reported by Deraniyagala (1975), de Silva (1980) and Somaweera (2006). The ventral counts of *R. tricoloratus*, and *Uropeltis ruhunae* have previously been reported as 154 and 160, respectively, but we counted 163 and 170, respectively. The uropeltid snakes of Sri Lanka remain incompletely known, with almost no primary studies carried out since Deraniyagala (1975). Geographic sampling probably remains incomplete, for example, there are no current records of any of uropeltids from the Southern dry zone part of Sri Lanka.

Acknowledgments

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Appendix 1: Comparative material examined.

Rhinophis blythii Kelaart, 1853.

NMSL 20081501, 20081502, 20081503 and 20081504, Kaniyon Power Station, Kaniyon, Maskeliya, Nuwara Eliya District, Central Province.

Rhinophis drummondhayi Wall, 1921.

NMSL uncatalogued specimens (MW 1718 and MW 1720). Carravanella Group, Near Passara, Baddulla District, Uva Province (N 06° 53' E 081° 06'), Alt. 1442 m. NMSL uncatalogued specimen (MW 1729). Carravanella Group, Near Passara, Baddulla District, Uva Province (N 06° 54' E 081° 07'), Alt. 1100 m.

Rhinophis philippinus (Cuvier, 1829).

NMSL uncatalogued specimens (MW 1739, 1741, 1743 and MW 1744). Kandehena, Near Rattota, Matale District, Central Province (N 07° 33' E 080° 40'), Alt. 673 m. NMSL uncatalogued specimens (MW 1754 and MW 1756). Dombawela, Near Palapatwela, Matale District, Central Province (N 07° 33' E 080° 37') Alt. 418 m.

Rhinophis homolepis (Hemprich, 1820).

NMSL uncatalogued specimens (MW 1785, MW 1788 and MW 1796). Near Rakwana, Ratnapura District, Sbaragamuwa Province (N 06° 27' E 080° 37'), Alt. 750 m.

Rhinophis tricoloratus Deraniyagala, 1975.

NMSL Type (Holotype) uncatalogued specimens Kurakstevatta estate, Kudawa villegge on border of Sinharaja forest, Near Veddagala, Ratnapura District, Sbaragamuwa Province.

Uropeltis ruhunae Deraniyagala, 1954.

NMSL RS 52 (Holotype), Galle District, Donated by Rev P. Abraham, Aloshiues college, Galle

Pseudotyphlops philippinus (Müller, 1832).

NMSL RS 03, Abagamuwa, April 1952. NMSL RS 03, Tonacombe, Namunukula. NMSL RS 03(a), Baddalgama.

Appendix 2: List of morphometric characters and their abbreviations.

AF-LLPF: distance between anterior tip of frontal and lower lateral tip of prefrontals, AF-PPF: distance between anterior tip of frontal and posterior tip of prefrontal, AIPE: interparietal to eye distance measured between anterior tip of interparietal to mid point of eye, AOW: distance between posterior tip of prefrontals and lower tip of ocular, APF-PR: distance between anterior tip of prefrontals and posterior tip of rostral, AW: maximum width of anal scale, BD: maximum body depth measured at the 75th ventral scale, BW: maximum body width measured at the 75th ventral scale, FL: maximum frontal length, FW2: frontal width measured between upper tips of oculars, HD: maximum head depth, HL: head length, between snout tip and posterior edge of posteriormost supralabial, HW: maximum head width, IN: internarial distance, IND: internasal scale distance between the posterior tips of nasals, IPL: maximum interparietal length, LAS1-LAS1': minimum rostral width measured between lower anterior edges of 1st supralabials, LLPF-PN: distance between lower lateral tip of prefrontal and posterior edge of nasal, LLSC: maximum length of last subcaudal scale, LO-AO: distance between lower tip of ocular and anterior tip of ocular, LO-LPS3: distance between lower tip of ocular and lower posterior tip of 3rd supralabial, LO-UPS4: distance between lower tip of ocular and upper posterior tip of 4th supralabial, LPS3-LPS4: distance between lower posterior tip of 3rd supralabial and lower posterior tip of 4th supralabial, LP-UPS4: distance between lateral tip of parietal and upper posterior tip of 4th supralabial, NL: nasal length measured from anterior tip of nasal to mid posterior tip of nasal, NPF: distance from posterior tip of nostril to posterior tip of frontal, NPP: distance from posterior tip of nostril to posterior tip of parietal, PFE: distance between posterior tip of frontal and mid point of eye, PFL: prefrontal length taken from anterior tip of frontal to anterior tip of prefrontals, PL1: parietal length measured from upper tip of ocular to posterior tip of parietal, PL2: parietal length measured from upper tip of ocular to lateral tip of interparietal, PO-LO: distance between posterior tip of ocular and lower tip of ocular, PO-UPS4: distance between posterior tip of ocular and upper posterior tip of 4th supralabial, PPF-AO: distance between posterior tip of prefrontal and anterior tip of ocular, PP-LP: distance between posterior tip of parietal and lateral tip of parietal, PR-LLPF: distance between posterior tip of rostral and lower lateral tip of prefrontals, PR-PN: distance between posterior tip of rostral and posterior tip of nasal, PRW: maximum width of preanal scale, RL: maximum rostral length dorsally, RW1: maximum rostral width dorsally, RW2: minimum rostral width taken between anterior tips of prefrontals, SHW2: maximum width of tail shield, SHD: maximum distance of tail shield taken laterally, SPP: snout tip to posterior tip of parietal, SVL: snout to vent length, TL: tail length from posterior tip of anal scale to tip of tail shield, UAI2-LAI2: distance between upper anterior tip of 2nd infralabial and lower anterior tip of 2nd infralabial, UO-PF: distance between upper tip of ocular and posterior tip of frontal, WRV1: maximum rostral width ventrally, WVA20: maximum width of the 20th ventral scale anterior to anal.