THE RAFFLES BULLETIN OF ZOOLOGY 2001 **49**(1): 39-49

TYPHLOPS ROXANEAE, A NEW SPECIES OF THAI BLINDSNAKE FROM THE *T. DIARDII* SPECIES GROUP, WITH A SYNOPSIS OF THE TYPHLOPIDAE OF THAILAND (SERPENTES: SCOLECOPHIDIA)

V. Wallach
4 Potter Park, Cambridge, MA 02138, USA. Email: vwallach@oeb.harvard.edu

ABSTRACT. – A new species of blind snake, *Typhlops roxaneae,* is described from Bangkok, Thailand. It appears to be a derived member of the *Typhlops diardii* group (sensu McDowell, 1974), most closely resembling *T. siamensis,* based upon a comparison of external features and the visceral anatomy, including paired foramina in a multicameral right lung and loss of the left lung. The composition of the *T. diardii* species group is discussed and a synopsis of species provided. An identification key is presented to the eleven species of *Ramphotyphlops* and *Typhlops* known to occur in Thailand.

KEY WORDS. – *Ramphotyphlops, Typhlops, T. diardii, T. muelleri, T. siamensis, T. roxaneae, Typhlops diardii* species group, viscera, Thailand, key

INTRODUCTION

In the most recent revision of Thailand snakes, Taylor (1965) listed nine species of *"Typhlops,"* including *Typhlops (=Ramphotyphlops) albiceps* (Boulenger, 1898), *T. (=Ramphotyphlops) braminus* (Daudin, 1803), *T. diardii* Schlegel (1839), *T. floweri* Boulenger in Flower (1899), *T. khoratensis* Taylor (1962), *T. (=Ramphotyphlops) lineatus* (Schlegel, 1839), *T. muelleri* Schlegel (1839), *T. siamensis* Günther (1864), and *T. trangensis* Taylor (1962). The genus *Ramphotyphlops* Fitzinger (1843) was revalidated by Robb (1966b) for the Australasian species possessing solid protrusible hemipenes in conjunction with retrocloacal sacs (Guibé, 1948; Robb, 1960, 1966a). McDowell (1974) first suggested that *T. braminus* was parthenogenetic (an hypothesis later supported by chromosomal data from Wynn et al., 1987 and Ota et al., 1991), and provisionally transferred it to *Ramphotyphlops* (based upon similarities to *R. erycinus)* but resurrected the name *Typhlina* Wagler (1830) for the genus due to its priority over *Ramphotyphlops.* As *Typhlina* is preoccupied in the Rotifera by *Typhlina* Hemprich and Ehrenberg (1828), *Ramphotyphlops* was designated as the official generic name under Opinion 1207 (I.C.Z.N., 1982). Hahn (1980) removed *T. albiceps* and placed it in *Typhlina (=Ramphotyphlops),* a move that was originally questioned by Wallach (1993b) but later confirmed by Wallach (1996a). Cox (1991), presumably following Brongersma (1934), and Smith (1943), recognized seven species in Thailand, considering *T. muelleri* to be a subspecies of *T. diardii,* placing *R. lineatus* in the genus *Typhlops,* and not recognizing *T. siamensis.* Nutphand (1990) also considered *T. muelleri* to be a subspecies of *T. diardii* and McDiarmid et al. (1999) relegate *T. muelleri* to the synonymy of *T. diardii.* David and Vogel (1996), Manthey and Grossman (1997), and Cox et al. (1998) recognized *T. muelleri* as a valid species separate from *T. diardii.* The most recent addition to the Thai fauna is *T. porrectus* (Cox & Nabhitabhata, 1997).

The ten recognized species of Typhlopidae inhabiting Thailand (Table 1) are considered members of five species groups, two *Ramphotyphlops* groups and three *Typhlops* groups (Wallach, 1998). The monotypic *R. lineatus* species group, with the preocular fused to the postnasal, inferior nasal suture contacting the first supralabial, and a T-III supralabial imbrication pattern (SIP: Wallach, 1993a), inhabits Southeast Asia and Indonesia (David & Vogel, 1996). The *R. braminus* species group (Taylor, 1947), with 20 scale rows and a T-III SIP, inhabits southern and southeastern Asia and contains ten or more species; its Thai membership includes *R. albiceps, R. braminus,* and *"Typhlops" khoratensis.* It may be an artificial group as currently recognized as it contains species assigned to both *Ramphotyphlops* and *Typhlops.* The *T. ater* species group (McDowell, 1974), with conspicuous glands under the central portions of the anterior head shields, T-II or T-V SIP, usually one or two suboculars, and vestigial or absent rectal caecum, ranges from India to Vietnam and southward to Indonesia. A well-defined group with at least 13 species, its sole Thai member is *T. floweri* (Wallach,

Received 23 Apr 1998 Accepted 29 Nov 2000

Table 1. Comparative external data for Thailand Typhlopidae. SG = species group (A = *ater*, B = *braminus*, D = *diardii*, L = *lineatus*, P = *porrectus*), MSR = midbody scale rows, TMD = total middorsal scales, SC = subcaudals, T/LOA = tail length/total length, LOA = total length, TL/D = tail length/midtail diameter, SIP = supralabial imbrication pattern, L/W = total length/midbody diameter, NS = inferior nasal suture contact, PT = postoculars, CS = clutch size.

	SG	MSR	TMD	SC	T/LOA	LOA	TL/D	SIP	L/W	NS	PT	CS
T. floweri	A	18	478–520	20–23	3.4–4.0	174–230	1.0–3.0	T–V	62–89	2	2–3	?
R. braminus	B	20	290–364	8–15	2.0–2.9	46–181	1.2–2.0	T–III	31–66	PO	1	1–8
R. albiceps	B	20	307–424	8–25	1.3–6.7	117–302	0.9–3.0	T–III	51–104	2	1–4	3–8
T. khoratensis	B	20	315–328	11–12	2.4–2.7	94–141	1.4–2.3	T–III	30–57	PO	1	5
R. lineatus	L	22–24	315–430	8–11	1.7–1.8	152–480	0.8–1.1	T–III	36–60	1	2–4	?
T. porrectus	P	18	388–468	7–12	1.4–2.3	65–285	1.0–2.0	T–V	50–91	2	1–2	13–16
T. roxaneae	D	20	329	5	1.3	231	0.5	T–V	39	2	2	14
T. siamensis	D	20–22	306–368	5–13	1.3–3.5	120–305	0.6–1.6	T–V	25–42	2	2	?
T. trangensis	D	24	324–370	8–12	1.8–2.3	155–257	0.8–1.0	T–V	31–32	2	2	?
T. diardii	D	24–28	260–341	8–12	1.9–3.4	96–430	0.8–1.7	T–V	29–48	2	2	3–14
T. muelleri	D	24–30	298–402	6–13	1.2–3.6	143–475	0.4–1.1	T–V	24–45	2	2–3	5–14

1997). The *T. porrectus* species group, with 18 scale rows and a T-III or T-V SIP, is poorly known and inhabits southern Asia (Wallach, 1999); among its half dozen species only *T. porrectus* inhabits Thailand. The *T. diardii* species group (McDowell, 1974), with 22-30 scale rows, T-V SIP, striated infranasal pit, vestigial left lung, and large pedunculate rectal caecum, is also poorly known, inhabiting southern and southeastern Asia and Indonesia (David and Vogel, 1996; Khan, 1998). With possibly a dozen species, its Thai members include the nominate species *T. diardii, T. muelleri, T. siamensis,* and *T. trangensis,* the former two species being widespread and common.

An undescribed *Typhlops* species was discovered in the herpetological collection of the Thai National Research Center. It is a unique specimen and a member of the *T. diardii* species group, originating from south-central Thailand. This new typhlopid brings the total number of species known from within the borders of Thailand to eleven.

MATERIALS AND METHODS

Longitudinal scale rows were counted 20 scales posterior to the mental, at midbody, and 10 scales anterior to the vent. Total middorsals were counted along the vertebral row between, but not including, the rostral and terminal spine. Tail length/width ratio (L/W) calculated as tail length (vent to terminus, including apical spine) divided by midtail horizontal diameter. Visceral characters are defined and discussed by Wallach (1985, 1993b, 1994, 1996b, 1998), Broadley & Wallach (1996), and Wallach & Ineich (1996). Visceral measurements made to the nearest 0.5 mm. All percentages (%) in text and tables refer to percent snout-vent length (% SVL), with SVL omitted; MP refers to midpoint position of organs. Data for paired organs presented as left/right. Ratios of two visceral characters presented as decimals. Museum abbreviations follow Leviton et al. (1985) excepting ISMT (Institute of Science Museum of Taiwan), SLS (St. Louis School, A. Bogadek pers. coll.), TNRC (Thailand National Research Center), and VW (V. Wallach, pers. coll.).

TAXONOMY

Typhlops roxaneae, new species
(Fig. 1)

Holotype. – MCZ 177984 (previously TNRC 523-549), a subadult female collected by locals (field no. PS-GY-137), 2 Oct.1963.

Type locality. – Thailand: Phra Nakhon Si Ayutthaya Province: Bangkok, Bangkok International School, 14° 20' N, 100° 20' E, elevation 1-2 m.

Diagnosis. – *Typhlops roxaneae* can be distinguished from all *Typhlops* except *T. siamensis* by the following combination of characters: 20 midbody scale rows, T-V supralabial imbrication pattern, less than 330 middorsals, and tail length one-half its breadth. From *T. siamensis, T. roxaneae* is identified by its deeply concave postnasal border, paired air chambers in the right lung, and absence of a left lung.

Description. – Total length 231 mm, midbody diameter 6 mm, tail length 2.75 mm, midtail diameter 5.5 mm; body stout, total length/midbody diameter ratio 38.5; tail short, tail length/total length 1.3%; tail twice as broad as long, tail length/midtail diameter 0.5; total middorsals 329, subcaudals 5, dorsocaudals 8; anal shields 5; terminal spine small. Longitudinal scale rows 20-20-18, midbody costals twice as broad as deep. Scale row reduction from 20 to 19 occurs on the left side from 177 mm (0.77 total length), as the first and second para-midventral rows fuse, to 193 mm (0.84 total length), where they divide. Reduction from 20 to 19 rows occurs on the right side at 210 mm (0.91 total length), where the first and second para-midventral rows fuse. The final reduction from 19 to 18 rows occurs on the left side at 219 mm (0.95 total length) where the first and second para-midventral rows once again fuse.

Snout rounded in dorsal view; rostral narrow (0.33 head width) and parallel with rounded apex, 1.5 times as long as broad, 1.5 times as broad as ventral rostral, not reaching interocular level; nasals nearly meeting on midline behind rostral; lacking discrete prefrontal; frontal equal in size to interparietal; supraoculars oblique, twice as long as deep, slightly larger than frontal, in broad contact with postnasal; parietals transversely oriented, twice the width of costals; occipitals not enlarged. Snout rounded in lateral view; nasal incompletely divided by superior nasal suture with deeply concave posterior border, broader than preocular or ocular; posteroventrally flared corner of postnasal with quadrangular shape; weak canthus rostralis present along postnasal and preocular; nostril directed laterally, its axis on a 45° angle, closer to rostral than preocular; inferior nasal suture contacting second supralabial; striated infranasal pit *(sensu* McDowell) present in inferior nasal cleft; superior nasal suture extending horizontally across 0.75 naso-rostral gap; preocular with obtuse triangular shape, broader than ocular, with weakly concave caudal border and strongly projecting cranial border; ocular twice as tall as broad, with weakly concave posterior border; eye small with a distinct pupil, its diameter slightly less than length of nostril along nasal suture, located beneath ocular near supraocular border; postoculars 2; supralabials 4 with T-V imbrication pattern (N1/SL1, N2/SL2/PreOc, PreOc/SL3/Oc, Oc/SL4), first supralabial half the size of second, second supralabial as broad as deep, third supralabial the tallest, deeper than broad, and larger than the second, fourth supralabial larger than third. Mental shield weakly (smoothly) projecting; ventral rostral flared caudally.

Squamous glands confined to borders of head shields, forming three diagonal lines. The postnasal line joins the first supralabial line while the preocular line joins the second supralabial line. The postnasal line, which is strongly convex anteriorly, joins the preocular line posteroventral to the nostril. Ocular line composed of four separate gland lines that join the third supralabial line.

Golden-brown dorsal coloration (middorsal 5-5-5 rows) separated from yellowish-tan venter (13-13-11 rows) by a single lateral row on each side that exhibits a reduction in density of melanophore pigmentation; preoculars, ventral snout, and cloacal region yellow with a yellow ring around the tail tip.

Internal anatomy. – Sternohyoideus muscle extending 0.29 snout-heart gap; heart length moderate (4.2%, MP = 34.3%), ventricle shorter than both atria (ventricle = 2.0%, left atrium = 2.2%, right atrium = 2.6%); distance between left and right systemic arch junctions equal to 0.21 heart length; liver not contacting heart, short heart-liver gap (0.4%); liver moderate (32.0%, MP = 52.9%), nearly symmetrical (LL/RL = 100.7), right liver lobe 29.6% (MP = 54.1%), left liver lobe 29.8% (MP = 51.8%); total liver lobes 59.4%; liver contour wavy with short left anterior extension (0.08 liver length) and short right posterior tail (0.07 liver length), left liver segments 2, right liver segments 5, with one loop posteriorly; moderate heart-liver interval (36.6%) and heart-gall bladder gap (35.1%); liver-gall bladder gap short (2.6%), liver-gall bladder interval moderate (34.4%); gall bladder (2.2%, MP = 72.6%) located between elongated spleen (2.2%) and small pancreas (1.5%); liver-kidney gap short (12.5%), liver-kidney interval moderate (53.5%); gall bladder-gonad gap short (3.5%), gall bladder-kidney gap moderate (7.7%); left and right ovaries short (2.0/3.1%, MP = 80.6/78.7%) with 4/10 undeveloped follicles, no eggs or developing ova; total ovary midpoint 79.7%; left and right adrenals (MP = 82.5/80.5%) located near posterior end of gonads; total adrenal midpoint 81.5%; kidneys moderate (3.7/3.5%, MP = 88.5/83.1%), with long kidney-vent interval (18.6%) and moderate kidney-vent gap (9.6%); total kidney midpoint 85.8%; rectal caecum short (1.5%), rectangular, 1.5 times the width of adjacent small intestine; rectal caecum 0.41 left kidney length; rectal caecum-vent interval moderate 10.1%.

Trachea moderate (35.1%, MP = 18.9%) with approximately 256 rings (or 73/10% SVL) with free tips, entirely extrapulmonary along left lateral side of lung; right bronchus moderate (11.4%), extending along cranial 0.37 right lung to terminate at 47.8%; trachea plus bronchus 46.5% (MP = 24.6%); tracheal lung moderate (21.7%, MP = 23.5%) with

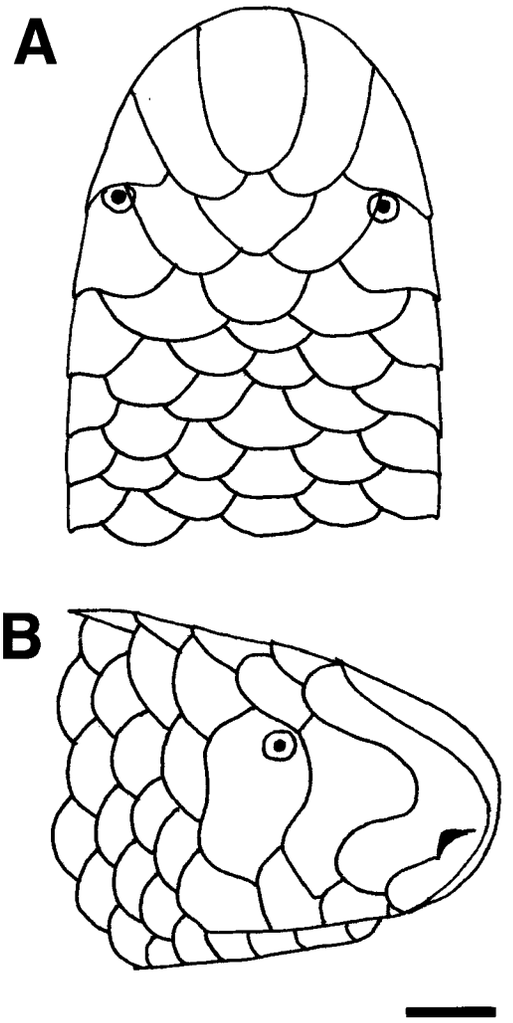

Fig.1. *Typhlops roxaneae,* new species. Holotype, adult female (MCZ 177984). A, dorsal view of head; B, lateral view of head. Bar = 1 mm.

anterior tip at 10.5%, multicameral, and heavily vascularized with 25 small type C foramina centered along an expanded tracheal membrane (TM/CR = 1.0) that has three longitudinal rows of faveoli; cardiac lung (4.2%) multicameral with 2 foramina; right lung long (31.1%, MP = 52.0%), wide, weakly vascularized with trabeculae to terminal tip at 67.5%, with 12 multicameral chambers and 4 paucicameral chambers cranially; foramina of right lung paired transversely, total lung chambers 43 (39 multicameral, 4 paucicameral). Right lung/tracheal lung length = 1.43. Total lung 57.0% (MP = 39.0%), trachea-bronchus/total lung = 0.82. Left lung complex absent.

Etymology. – I dedicate this species to Roxane Coombs, a special friend, talented artist, and excellent librarian. As the former Special Collections librarian at Harvard's Museum of Comparative Zoology, Roxane was instrumental in assisting me to locate numerous rare and obscure works on snakes. She has illustrated a number of snake specimens for my publications, proofread my manuscripts, and supported my research in numerous ways.

DISCUSSION

A phylogenetic analysis of 41 typhlopid species groups, based upon 42 external and 88 internal characters, resulted in two shortest trees of 4302 steps with a consistency index (CI) of 0.68 and a retention index (RI) of 0.58 (Wallach, 1998: fig. 4). In these two trees, which only differed in the placement of two monotypic African species (*T. leucostictus* and *T. ulugurensis)* as either sister taxa or a monophyletic clade, the *T. diardii* group is placed as the sister taxon to *T. koekkoeki* and basal to one of two African clades. The sister group (or outgroup) to the *diardii-koekkoeki-schlegelii-bibronii-angolensis-punctatus* species group clade is the *T. madagascariensis* group. It consists of species that are large-sized (maximum length 300-600 mm) with a high number of both logitudinal scale rows (24-28) and total middorsals (421-580); most members have a striated infranasal pit, a T-V SIP, a rounded snout in dorsal and lateral profile, and a tail of moderate length (L/W = 1.0-2.0).

Polarization of mensural scutellation characters in typhlopids has not been rigorously examined. In Africa, Roux-Estève (1975) considered a low number of longitudinal scale rows to be primitive in *Typhlops* whereas a high number was considered primitive in *Rhinotyphlops.* However, a low total middorsal scale count was assumed to be primitive in both *Typhlops* and *Rhinotyphlops* (Roux-Estève, 1975). In the Caribbean region, Thomas (1989) suggested that a high number of scale rows and total middorsals were primitive for *Typhlops.* Wallach (1998) considered both a high number of scale rows and total middorsals to be primitive in typhlopids. A reanalysis of the Wallach (1998) data set with the polarity reversed for the following eight characters related to scale counts (midbody scale rows, total middorsals, subcaudals, relative body width, relative tail length, relative tail width, anterior scale row reduction, and posterior scale row reduction), while it does not change the topography of the resulting tree, increases both the CI and RI a little for each character. This indicates that a low number of scale rows and total middorsals may be primitive for typhlopids as Roux-Estève (1975) suggested.

McDowell (1974) defined the *T. diardii* species group based on the following characters: preocular-ocular and nasal-preocular head gland lines not joining, T-V supralabial imbrication pattern, glands in nasal cleft expanded into an anteroposteriorly striated pit, large pedunculate rectal caecum, and short tail that is broader than long. Comparison with the presumed *T. madagascariensis* outgroup (Wallach, 1998) indicates that the following characters shared with the *T. diardii* group are primitive and therefore phylogenetically uninformative: snout rounded in dorsal and lateral views, T-V supralabial imbrication pattern, striated infranasal pit, large maximum body size (300-600 mm), high number of longitudinal scale rows (24-28), stout body (L/W ratio 25-40), vestigial left lung present, short right bronchus, nearly symmetrical liver lobes with low number of liver segments, and large pedunculate rectal caecum. However, three derived features are considered synapomorphic: low number of middorsals (250-400), short tail that is as broad as or broader than long (L/W < 1.0), and narrow rostral (RW/HW < 0.33).

Smith (1943) described the specialized structure in the inferior nasal suture of *T. diardii* as a glandular patch or pit, McDowell (1974) called it a striated pit, Wynn and Leviton (1993) a striated organ, and Khan (1998) a sub-narial pit. McDowell (1974) used the expanded glandular line as a systematic character, reporting its presence in the *T. diardii* and *T. ruficaudus* groups, in addition to *Ramphotyphlops leucoproctus* and *R. wiedii.* Wynn and Leviton (1993) noted its presence in *T. castanotus* and *T. collaris* of the *T. ruficaudus* group. It is also present in the *T. madagascariensis* group of Madagascar, and other forms such as *T. vermicularis* of Europe and *R. polygrammicus* of Australia (pers. obs.), despite McDowell's (1974) assertion of its absence in *R. polygrammicus.* As McDowell (1974) explained, the structure appears to be a transverse enlargement of the glands in the nasal suture. It is probably related to the length of the suture and amount of available space between the nostril and lip (A. H. Wynn, pers. comm.) because the "pit" is not obvious or lacking in those species with a short nasal suture. In specimens with a short nasal suture, the glands, if present, are small, narrow or even circular in shape. Compounding the difficulty in assessing the presence or absence of this character is the fact that some species lack pigmentation of the head shields (particularly in the lower snout region, which is usually light colored even in darkly pigmented animals) or else certain individuals in preservative have faded so that detection of the "pit" is impossible. When present, the enlarged gland or "pit" is distinctive but may represent only one extreme of clinal variation in gland size. Since an objective distinction between a "pit" and a normal gland line is lacking, it cannot be employed as a reliable taxonomic character.

McDowell's (1974) gland line character holds more promise for systematic use. He identified patterns of variation in the

Table 2. Comparative external data for presumed members of the *T. diardii* group. MSR = midbody scale rows, TMD = total middorsal scales, SC = subcaudals, T/LOA = tail length/total length, LOA = total length, TL/D = tail length/midtail diameter, SIP = supralabial imbrication pattern, L/W = total length/midbody diameter, RW = rostral width/head width (eye level), PT = postoculars, SL = inferior nasal suture contact, IP = infranasal pit.

	MSR	TMD	SC	T/LOA	LOA	TL/D	SIP	L/W	RW	PT	SL	IP
T. bothriorhynchus	22–24	283–330	9–11	2.3–3.0	180–279	1.1	T-V	26–30	0.33	2–3	2	+
T. diardii	24–28	260–341	8–12	1.9–3.4	96–430	0.8–1.7	T–V	29–48	0.33	2	2	+
T. giadinhensis	22	319–340	7–10	2.1–2.3	237–238	0.8	T-V	26	0.30	2	2	0
T. hypsobothrius	20	?	?	?	285	1.0	T-V	52	0.50	?	2	?
T. klemmeri	24	292	11	1.7	151	0.9	T-V	28	0.40	2	2	+
T. koshunensis	22–23	246	26	1.0–2.4	273-290	2.0	T-V	39–48	0.33	2	2	?
T. muelleri	24–30	298–402	6–13	1.2–3.6	143–475	0.4–1.1	T–V	24–45	0.33–0.40	2–3	2	+
T. oatesii	24–25	?	?	1.0	75–200	1.0	T-V	31–33	0.20–0.25	3	2	?
T. roxaneae	20	329	5	1.3	231	0.6	T–V	39	0.33	2	2	+
T. siamensis	20–22	306–368	5–13	1.3–3.5	120–305	0.6–1.6	T–V	25–42	0.25–0.33	2	2	+
T. trangensis	24	324–370	8–12	1.8–2.3	155–257	0.8–1.0	T–V	31–32	0.33	2	2	?

squamous gland lines in the sutures between the ocular-preocular, preocular-nasal, first and second supralabial, and second and third supralabial shields. Although glands lie in the suture between two shields, because of the extensive overlap of the free margin of each head shield and costal scale (Jackson and Reno, 1975), the lines appear to be beneath the anteriormost of the scale pairs. In order to simplify discussion of gland lines, I refer to the line by the abbreviation of the shield under which it is visible (i.e., shield anterior to suture), as follows: postocular-ocular line (O), ocular-preocular line (P), preocular-nasal line (N), first-second supralabial line (I), second-third supralabial line (II), and third-fourth supralabial line (III). In the *T. diardii* group, the N and P gland lines are separated posteroventral to nostril, with lines N-I being parallel to the P-II lines. This condition also is present in the *T. madagascariensis* group and New World *Typhlops*. In some members of the *T. ruficaudus* group, N and P lines converge ventrally and join posteroventral to the nostril.

McDowell (1974) noted that several Asiatic species should probably also be referred to the *T. diardii* group. The *T. diardii* group may consist of the following forms, some of which are currently considered to be synonyms: *T. bothriorhynchus* Günther (1864), *T. diardii, T. giadinhensis* Bourret (1937), *T. hypsobothrius* Werner (1917), *T. klemmeri* Taylor (1962), *T. koshunensis* Oshima (1916), *T. muelleri, T. oatesii* Boulenger (1890), *T. roxaneae, T. siamensis,* and *T. trangensis* (Table 2). Four of the above species are known only from the holotypes *(T. giadinhensis, T. hypsobothrius, T. klemmeri,* and *T. trangensis)* and four others are quite rare *(T. bothriorhynchus, T. koshunensis, T. oatesii,* and *T. siamensis).* The *T. diardii* species group may be defined on the basis of the three synapomorphies listed above in conjunction with a large maximum length (> 300 mm), stout body (L/W = 25-45), and a T-V labial pattern. Until additional material becomes available for examination and dissection, the actual composition of the *T. diardii* species group cannot be determined.

The *T. diardii* species group includes the only typhlopids outside of Africa known to retain a left lung. As in the African typhlopids, the right bronchus is typically short (<5% SVL) and the rectal caecum is long. The left and right liver lobes are nearly equal in length (LL/RL = 0.9-1.0), asymmetry of the anterior and posterior extensions is less than 0.10, and the number of liver segments is low (1-8). Variation in certain characters of the four species examined (liver length, liver-kidney gap, gall bladder-kidney gap, rectal caecum length, right lung length, midpoint, posterior tip and number of foramina, left lung, and left lung/right lung) supports the primitive position of *T. diardii* and the derivitived position of *T. roxaneae,* with *T. muelleri* and *T. siamensis* intermediate, the latter closer to *T. roxaneae* and the former to *T. diardii.*

Typhlops schneideri Jan (1864) was placed in the synonymy of *T. diardii muelleri* by Smith (1943). With a type locality of Bangkok, Thailand, its relationship to *T. roxaneae* is relevant. Unfortunately the holotype (and presumably the paratype), deposited in Milan (MSNM), was destroyed during World War II (Hahn, 1980). However, the short description (Jan, 1864) and figures (Jan and Sordelli, 1865: livr. 9, pl. 1, fig. 3) provide ample evidence that *T. schneideri* is not conspecific with *T. roxaneae.* It differs from *T. roxaneae* in the following critical features *(T. schneideri* first, followed by *T. roxaneae* data): midbody scale rows (26 vs. 20), postnasal concavity (shallow vs. deep), eye (invisible vs. well developed), and postoculars (one vs. two). *Typhlops schneideri* also differs from typical *T. muelleri* in the absence of a visible eye, and the fact that both specimens available to Jan lacked visible eyes argues against it being an artefact of ecdysis. The only member of the *T. diardii* group lacking a visible eye is *T. trangensis* from Thailand with 24 midbody scale rows; since most species in the *T. diardii* group exhibit variation in the number of midbody scale rows, it is possible that *T. schneider* and *T. trangensis* are synonymous. However, without the type specimen of *T. schneideri* for comparison with *T.*

trangensis, it would be nomenclaturally unwise to revive the name of *T. schneideri* as a senior synonym of *T. trangensis. Typhlops schneideri* may well be an aberrant (blind) example of *T. diardii* and it seems best to leave the name in the synonymy of *T. diardii* as proposed by Smith (1943).

Typhlops trangensis is itself problematic. It differs from the *T. diardii* group in lacking any scale row reduction. The eye is faintly discernible as a shadow of an eyespot. The dorsum is gray, dorsal head scales are blocky, and dorsal head profile is faintly trilobed (all normally associated with ecdysis in typhloids). However, the venter is yellowish-white and unclouded so it is debatable whether the specimen was in a premolt condition when collected. The left and right sides of the head display different SIP's: T-II on the right side, T-V on the left. Because the only typhlopids to possess a T-II pattern are from the *Typhlops ater* species group and Africa (i.e., some *Typhlops* and *Rhinotyphlops),* it is presumed that the T-V pattern is characteristic of *T. trangensis.*

Typhlops roxaneae appears to be a member of the *T. diardii* species group but differs in lacking a left lung, bronchus, and orifice as present in all other members of the *T. diardii* group that have been examined *(T. diardii, T. muelleri,* and *T. siamensis). Typhlops roxaneae* differs from all other members of the *T. diardii* group, except *T. siamensis* and *T. hypsobothrius* from Sumatra, in having a low number of midbody scale rows (20 vs. 22-30). *Typhlops hypsobothrius* is easily distinguished from *T. roxaneae* by the deep pits on the snout, thinner body form (L/W ratio 52-71 vs. 39), and broad rostral. *Typhlops roxaneae* appears to be most closely related to *T. siamensis* based upon the following similarities not shared with other members of the group: 20 midbody scale rows, 5 subcaudals, flared ventral rostral, tail/total length ratio of 1.3, long bronchus, long trachea-bronchus, caudal trachea-bronchus midpoint, long right liver lobe, short gonads, short gall bladder-kidney gap and inteval, nearly symmetrical liver lobes, and large number of right liver segments.

However, *T. roxaneae* differs from *T. siamensis* in having a deeply concave nasal border, 5 middorsal rows brown (vs. 9 or 11 pigmented rows), absence of a left lung, paired foramina in the right lung, shorter sternohyoideus, longer right lung, total lung, and caudal trabecular portion, longer left liver lobe, shorter left, right and total kidneys, shorter rectal caecum, more cranial anterior vascular tip of lung, more caudal right lung midpoint, more cranial right kidney and total kidney midpoints, more caudal lung tip, shorter heart-liver gap, more cranial left, right, and total adrenal midpoint, longer kidney-vent gap and interval, greater number of tracheal rings, more rings per 10% SVL, larger sternohyoideus/snout-heart gap ratio, larger bronchus/right lung ratio, smaller trachael/right lung ratio, greater number of tracheal and total foramina, smaller number of left liver segments, and shorter snout-heart interval (Table 3).

The status of *Typhlops bothriorhynchus* is questionable. Peters (1864) synonymized it with *T. diardii* but it was considered valid by Boulenger (1893) and Smith (1943). Both *T. bothriorhynchus* and *T. hypsobothrius* (of which the type is destroyed) are characterized by grooves or pits in the infranasal shield or supralabials. It is possible that the noted structures are merely the conspicuous striated pits of McDowell (1974). A specimen that agrees in most respects with the descriptions of *T. bothriorhynchus* is UF 48813 from Taunggyi, Myanmar (which is intermediate between the known localities of *T. bothriorhynchus* from Assam and Penang). It is a 234 mm male with 24-22-20 scale rows, 283 middorsals, 11 subcaudals, T-V supralabial pattern, narrow rostral (0.25 head width), large eyespot beneath ocular at supraocular-preocular junction, 2/3 postoculars, nasals completely divided, inferior nasal suture contacting second supralabial, a distinct infranasal gland plus tiny pits on the dorsal rostral and third supralabial (right side) and lowermost preocular (left side), large robust apical spine, and lateral tongue papillae.

Typhlops muelleri has either been considered a subspecies of *T. diardii* by some authors (Brongersma, 1934; Smith, 1943; Haas, 1950; Deuve, 1970; Hahn, 1980; Tweedie, 1983; Cox, 1991; Das, 1994, 1996) or a synonym of *T. diardii* by others (Zhao and Adler, 1993; McDiarmid et al., 1999). However, it was recognized as a distinct species by Boulenger (1893) and more recently by others (Taylor, 1965; Stuebing, 1991; David & Vogel, 1996; Cox et al., 1998; Wallach, 1998; Mattison, 1999). The two forms are readily distinguishable by coloration, with *T. muelleri* having a dark brown, black, or purple dorsum sharply separated from a creamy white or yellow venter whereas in *T. diardii* the dorsum is brown or reddish-brown, gradually fading laterally to a light brown or yellowish-brown venter. Both species are sympatric in Thailand and southern Annam, Vietnam (David & Vogel, 1996). Additionally, most *T. muelleri* have more than 330 middorsals and most *T. diardii* have less than 330 middorsals. Internally, the right lung and cardiac lung of *T. diardii* are unicameral (lacking chambers) but in *T. muelleri, T. roxaneae,* and *T. siamensis* they both are multicameral with 3-12 chambers. The ovaries of *T. muelleri* are positioned more cranially than in *T. diardii* but the kidneys are placed more caudally (Table 3). Smith (1943) considered *T. siamensis* a synonym of *T. diardii muelleri,* reporting the latter to rarely exhibit 22 midbody scale rows *(=T. siamensis). Typhlops siamensis,* with 20-22 scale rows, is separable from *T. diardii* and *T. muelleri* as suggested by Taylor (1965) and Saint Girons (1972). Additional differences in the visceral anatomy can be seen in Table 3.

An abbreviated synonymy is provided below for the *Typhlops diardii* species group as currently conceived (bearing in mind the fact that types or representatives of many of the taxa have not been examined).

Typhlops diardii Species Group

1. *Typhlops diardii* Schlegel, 1839: 39. Type locality: "Cochinchina" [=South Vietnam]. Holotype: MNHN

Table 3. Visceral data for the *T. diardii* species group (sex, M = male, F = female; * = sample size of 1)

Character	*roxaneae*	*diardii*	*muelleri*	*siamensis*
Sample size and sex	1F	3M, 1F	6M, 2F	2M
Sternohyoideus posterior tip	9.2	14.1 (12.0–15.7)	13.0 (8.0–17.7)	14.8 (12.9–16.7)
Sternohyoideus/snout-heart gap	0.71	0.55 (0.52–0.59)	0.58 (0.50–0.73)	0.56 (0.51–0.61)
Snout-heart interval	36.4	35.9 (32.6–39.4)	35.9 (30.2–41.6)	38.6 (37.9–39.2)
Heart-liver gap	0.4	0.5 (–0.3 to 1.1)	1.7 (0–4.0)	1.8 (1.7–1.9)
Left liver length	29.8	23.0 (19.7–30.4)	24.3 (21.2–27.1)	27.4 (25.0–29.8)
Total liver length	59.4	49.1 (41.0–66.5)	49.2 (42.4–53.6)	55.2 (50.0–60.3)
Right liver segments	5	2.8 (1–6)	2.3 (1–5)	5.0 (4–6)
Left liver segments	2	4.5 (2–8)	3.2 (1–5)	6.0 (4–8)
Liver-kidney gap	12.5	20.9 (15.5–24.2)	22.8 (17.1–30.0)	15.3 (13.8–16.7)
Gall bladder-kidney gap	7.7	15.2 (8.6–18.9)	14.2 (6.8–19.8)	9.8 (6.7–12.9)
Left adrenal midpoint	82.5	84.5 (83.5–85.5)	84.3 (80.8–88.1)	84.8 *
Right adrenal midpoint	80.5	80.9 (78.6–83.7)	81.4 (78.5–84.0)	82.1 *
Total adrenal midpoint	81.5	82.7 (81.1–84.6)	82.8 (79.9–86.0)	83.5 *
Left kidney length	3.7	4.3 (3.9–4.9)	4.8 (4.2–6.1)	4.6 (4.2–5.0)
Right kidney length	3.5	4.2 (3.1–5.3)	4.8 (4.0–6.1)	4.7 (4.2–5.2)
Total kidney length	7.2	8.5 (7.0–10.2)	9.5 (8.3–12.2)	9.3 (8.4–10.2)
Right kidney midpoint	83.1	86.5 (84.8–89.0)	89.4 (85.6–92.4)	87.9 (87.9–87.9)
Total kidney midpoint	85.8	87.8 (86.6–89.9)	90.4 (86.7–93.0)	88.8 (88.8–88.9)
Kidney-vent gap	9.6	8.8 (7.2–10.2)	6.1 (4.1–9.5)	8.0 (7.6–8.3)
Kidney-vent interval	18.6	15.6 (13.2–17.8)	12.9 (10.0–16.7)	14.5 (14.2–14.8)
Kidney overlap/total kidney length	–0.20	0.30 (0.17–0.38)	0.42 (0.19–0.78)	0.43 (0.43–0.43)
Rectal caecum length	1.5	3.6 (3.0–4.0)	3.4 (2.4–4.8)	3.1 (1.2–5.0)
Rectal caecum/left kidney length	0.41	0.81 (0.53–1.00)	0.73 (0.57–1.12)	0.72 (0.24–1.19)
Estimated number of tracheal rings	256	221.2 (195–253)	227.5 (196–275)	217.5 (195–240)
Tracheal rings/10% SVL	73.0	64.4 (55.1–76.8)	66.9 (60.5–79.9)	59.6 (52.0–67.2)
Tracheal lung anterior tip	10.5	11.6 (9.5–15.0)	11.9 (9.0–15.2)	13.0 (11.7–14.2)
Right lung length	31.1	19.9 (16.5–23.5)	20.5 (15.4–25.6)	22.5 (16.7–28.3)
Right lung midpoint	52.0	45.8 (44.3–47.6)	46.2 (41.8–49.8)	49.8 (47.5–52.0)
Right bronchus length	11.4	3.7 (1.1–6.3)	4.7 (2.4–6.0)	6.2 (1.7–10.7)
Right bronchus/right lung	0.37	0.19 (0.06–0.38)	0.24 (0.10–0.37)	0.24 (0.10–0.38)
Right lung posterior tip	67.5	55.7 (54.7–56.1)	56.4 (49.7–62.4)	61.0 (55.8–66.2)
Tracheal lung foramina	25	38.3 (34–43)	34.0 (30–38)	21.0 (19–23)
Right lung foramina	12	0	5.4 (4–8)	3
Total lung length	57.0	44.1 (40.9–46.6)	44.5 (37.7–50.0)	48.1 (41.7–54.5)
Right lung/tracheal lung	1.43	1.03 (0.83–1.35)	1.08 (0.79–1.47)	1.09 (0.84–1.33)
Left lung length	0	3.0 (2.2–3.6)	1.7 (0.7–2.5)	2.3 (1.7–2.9)
Left lung/right lung length	0	0.18 (0.17–0.19)	0.09 (0.05–0.13)	0.01 (0.01–0.01)

1065. Distribution: NE Pakistan, N India, W Nepal, Bangladesh, Myanmar, Thailand, N Laos, N Vietnam, S China, and Hainan Is.

Argyrophis horsfieldii Gray, 1845: 137. Type locality: "Khassia, Hill," [=Khasi Hills], Assam, India. Holotype: BMNH 1946.1.11.50. Synonymy *fide* Boulenger, 1893: 22.

Typhlops striolatus Peters, 1861: 922. Type locality: "Ganges," [=Ganges River], India. Holotype: ZMB 4076 (not BMNH 1946.1.11.61 *fide* Hahn, 1980: 56). Synonymy *fide* Boulenger, 1893: 22.

Typhlops barmanus Stoliczka, 1872: 144. Type locality: "near Moulmain, Tenaserim, Barma" [=Mawlamine, Myanmar]. Holotype: ZSI 6879. Synonymy *fide* Boulenger, 1893: 22.

Typhlops tephrosoma Wall, 1908: 314. Type locality: "Shillong, Khasi Hills, Assam," India. Holotype: BMNH 1946.1.11.65. Synonymy *fide* Smith, 1943: 51.

Typhlops diardi cinereus Wall, 1909: 609 (preoccupied by *Typhlops cinereus* Guérin-Méneville, 1829-1844: 30, pl. 18, fig. 2). Type locality: "near Dibrugarh,

Upper Assam," India. Holotype: unknown. Synonymy *fide* Smith, 1943: 51.

Typhlops diardi platyventris Khan, 1998: 214. Type locality: "Goi Madan, District Kotli, Azad Kashmir, Pakistan." Holotype: CAS 170526.

2. *Typhlops giadinhensis* Bourret, 1937: 68, fig. 7. Type locality: "Giadinh (Cochinchine)," [=South Vietnam]. Holotype: MNHN 1938.118. Distribution: South Vietnam, known only from the type specimen.

3. *Typhlops hypsobothrius* Werner, 1917: 34. Type locality: "Sumatra," Indonesia. Holotype: ZMH, destroyed in World War II. Distribution: Indonesia, known only from the type specimen.

4. *Typhlops klemmeri* Taylor, 1962: 253. Type locality: "Koh Phai, near Kuala Lumpur, Malaya" [=Malaysia]. Holotype: FMNH 178238. Distribution: Malaysia, known only from the type specimen.

5. *Typhlops koshunensis* Oshima, 1916: 85. Type locality: "Koshun, Formosa" [=Taiwan]. Holotype: ISMT 5. Distribution: Taiwan, known only from the type specimens.

6. *Typhlops muelleri* Schlegel, 1839: 39, pl. 32, figs. 25-28. Type locality: "Padang auf Sumatra," Indonesia. Holotype: RMNH 3718. Distribution: S Thailand, S Myanmar, Kampuchea, S Vietnam, West Malaysia, Penang Is., Singapore, East Malaysia, and Indonesia (Nias Is., Sumatra, Wé Is., Bangka Is., Java, Kalimantan, and Irian Jaya).

Typhlops nigroalbus Duméril and Bibron, 1844: 295. Type locality: "Sumatra," Indonesia. Holotype: MNHN 6991. Synonymy *fide* Smith, 1943: 51.

Argyrophis bicolor Gray, 1845: 136. Type locality: "Singapore." Holotype: BMNH 1946.1.10.63. Synonymy *fide* Günther, 1864: 172.

Pilidion dimidiatum Bleeker, 1860: 291. Type locality: "Ampat Lawang, Sumatra" [=Pendopo, Sumatra, Indonesia]. Holotype: BMNH 1946.1.10.49. Synonymy *fide* Boulenger, 1893: 25.

Typhlops schneideri Jan, 1864: 20. Type locality: "Bangkok, capitale du Royaume de Siam" [=Thailand]. Holotype: MSNM, destroyed during World War II. Synonymy *fide* Smith, 1943: 51.

Typhlops kapaladua Annandale, 1905: 208. Type locality: "Malay Archipelago, probably Java," [Indonesia]. Holotype: ZSI 15284. Synonymy *fide* McDowell, 1974: 10.

Typhlops labialis Waite, 1918: 30, fig. 22. Type locality: "Western Australia" [in error]. Holotype: WAM 630. Synonymy *fide* McDowell, 1974: 10.

Typhlops fusconotus Brongersma, 1934: 192, figs. 19-21. Type locality: "Doré, New Guinea" [=Manokwari, Irian Jaya, Indonesia]. Holotype: RMNH 6293. Synonymy *fide* McDowell, 1974: 10.

7. *Typhlops oatesii* Boulenger, 1890: 238. Type locality: "Table Island, Cocos group," Andaman Islands, India. Syntypes: BMNH 1946.1.10.51-52. Distribution: Andaman Islands.

8. *Typhlops roxaneae* n. sp. Type locality: "Bangkok, Thailand." Holotype: MCZ 177984. Distribution: Thailand, known only from the type specimen.

9. *Typhlops siamensis* Günther, 1864: 175, pl. 16, fig. D. Type locality: "Siam" [=Thailand]. Holotype: BMNH 1946.1.11.69. Distribution: Thailand and Kampuchea.

Taxa of uncertain status

10. *Typhlops bothriorhynchus* Günther, 1864: 174, pl. 16, fig. G. Type locality: "Pinang," [=Penang], Malaysia, but probably from Wellesley Province, opposite Penang fide Stoliczka, 1871: 424. Holotype: BMNH 1946.1.11.59. Distribution: N India, Myanmar, and West Malaysia.

11. *Typhlops trangensis* Taylor, 1962: 251, fig. 14. Type locality: "Khao Chong, Trang, Thailand." Holotype: FMNH 178236. Distribution: Thailand, known only from the type specimen.

The following key will aid in the identification of the Typhlopidae of Thailand.

1. Preocular fused to nasal, inferior nasal suture contacting first supralabial, rostral broad (> 0.6 head width), dorsum striped ..... *R. lineatus*
– Preocular separate from nasal, inferior nasal suture contacting second supralabial or preocular, rostral narrow (< 0.4 head width), dorsum uniform 2

2. Midbody scale rows 18 3
– Midbody scale rows 20-30 4

3. Glands present under central portions of head shields, subocular present, 2-3 postoculars, subcaudals >15 ..... *T. floweri*
– Glands confined to scale sutures, not present under central portions of shields, lacking subocular, 1 postocular, subcaudals <15 ..... *T. porrectus*

4. Midbody scale rows 20-22 5
– Midbody scale rows 24-30 9

5. Inferior nasal suture contacting preocular 6
– Inferior nasal suture contacting second supralabial 7

6. Eye, with visible pupil, under ocular, snout not depressed, prefrontal, frontal and interparietal not enlarged, multicameral tracheal lung ..... *R. braminus*
– Eyespot, lacking pupil, under supraocular-ocular border, snout depressed, prefrontal, frontal and interparietal enlarged, paucicameral tracheal lung ..... *T. khoratensis*

7. Superior nasal suture extending dorsally, parallel to rostral and

visible from above, T-III SIP ..... *R. albiceps*
- Superior nasal suture extends horizontally to rostral, not visible dorsally, T-V SIP 8

8. Midbody scale rows 20, postnasal deeply concave, left lung absent ..... *T. roxaneae*
- Midbody scale rows 20-22, postnasal not concave, left lung present ..... *T. siamensis*

9. Midbody scale rows 24, lacking scale row reduction, eye indistinct, parietals barely broader than deep, dorsal head scales large and uniform ..... *T. trangensis*
- Midbody scale rows 24-30, midbody and/or posterior scale row reduction of at least two rows, eye distinct with pupil, parietals at least twice as broad as deep, dorsal head scales variable in size 10

10. Sharp demarcation between dark brown, purple or black dorsum and yellow or gold venter, multicameral right lung ..... *T. muelleri*
- Gradual lateral transition between brown dorsum and light brown venter, unicameral right lung ..... *T. diardii*

CONCLUSIONS

Eleven species of Typhlopidae are now recognized as occurring within Thailand: *Ramphotyphlops albiceps, R. braminus, R. lineatus, T. diardii, T. floweri, T. khoratensis, T. muelleri, T. porrectus, T. roxaneae, T. siamensis,* and *T. trangensis. Typhlops roxaneae* represents the most derived member of the *T. diardii* species group, based upon absence of a left lung, paired air chambers in the right lung, vestigial rectal caecum, long right bronchus, and low number of scale rows. It appears to be most closely related to *T. siamensis,* based upon the flared ventral rostral and numerous shared visceral characters. The *T. diardii* group is primitive within a clade containing also *T. koekkoeki* and African typhlopids *(T. diardii-koekkoeki-schlegelii-bibronii-angolensis-punctatus* species groups). Although visceral data is available for only four of the species (all of which inhabit Thailand), the group apparently consists of *T. bothriorhynchus, T. diardii, T. giadinhensis, T. hypsobothrius, T. klemmeri , T. koshunensis, T. muelleri, T. oatesii, T. roxaneae, T. siamensis,* and *T. trangensis.*

ACKNOWLEDGMENTS

Sincerest thanks are due to Jarujin Nabhitabhata of the National Thai Research Center and Merel J. Cox of Bangkok, who facilitated loan of the entire Thai collection of blind snakes for my examination. Nikolai Orlov (ZIL) presented Vietnamese material of *T. diardii* and *T. muelleri* from Vietnam to the Field Museum. Robert W. Murphy (ROM) provided *T. diardii* and J. R. Dixon (TCWC) supplied *T. siamensis* from Vietnam. The type of *T. giadinhensis* was loaned for external examination by I. Ineich. The curators and staff of CAS (R. C. Drewes, J. V. Vindum), FMNH (R. F. Inger, H. Marx, H. K. Voris, A. Resetar), and MCZ (J. P. Rosado and E. E. Williams) have been most helpful and accomodating in allowing me access to their specimens. In addition to the above, material of *R. braminus* was made available by W. Böhme (ZFMK) and F. Glaw (ZSM). R. Coombs proofread the manuscript. Comments from the reviewers, particularly A. H. Wynn who reviewed the manuscript twice, were most helpful in pointing out errors and improving the quality of this paper.

LITERATURE CITED

Annandale, N., 1905. Additions to the collection of Oriental snakes in the Indian Museum, Part 3. *Proc. Asiatic Soc. Bengal,* ser. 2, **1**: 208-214.

Bleeker, P., 1860. Over de reptiliën-fauna van Sumatra. *Nat. Tijdschr. Ned. Indië* **16**: 284-298.

Boulenger, G. A., 1890. *The Fauna of British India, including Ceylon and Burma. Reptilia and Batrachia.* Taylor and Francis, London. 541 pp.

Boulenger, G. A., 1893. *Catalogue of the snakes in the British Museum (Natural History). Vol. I.* British Museum (Natural History), London. 448 pp.

Boulenger, G. A., 1898. Description of two new blind snakes. *Ann. Mag. Nat. Hist.,* ser. 7, **1**: 124.

Bourret, R., 1937. Notes herpétologiques sur l'Indochine Française. XV. Lézards et serpents reçus au Laboratoire des Sciences Naturelles de l'Université au cours de l'année 1937. Descriptions de deux espèces et deux variétés nouvelles. *Bull. Gén. Instr. Publ.,* Hanoi **4** (Décembre): 57-80.

Broadley, D. G. & V. Wallach, 1996. A remarkable new worm snake (Serpentes: Leptotyphlopidae) from the East African coast. *Copeia* **1996**: 162-166.

Brongersma, L. D., 1934. Contributions to Indo-Australian herpetology. *Zool. Meded.* **17**: 161-251.

Cox, M. J., 1991. *The Snakes of Thailand and their Husbandry.* Krieger, Malabar. 526 pp.

Cox, M. J. & J. Nabhitabhata, 1997. Geographic distribution: Serpentes: *Typhlops porrectus. Herp. Rev.* **28**: 53.

Cox, M. J., P. P. van Dijk, J. Nabhitabhata & K. Thirakhupt, 1998. *A photographic guide to snakes and other reptiles of peninsular Malaysia, Singapore and Thailand.* Ralph Curtis Books, Sanibel Island. 144 pp.

Das, I., 1994. The reptiles of South Asia: checklist and distributional summary. *Hamadryad* **19**: 15-40.

Das, I., 1996. *Biogeography of the reptiles of South Asia.* Krieger, Malabar. 87 pp.

Daudin, F. M., 1803. *Histoire Naturelle Génerale et Particulière des Reptiles.* Tome septième. F. Dufart, Paris. 436 pp.

David, P. & G. Vogel, 1996. *The Snakes of Sumatra; an Annotated Checklist and Key with Natural History Notes.* Edition Chimaira, Frankfurt am Main. 260 pp.

Deuve, J., 1970. Serpents du Laos. *Mém. Off. Rech. Scient. Tech. Outre-Mer* **39**: 1-251.

Duméril, A. M. C. & G. Bibron, 1844. *Erpétologie générale ou histoire naturelle complète des reptiles. Tome sixième.* Librairie Encyclopédique de Roret, Paris. 609 pp.

Fitzinger, L. J. F. J., 1843. *Systema Reptilium. Fasciculus Primus. Amblyglossae.* Braunmüller et Seidel, Vindobonae. 106 pp.

Flower, S. S., 1899. Notes on a second collection of reptiles made in the Malay Peninsula and Siam, from November 1896 to September 1899, with a list of the species recorded from these countries. *Proc. Zool. Soc. London* **1899**: 600-696.

Gray, J. E., 1845. *Catalogue of the specimens of lizards in the collection of the British Museum.* British Museum (Natural History), London. 289 pp.

Guibé, J., 1948. Contribution a l'étude de l'appareil génital des typhlopidea (ophidiens). *Bull. Soc. Zool. France* **73**: 224-228.

Günther, A. C. L. G., 1864. *The Reptiles of British India.* Ray Society, London. 452 pp.

Haas, C. P. J. de, 1950. Checklist of the snakes of the Indo-Australian Archipelago (Reptiles, Ophidia). *Treubia* **20**: 511-625.

Hahn, D. E., 1980. Liste der rezenten Amphibien und Reptilien: Anomalepididae, Leptotyphlopidae, Typhlopidae. *Das Tierreich* **101**: 1-93.

Hemprich, F. G. & C. G. Ehrenberg, 1828. *Symbolae physicae seu icones et descriptiones animalium evertebratorum sepositis insectis quae ex itinere per Africam borealem et Asiam occidentalem. Decas prima. Animalia evertebrata. Phytozoa. Polygastrica et Rotatoria Africam et Asiatica.* Officina Academica, Berolini. 67 unnumbered pp.

I. C. Z. N., 1982. Opinion 1207. *Leptotyphlops* and *Ramphotyphlops* Fitzinger, 1843 (Reptilia, Serpentes): conserved. *Bull. Zool. Nomen.* **39**: 106-108.

Jackson, M. K. & H. W. Reno, 1975. Comparative skin structure of some fossorial and subfossorial leptotyphlopid and colubrid snakes. *Herpetologica* **31**: 350-359.

Jan, G., 1864. *Iconographie générale des ophidiens. Première famille: les typhlopiens.* Georges Jan, Milan. 42 pp.

Jan, G., 1865 *in* G. Jan & F. Sordelli, 1860-1866. *Iconographie générale des ophidiens.* [Atlas]. Tome premier (livrais. 1 à 17). Georges Jan and Ferdinand Sordelli, Milan. 11 pp., 102 pls.

Khan, M. S., 1998. Notes on *Typhlops diardi* Schlegel, 1839, with description of a new subspecies (Squamata, Serpentes, Scolecophidia). *Pakistan J. Zool.* **30**: 213-221.

Leviton, A. E., R. H. Gibbs, Jr., E. Heal & C. E. Dawson, 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia* **1985**: 802-832.

Manthey, U. & W. Grossmann, 1997. *Amphibien & Reptilien Südostasiens.* Natur und Tier, Münster. 512 pp.

Mattison, C., 1999. *Snake.* DK Publishing, New York. 192 pp.

McDiarmid, R. W., J. A. Campbell & S. A. Touré. 1999. *Snake species of the world. A taxonomic and geographic reference.* Vol. 1. Herpetologist's League, Washington. 511 pp.

McDowell, S. B., Jr., 1974. A catalogue of the snakes of New Guinea and the Solomons, with special reference to those in the Bernice P. Bishop Museum. Part I. Scolecophidia. *J. Herpetol.* **8**: 1-57.

Nutphand, W., 1990. "Blind snakes, the smallest snakes in the world." *Bull. Thai Zool. Ctr.,* Bangkok **5**: 49-60. [In Thai]

Oshima, M., 1916. "A correction of the scientific names of Formosan snakes." *Zool. Mag.,* Tokyo **28**: 84-86. [In Japanese]

Ota, H., T. Hikida, M. Matsui, A. Mori & A. H. Wynn, 1991. Morphological variation, karyotype and reproduction of the parthenogenetic blind snake, *Ramphotyphlops braminus,* from the insular region of East Asia and Saipan. *Amphibia-Reptilia* **12**: 181-193.

Peters, W. C. H., 1861. Über neue Schlangen des Königl. zoologischen Museums: *Typhlops striolatus, Geophidium dubium, Streptophorus (Ninia) maculatus, Elaps hippocrepis. Mber. Königl. Akad. Wiss. Berlin* **1861**: 922-925.

Robb, J., 1960. The internal anatomy of *Typhlops* Schneider (Reptilia). *Aust. J. Zool.* **8**: 181-216.

Robb, J., 1966a. The structure and possible function of the cloacal pouches of male Australian typhlopids. *Aust. J. Zool.* **14**: 27-30.

Robb, J., 1966b. The generic status of the Australasian typhlopids (Reptilia: Squamata). *Ann. Mag. Nat. Hist.,* ser. 13, **9**: 675-679.

Roux-Estève, R., 1975. Recherches sur la morphologie, la biogéographie et la phylogénie des Typhlopidae d'Afrique. *Bull. Inst. Fond. Afr. Noire* (1974), ser. A, **36**: 428-508.

Saint Girons, H., 1972. Les serpents du Cambodge. *Mém. Mus. Natl. Hist. Nat.,* sér. 2, Zool., **74**: 1-170.

Schlegel, H., 1839 *in* 1837-1844. *Abbildungen neuer oder unvollständig bekannter Amphibien, nach der Natur oder dem leben entworfen, herausgegeben und mit einem erläuternden Texte begleitet.* Arnz & Comp., Düsseldorf. 141 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. 3. Serpentes.* Taylor and Francis, London. 583 pp.

Stoliczka, F., 1871. Notes on some Indian and Burmese ophidians. *J. Asiatic Soc. Bengal,* ser. 2, **40**: 421-445.

Stoliczka, F., 1872. Note on a few Barmese species of Sauria, Ophidia and Batrachia. *Proc. Asiatic Soc. Bengal,* ser. 2, **41**: 143-147.

Stuebing, R. B., 1991. A checklist of the snakes of Borneo. *Raffles Bull. Zool.* **39**: 323-362.

Taylor, E. H., 1947. Comments on Ceylonese snakes of the genus *Typhlops* with descriptions of new species. *Univ. Kansas Sci. Bull.* **31**: 283-298.

Taylor, E. H., 1962. New Oriental reptiles. *Univ. Kansas Sci. Bull.* **43**: 209-263.

Taylor, E. H., 1965. The serpents of Thailand and adjacent waters. *Univ. Kansas Sci. Bull.* **45**: 609-1096.

Thomas, R., 1989. The relationships of Antillean *Typhlops* (Serpentes: Typhlopidae) and the description of three new Hispaniolan species. In: C. A. Woods (ed.), *Biogeography of the West Indies: past, present, and future.* Pp. 409-432. Sandhill Crane Press, Gainesville.

Tweedie, M. W. F., 1983. *The Snakes of Malaya.* Singapore National Printers, Singapore. 167 pp.

Wagler, J. G., 1830. *Natürliches System der Amphibien, mit vorangehender Classification der Säugthiere und Vögel. Ein Beitrag zur vergleichenden Zoologie.* J. G. Cotta'schen, München. 354 pp.

Waite, E. R., 1918. Review of the Australian blind snakes (family Typhlopidae). *Rec. So. Aust. Mus.* **1**: 1-34.

Wall, F., 1908. Notes on a collection of snakes from the Khasi Hills, Assam. *J. Bombay Nat. Hist. Soc.* **18**: 312-337.

Wall, F., 1909. Notes on snakes collected in Upper Assam [Part I]. *J. Bombay Nat. Hist. Soc.* **19**: 608-623.

Wallach, V., 1985. A cladistic analysis of the terrestrial Australian Elapidae. In: G. Grigg, R. Shine, & H. Ehmann (eds.), *Biology of Australasian Frogs and Reptiles.* Pp. 223-253. Royal Zoological Society of New South Wales, Chipping Norton.

Wallach, V., 1993a. The supralabial imbrication pattern of the Typhlopoidea (Reptilia: Serpentes). *J. Herpetol.* **27**: 214-218.

Wallach, V., 1993b. A new species of blind snake, *Typhlops marxi,* from the Philippines (Serpentes: Typhlopidae). *Raffles Bull. Zool.* **41**: 263-278.

Wallach, V., 1994. The status of the Indian endemic *Typhlops acutus* (Duméril & Bibron) and the identity of *Typhlops psittacus* Werner (Reptilia, Serpentes, Typhlopidae). *Bull. Inst. Roy. Sci. Nat. Belgique* **64**: 209-229.

Wallach, V., 1996a. Notes and corrections on two scolecophidians: *Ramphotyphlops albiceps* and *Leptotyphlops brasiliensis. Herp. Rev.* **27**: 10.

Wallach, V., 1996b. The systematic status of the *Ramphotyphlops flaviventer* (Peters) complex (Serpentes: Typhlopidae). *Amphibia-Reptilia* **17**: 341-359.

Wallach, V., 1997. Two new blind snakes of the *Typhlops ater* species group from Papua New Guinea (Serpentes: Typhlopidae). *Russian J. Herpetol.* **3**: 107-118.

Wallach, V., 1998. *The visceral anatomy of blindsnakes and wormsnakes and its systematic implications (Serpentes: Anomalepididae, Typhlopidae, Leptotyphlopidae).* Unpubl. Doctoral Dissertation, Northeastern University, Boston. 611 pp.

Wallach, V., 1999. *Typhlops meszoelyi,* a new species of blind snake from northeastern India (Serpentes: Typhlopidae). *Herpetologica* **55**: 185-191.

Wallach, V. & I. Ineich, 1996. Redescription of a rare Malagasy blind snake, *Typhlops grandidieri* Mocquard, with placement in a new genus (Serpentes: Typhlopidae). *J. Herpetol.* **30**: 367-376.

Werner, F., 1917. Über einige neue Reptilien und einen neuen Frosch des Zoologischen Museums in Hamburg. *Mitt. Zool. Mus. Hamburg* **34**: 31-36.

Wynn, A. H. & A. E. Leviton, 1993. Two new species of blind snake, genus *Typhlops* (Reptilia: Squamata: Typhlopidae), from the Philippine Archipelago. *Proc. Biol. Soc. Wash.* **106**: 34-45.

Wynn, A. H., C. J. Cole & A. L. Gardner, 1987. Apparent triploidy in the unisexual Brahminy blind snake, *Ramphotyphlops braminus. Amer. Mus. Novit.* **2868**: 1-7.

Zhao, E.-M. & K. Adler, 1993. *Herpetology of China.* Society for the Study of Amphibians and Reptiles, Oxford. 522 pp.

APPENDIX: MATERIAL EXAMINED

Ramphotyphlops albiceps: Hong Kong (BMNH 1954.1.13.4, 1983.946; SLS 196), Malaysia (ZRC 3043-45), Thailand (BMNH 1946.1.10.50 [holotype]; MCZ 177983, 181196; ZMUC 52203-04); *R. braminus:* Comoros (CAS 16937; ZFMK 32119-21), Egypt (MVZ 230077), Guam (FMNH 189357 [holotype of *Typhlops pseudosaurus]),* Hong Kong (MCZ 172796, 175924), India (CAS 94443), Madagascar (FMNH 18283; MCZ 181301; NHRM 2439, 12438; UMMZ 209690-98, 220675-94; ZFMK 9161, 19299-302, 60790, 70001; ZSM 1219/0), Mascarenes (ZFMK 35704-05), Mauritius (USNM 150957), Philippines (FMNH 53251), Seychelles (UMMZ 167976-77); *R. lineatus:* Indonesia (FMNH 131235; RMNH 5788), Malaysia (FMNH 158645, 197951); *Typhlops diardii:* India (CAS-SU 13982; MCZ 165004), Thailand (FMNH 180008, 252064), Vietnam (FMNH 252064; ROM 25640); *T. floweri:* Thailand (CAS 101599; MCZ 181198; USNM 72709), Vietnam (NMBA 328); *T. giadinhensis:* Vietnam (MNHN 1938.118 [holotype]); *T. khoratensis:* Thailand (FMNH 189933; MCZ 74097; NTRC uncat.); *T. muelleri:* Malaysia (FMNH 161275), Thailand (TNRC 3788, 7336-37; VW 5924, 5927-28), Vietnam (BPBM 2156; FMNH 252063; USNM 86885, 90373); *T. porrectus:* Burma (MCZ 3702), India (CAS 17169; FMNH 60645; MCZ 4082, 165023-24), Singapore (FMNH 217449); *T. roxaneae:* Thailand (MCZ 177984 [holotype]); *T. siamensis:* Thailand (MCZ 16655), Vietnam (TCWC 29356); *T. trangensis:* Thailand (FMNH 178236 [holotype], NMV 1914 [?]).