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TWO NEW BLIND SNAKES OF THE *Typhlops ater* SPECIES GROUP FROM PAPUA NEW GUINEA (SERPENTES: TYPHLOPIDAE)[1]

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Two new blind snake species of the *Typhlops ater* group are described from low elevations of southeastern Papua New Guinea. *Typhlops mcdowelli* closely resembles *T. depressiceps*, differing in total middorsals, rostral shape, lateral snout profile, length/width ratio, tracheal lung type, and form of terminal spine. *Typhlops fredparkeri* is most similar externally to *T. oligolepis* and internally to *T. inornatus*; it differs from all other members of the *T. ater* group (except *T. oligolepis*) in possessing only 16 longitudinal scale rows. The internal anatomy is described for two paratypes of *T. mcdowelli* and the holotype of *T. fredparkeri*. An identification key to fourteen species of the *T. ater* group is presented and visceral data for 10 members are summarized. A key is provided for the thirteen species of the Typhlopidae currently known to inhabit Papua New Guinea.

Key words: Typhlopidae, *Typhlops mcdowelli*, *Typhlops fredparkeri*, *Typhlops ater* group, viscera, Papua New Guinea.

In a revision of the scolecophidians of the New Guinea-Solomon Islands region, McDowell (1974) defined the *Typhlops ater* species group based upon a suite of characters, only one of which is uniquely diagnostic of the group: head glands present beneath the central portions of shields in addition to those along the sutures. The *Typhlops ater* species group inhabits southern and southeastern Asia, the Philippines, Indonesia, and Papua New Guinea. It appears to contain the following twelve species (Table 1): *T. andamanensis* Stoliczka (1871), *T. ater* Schlegel (1839), *T. beddomii* Boulenger (1890), *T. bisubocularis* Boettger (1893), *T. ceylonicus* Smith (1943), *T. depressiceps* Sternfeld (1913), *T. floweri* Boulenger (1899), *T. hedraeus* Savage (1950), *T. inornatus* Boulenger (1888), *T. mirus* Jan (1860), *T. oligolepis* Wall (1909), and *T. tindalli* Smith (1943). The status of *T. ceylonicus* is questionable *fide* Addison Wynn (personal communication) and it may be a synonym of *T. mirus* as suggested by Deraniyagala (1955). It is undetermined at present whether the diagnostic glands are present under the central portions of the head shields in the type of *T. andamanensis* as they were not reported in the original description. Examination of the types of *T. andamanensis*, *T. oligolepis*, and *T. tindalli* is necessary before these species can be confirmed to be members of the *T. ater* species group. The following key to the species of the *T. ater* group includes the two species that are described below.

Identification key
to the *Typhlops ater* species group

1a	Midbody scale rows 16	2
1b	Midbody scale rows 18 or more	3
2a	Subocular absent; one postocular; SIP T-II; length/width ratio 50 – 60; India	*T. oligolepis*
2b	Subocular present; 3 postoculars; SIP T-V; length/width ratio 85; Papua New Guinea	*T. fredparkeri* n. sp.
3a	Midbody scale rows 18; southern and southeast Asia, Philippines and Indonesia	4
3b	Midbody scale rows 20 or more; Papua New Guinea	12
4a	No subocular or presubocular	5
4b	One subocular and/or presubocular	7
5a	Inferior nasal suture contacts preocular; preocular contacts inferior nasal	*T. tindalli*
5b	Inferior nasal suture contacts second supralabial; preocular separated from inferior nasal	6
6a	Total middorsals < 225; subcaudals < 14; length/width ratio < 40; tail length/width ratio < 2.0; India	*T. beddomii*
6b	Total middorsals > 330; subcaudals > 14; length/width ratio > 45; tail length/width ratio > 2.5; Philippines	*T. hedraeus*

[1] Publication of a book by Mark O'Shea, *A guide to the snakes of Papua New Guinea* (Independent Publishing, Port Moresby), in which a synopsis of the above species is given, is scheduled for 1996. It may appear before this paper, in which case the correct authorship citation for the two species described herein should be Wallach *in* O'Shea.

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7a	One subocular and one presubocular	8
7b	One presubocular	9
8a	Total middorsals < 350; venter uniform; superior nasal suture incomplete; parietals and occipitals enlarged; Java	*T. bisubocularis*
8b	Total middorsals 390; venter white-spotted; superior nasal suture complete; parietals and occipitals not enlarged; Andaman Is	*T. andamanensis*
9a	SIP T-V; total middorsals > 475; subcaudals > 19	*T. floweri*
9b	SIP T-II; total middorsals < 400; subcaudals < 18	10
10a	Distinct eye with pupil; Indonesia	*T. ater*
10b	Eye indistinct (lacking pupil) or absent; Sri Lanka	11
11a	Nasals overlap on midline	*T. ceylonicus*
11b	Nasals separated on midline by prefrontal	*T. mirus*
12a	Lateral snout profile rounded; color black	*T. inornatus*
12b	Lateral snout profile with beak-like transverse keel; color brown	13
13a	Total middorsals less than 500; apical spine small; needle-like; length/width ratio < 54	*T. mcdowelli* n. sp.
13b	Total middorsals more than 600; apical spine large; transversely expanded; length/width ratio > 53	*T. depressiceps*

MATERIALS AND METHODS

Dissection procedure followed Wallach (1985, 1991) with measurements made to the nearest 0.5 mm. All measurements of body and tail diameters are horizontal measurements. Supralabial imbrication patterns (SIP) follow Wallach (1993a). Visceral characters are defined in Wallach (1991, 1993b). All values of organ lengths, gaps, and intervals are given as percent snout-vent length (% SVL) followed only by the per cent sign. The length of an organ is usually followed by its midpoint (MP) value as % SVL. Ratios between two visceral characters are presented in decimal form to differentiate them from % SVL figures. A negative value for a visceral gap indicates an overlap of the organs involved. Data for paired organs are presented as right/left. Museum acronyms follow Leviton et al. (1985).

DESCRIPTIONS

Examination of blind snake material from the collections of the University of Papua New Guinea (UPNG) and the Papua New Guinea National Museum and Art Gallery (PNGM) has brought to light a new member of the *T. ater* group that is named

Typhlops mcdowelli n. sp. (Fig. 1)

Holotype. UPNG 7502, an adult male from Hombron's Bluff (9° 23′ S, 147° 20′ E), Central Province, Papua New Guinea, ca. 600 m.

Paratypes. UPNG 5978, an adult female from Taurama Barracks (9° 30′ S, 147° 14′ E), Port Moresby, ca. 50 m, and PNGM 24604, a juvenile

TABLE 1. Synopsis of the *Typhlops ater* species group

Species	LSR	TSR	SC	LOA	L/W	T/LOA	TL/TW
andamanensis	18	390	17	150	28	3.5	1.8
ater	18	263 – 372	13 – 17	110 – 166	41 – 70	3.3 – 3.8	1.6 – 2.2
beddomii	18	190 – 225	10 – 13	90 – 140	20 – 40	2.3 – 3.7	1.3 – 1.8
bisubocularis	18	308	16	111 – 131	44 – 55	3.4 – 3.6	1.5 – 2.0
ceylonicus	18	329	12	138	35 – 39	3.6	1.7
depressiceps	20 – 24	631 – 713	22 – 27	303 – 331	54 – 81	2.5 – 3.3	1.8 – 3.0
floweri	18	478 – 520	20 – 23	174 – 230	62 – 89	3.4 – 4.0	1.0 – 3.0
fredparkeri	16	539	23	149	85	3.7	3.7
hedraeus	18	332 – 398	15 – 17	119 – 134	45 – 61	3.3 – 5.1	1.9 – 3.0
inornatus	20 – 22	295 – 434	13 – 17	87 – 227	31 – 57	2.6 – 4.0	1.5 – 2.0
mcdowelli	22 – 24	431 – 464	17 – 25	94 – 199	44 – 53	2.3 – 4.0	1.4 – 2.3
mirus	18	298 – 360	12 – 16	99 – 140	35 – 60	2.8 – 3.7	1.2 – 2.0
oligolepis	16	?	13	140	47	3.6	1.7
tindalli	18	300	9	140 – 175	42 – 53	1.9	1.0

AS) apical spine (0 – absent, conelike scale, S – small, L – large), E) transversely expanded), DC) dorsocaudals, DIST) distribution (PNG – Papua New Guinea), DRS) dorsal rostral shape, E) eye (P – distinct with pupil, D – distinct, I – indistinct spot, B – blind), E/PO) portion of eye under preocular, LOA) total length, L/W) total length/midbody horizontal diameter, LSR) longitudinal scale rows, M) mental projecting beyond lip curvature, N) nasals on dorsal midline (S – separated, C – contact, O – overlap), NS) superior nasal suture (C – complete, I – incomplete), PRB) posterior rostral border (V – angled, L – linear), PTO – postoculars, SO – subocular (0 – none, PO – presubocular,

male from Port Moresby (9° 29′ S, 147° 11′ E), Central Province, Papua New Guinea, elevation less than 175 m.

Etymology. This species is named in honor of Samuel B. McDowell, Jr., in recognition of his numerous contributions to snake systematics and comparative anatomy. In particular, this New Guinea typhlopid is an appropriate namesake for McDowell, who revised the scolecophidians of the New Guinea region. McDowell (1974) was uncertain about the generic affinity of the specimens that he discussed and figured and also whether they were conspecific with the taxon described by Sternfeld (1913) as *Typhlops depressiceps*. Examination of Sternfeld's type plus additional material (MCZ 145954, USNM 195953) confirms that McDowell's material was correctly identified as *T. depressiceps*, which lacks retrocloacal sacs and possesses a straight retracted hemipenis lacking a terminal awn.

Diagnosis. *Typhlops mcdowelli* is most closely related to *T. depressiceps* but distinguished therefrom by its total middorsal count (431 – 464 vs. 631 – 713), length/width ratio (44 – 53 vs. 61 – 81), dorsal rostral shape (oval vs. parallel) and posterior rostral border (angled vs. linear), angle of preoral snout in lateral aspect (inclined at 30° vs. horizontal), vertical position of tip of rostral keel in lateral view (above supralabials vs. below supralabials), gular region (visible in lateral profile vs. invisible), and apical spine (short, needlelike and horizontally oriented vs. long, transversely flattened and vertically oriented) (Table 2).

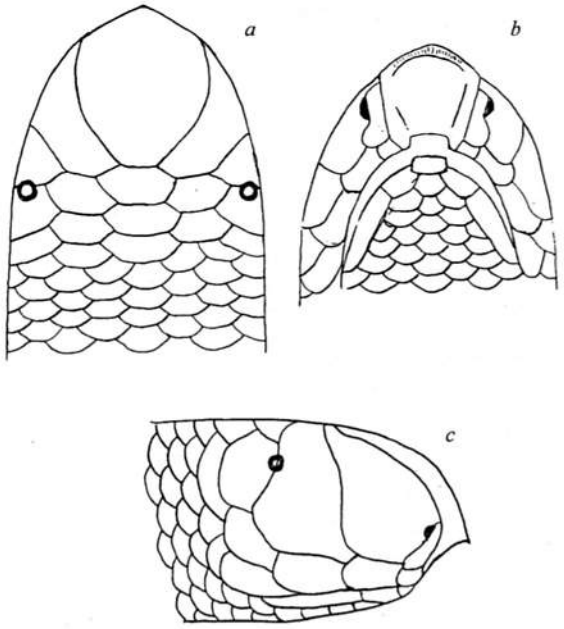

Fig 1. Head of holotype of *Typhlops mcdowelli* (UPNG 7502): *a*) dorsal view, *b*) ventral view, *c*) lateral view.

Species	PTO	SO	AS	NS	N	SIP	M	E	S	TLT	DIST
andamanensis	2	PSO	S	C	S	T-II	+	I	R	?	Andaman
ater	1 – 2	PO	S/0	C(I)	C	T-II	+	D	R	P	Indonesia
beddomii	1	0	0(S)	C	O	T-II	+	P/D	R	P	India
bisubocularis	2	PSO	S/0	I	S	T-II	+	I	R	P	Java
ceylonicus	2	PO	0	C	O	T-II	?	B/I	R	?	Sri Lanka
depressiceps	2 – 4	SO	E	C(I)	S	T-V	+	P	P	U	N PNG
floweri	2 – 3	PO	0	C	S	T-V	+	D	R	M	Thailand
fredparkeri	3	SO	0	C/I	S	T-II	+	I	R	P	SE PNG
hedraeus	2 – 3	0	S/0	C	O(S)	T-II	+	I	R	U	Philippines
inornatus	3 – 4	SO	L	C/I	S	T-V	+	P	R	P	SE PNG
mcdowelli	3 – 4	SO	S	C	S	T-V	+	P	P	P	SE PNG
mirus	1 – 2	PO	0	C	S	T-II	+	B/I	R	U	Sri Lanka
oligolepis	1	0	0	C	O	T-II	+	D	R	?	NE India
tindalli	1	0	0	C/I	O	T-II	+	B	R	?	S India

SO – subocular, PSO – presubocular plus subocular), RK) rostral keel, RK/SL) rostral keel relative to supralabials, S) lateral snout profile (R – rounded, P – pointed), SC) subcaudals, SIP) supralabial imbrication pattern, T/LOA) tail length/total length, TLT) tracheal lung type (U – unicameral, P – paucicameral, M – multicameral), TL/TW) tail length/midtail horizontal diameter, TSR) transverse scale rows, VPS) ventral preoral snout (A – angled, H – horizontal).

Description of holotype. An adult male with a total length of 198.5 mm, nuchal diameter of 4.0 mm, midbody diameter of 4.5 mm, cloacal diameter of 3.5 mm, tail length of 8.0 mm, midtail diameter of 3.5, total length/midbody diameter ratio of 44.1, tail/total length ratio of 4.03, and tail length/midtail diameter ratio of 2.29. Longitudinal scale rows 26-24-22, middorsal scale rows between rostral and apical spine 464, subcaudals 25, and dorsocaudals 22. Tail with small, thin apical spine that extends horizontally in a plane parallel to the body axis.

The snout is pointed in dorsal and lateral views. The rostral is large (0.5 head width), oval in shape with tapered posterior border, the free edge not reaching the level of the eyes. Nasals separated on midline by prefrontal that is equal in size to the supraoculars, frontal, parietals, and interparietal, all of which are subhexagonal in shape. The left occipital is subequal in size to the preceding shields but on the right side two costal scales occupy this position. The rostral has a beaklike hook formed from a transverse corneal keel that in lateral view is raised above the level of the supralabials; the ventral preoral snout, which is inclined at a 30° angle in lateral view, forms a concavity posterior to the keel. Superior nasal large with nearly straight posterior border. Nostril close to rostral border; superior nasal suture complete, extending horizontally from nostril to rostral. Inferior nasal suture contacts second supralabial; infranasal gland not present. Preocular large, slightly broader than superior nasal and larger than ocular. Ocular small, extending ventrally to mid-preocular level, bordered below by a slightly smaller subocular. Eye with distinct pupil and iris, anterior 1/3 located under preocular shield. Three postoculars between parietal and fourth supralabial; uppermost postocular elongated, apparently formed from two fused scales. Four supralabials, third the largest, all except first longer than deep. Supralabial imbrication pattern T-V, posterior border of second supralabial overlapping anteroventral corner of preocular and posterior edge of third supralabial overlapping anteroventral edge of subocular (Wallach, 1993a). Two infralabials, the second more than twice the length of the first (apparently formed from two fused scales), separated on the midline by a rectangular mental, twice as broad as deep, that projects beyond the border of the lower lip and fits into a notch in the upper lip between the pair of first supralabials when mouth is closed.

Middorsal 9 scale rows brown (anterior 1/3 of scale black and posterior 2/3 brown), grading into the whitish ventral coloration (anterior 1/2 of scale

TABLE 2. Comparison of *Typhlops mcdowelli* with *Typhlops depressiceps*

	mcdowelli	*mcdowelli*	*mcdowelli*	*depressiceps*	*depressiceps*	*depressiceps*
Mus.	UPNG	UPNG	PNGM	ZMB	MCZ	USNM
No.	7502	5978	24604	23986	145954	195953
Status	Holotype	Paratype	Paratype	Holotype	nontype	nontype
Sex	M	F	M	M	F	M
LSR	26-24-22	24-24-22	24-22-22	24-24-20	24-22-22	24-22-20
TSR	464	432	431	713	648	631
SC/DC	25/22	17/16	22/19	27/25	22/21	24/24
LOA	198.5	193.5	93.5	323	321	303
L/W	44.1	48.0	53.4	80.8	61.1	75.8
T/LOA	4.03	2.34	3.74	3.25	2.49	2.64
TL/TW	2.29	1.43	2.33	3.00	1.78	2.67
PTO	3/3	3/3	4/4	3/3	4/3	3/3
E/PO	0.33	0.67	0.33	0.20	0.33	0.50
DRS	oval	oval	oval	parallel	parallel	parallel
PRB	V	V	V	L	L	L
RK	angle	angle	angle	vertical	vertical	vertical
RK/SL	above	above	above	below	below	below
VPR	A	A	A	H	H	H
AS	S	S	S	E	E	E

Note. See Table 1 for abbreviations.

speckled with brown, posterior 1/2 white). In addition to their presence along scale sutures, head glands prominently dispersed beneath the following head shields: dorsal and ventral rostral, superior and inferior nasals, preoculars, supraoculars, oculars, subocculars, and first to fourth supralabials.

Internal anatomy. In the following description of the viscera of the paratypes, data are presented first for the adult female (UPNG 5978) followed by those for the juvenile male (PNGM 24604). The trachea (28.4%, 36.1%; MP = 15.5%, 19.7%) is oriented with its free tips pointing laterally to the right. The estimated number of rings in the trachea is 261 and 288 (mean = 274.5), with the number per 10% SVL of 91 and 81 (mean = 86). Tracheal entry into right lung terminal. Right bronchus long (15.9%, 18.3%); total length of trachea plus bronchus also long (44.3%, 54.4%; MP = 23.5%, 28.9%). The bronchus/right lung ratio is 0.75 (0.82). The tracheal lung is narrow and poorly vascularized with a paucicameral (P^2) development of 24 (22) deep pockets or pseudochambers that are roughly square cranially but rectangular (twice as deep as wide) posteriorly; it is moderate in length (17.2%, 23.3%; MP = 17.4%, 21.7%). Both the cardiac lung (3.7%, 4.4%) and right lung are unicameral (U^2) with weak vascularization. The right lung is narrow and moderate in length (21.2%, 22.2%; MP = 40.3%, 48.9%) with its caudal tip at 50.9% (60.0%). In UPNG 5978 the caudal tip of the lung was folded back upon itself for a distance of 2.7% SVL. Anteriorly the vascular portion of the right lung (15.9%, 18.9%) exhibits two ediculae in transverse arrangement with thick walls while posteriorly the lung consists of three to four transversely arranged ediculae. The caudal reticulate or trabecular portion of the right lung is short (5.3%, 4.4%). Left lung complex absent.

The sternohyoideus muscle extends 0.41 (0.45) of the snout-heart gap. The snout-heart interval is 29.7% (37.8%). The heart is short (3.7%, 4.4%; MP = 27.9%, 35.6%). A short heart-liver gap is present in the adult (1.1%) but in the juvenile the liver overlaps the ventricle as the heart-liver gap is −2.2%. Liver length is moderate (33.4%, 38.3%; MP = 47.5%, 54.7%) with left and right liver lobes nearly equal in length (LL/RL = 0.96, 1.03). Liver asymmetrical with left lobe extending craniad of right by 10.3% (7.3%) and right lobe extending caudad of left by 14.3% (4.4%). Liver segments number 13/14 (13/13). Liver-gall bladder gap very short (1.6%, 1.7%); liver-gall bladder interval moderate (36.6%, 41.1%); gall bladder MP = 66.6% (76.1%). In the female, right ovary larger than left ovary (4.5/2.9%; MP = 79.2/82.4%) with four developing ova in the right (2.0 × 1.0 mm to 1.0 × 0.75 mm in size) and two in the left ovary (1.5 × 1.0 and 1.0 × 0.75 mm). Undeveloped follicles number 8 in the right and 13 in the left ovary. The undeveloped testes of the male are short and identical in size (2.2%; MP = 76.1/82.2%). The mean gonad MP = 80.8% (83.3%). The right and left adrenal MP = 81.2/84.0% (mean = 82.6%) in female, 83.3/85.0% (mean = 84.2%) in male. The gall bladder-kidney gap is longer in the female (15.4%) than the male (7.8%) as is the gall bladder-kidney interval (23.3% vs. 15.6%). The kidneys are smaller in the female (4.0/3.7%; MP = 84.8/87.3%) than in the male (5.0/4.4%; MP = 86.9/88.9%). Total kidney (left plus right) length is 7.7%, 9.4% (MP = 86.0%, 87.9%). The kidney-vent interval is long (17.2%, 15.6%) as is the kidney-vent gap (10.9%, 8.9%). The rectal caecum is absent, but a trace is evident of its fusion with the small intestine by way of a short suture (0.5%, 0.6%). Left systemic arch joins aorta 0.30 heart length caudad of anterior tip. Gap between left and right systemic arch junctions is 0.15 heart length.

Examination of material in the Museum of Comparative Zoology (MCZ) collected by Fred Parker in Papua New Guinea has revealed a new member of the *T. ater* group, named after its collector

***Typhlops fredparkeri* n. sp. (Fig. 2)**

Holotype. MCZ 142651, an adult female collected by Fred Parker (field No. F-14163) October 24, 1973.

Type locality. Korobosea (9° 29′ S, 147° 11′ E), 9 km east of Port Moresby, Central Province, Papua New Guinea, 40 – 60 m.

Diagnosis. *Typhlops fredparkeri* is distinct from all Australasian scolecophidians in possessing 16 longitudinal scale rows in conjunction with a rounded snout.

Etymology. This species is named in honor of its collector, Fred Parker, whose prodigious efforts in the field have provided abundant material (and often large series of individual species from a single locality as in the case of *Acutotyphlops kunuaensis* Wallach (1995)) of principally New Guinean reptiles. The collections of the California Academy of Sciences, Field Museum of Natural History, and Museum of Comparative Zoology contain abundant material collected by Parker over the past three decades.

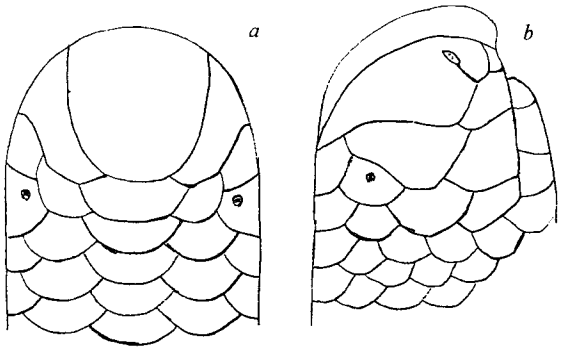

Fig. 2. Head of holotype of *Typhlops fredparkeri* (MCZ 142651): *a*) dorsal view, *b*) lateral view.

Description of holotype. Adult female with a total length of 148.5 mm, tail length of 5.5 mm, midtail diameter of 1.5 mm, tail/total length ratio of 3.7%, and tail length/width ratio 3.7. Thin-bodied form with nuchal, midbody and precloacal diameters of 1.25, 1.75, and 1.75 mm, respectively; total length/midbody diameter ratio 84.9. Tail tip rounded, lacking apical spine, terminating in a conical scale. Longitudinal scale rows 16 – 16 – 16, midtail scale rows 14, middorsal scales between rostral and terminal spine 539, subcaudals 23, dorsocaudals 22.

Head rounded in dorsal and lateral profile, equal in diameter to body. Rostral large, slightly less than 0.6 the diameter of head, rounded posteriorly, with free edge extending nearly to the level of the eyes. Nasal large, completely divided on the left and incompletely divided on the right, inferior nasal cleft contacting second supralabial. Nostril lateral, closer to rostral than preocular, and oriented vertically. Superior nasal suture directed horizontally towards rostral, division incomplete on right side but complete on left side. Nasal more than twice as wide as preocular, which is second largest shield on lateral aspect of head and three times as large as the ocular. Following rostral on dorsum of head are 11 transversely enlarged scales (prefrontal, frontal, and succeeding eight scales), each approximately twice as broad as deep. Supraoculars, parietals, and occipitals not enlarged. Subocular present, 1.5 times as large as ocular and twice as large as postoculars. Eye barely visible as a faintly pigmented spot beneath ocular near junction with supraocular and preocular; ocular only slightly larger than the postoculars. Three postoculars bordering ocular and subocular between the parietal and fourth supralabial. Four supralabials, third supralabial largest (twice the size of fourth and larger than subocular), taller than wide, with fourth larger than second and second twice the size of first. In addition to presence along sutures, head glands also are distributed at least under rostral, nasals and preocular (possibly others also but due to small size and lack of pigmentation on head shields they are not discernible). Supralabial imbrication pattern type T-V with posterior border of second supralabial overlapping anteroventral corner of preocular and posterior edge of third supralabial overlapping anteroventral edge of subocular. Shallow concavity present on preoral portion of ventral rostral. Mental shield projecting beyond border of lower lip to fit in notch in upper lip. Infralabials three. Anals three.

Coloration of dorsum light brown with a gradual fading of pigmentation laterally to a light tan venter. Each scale with brown pigment along the basal anterior half of the scale and a lighter tan color along the free margin, the two colors separated by a thin dark brown streak along the transverse axis between the anterior gland and posterior portion of scale. All body scales are bordered in white, the intervening light areas between each scale being wider on the anterior body (about equal in width to that of the scales) than on the posterior body (about half the width of a scale). The vertebral scale row exhibits a pair of very thin dark brown lines, close to its lateral edges, that extend the length of the body.

Internal anatomy. Trachea short (25.9%; MP = 13.6%), oriented with its tips dextrolaterad; free tips present on cartilaginous rings which number approximately 333; number of rings per 10% SVL = 129. Tracheal entry to right lung terminal. A moderately long bronchus (9.1%) extends 0.72 length of right lung. Length of trachea plus bronchus 35.0% (MP = 18.2%). Tracheal lung narrow (< 0.5 body diameter), paucicameral (P^2), and weakly developed (14.0%, MP = 16.1%), the wall merely an avascular membrane that is traversed by 36 radiating blood vessels in conjunction with low smooth muscle septa that separate 35 shallow chambers that are roughly square or transversely elongated rectangles in shape. The septa extend across the lumen of the lung for 0.25 – 0.33 of its diameter. The cardiac and right lungs are unicameral (U^2) in structure. The right lung (12.6%, MP = 32.9%) is extremely narrow (0.1 – 0.2 body diameter) but weakly vascularized with trabeculae to its terminal tip at 39.2%. The cranial 9.1% is edicular and the caudal 3.5% is trabecular. Like all scolecophidian right lungs, it is entirely surrounded

by the convoluted multisegmented liver that wraps around it along the longitudinal axis. Left lung complex absent.

The sternohyoideus muscle extends 0.33 of the snout-heart gap. The snout-heart interval is short at 26.7%. The heart is short (3.5%; MP = 24.8%). Liver does not overlap the heart, the anterior tip just touches the heart apex (heart-liver gap = 0). Liver length is moderate (24.5%, MP = 38.8%). Liver highly asymmetrical (LL/RL = 0.79) with left lobe extending craniad of right by 0.23 liver length but right lobe extending caudad of left only by 0.03 liver length. Liver segments number 16/17. Liver-gall bladder gap long (16.8%) and liver-gall bladder interval moderate (42.7%); gall bladder MP = 68.5%. Gall bladder-kidney gap 21.7%, gall bladder-kidney interval 27.3%. Right ovary (1.8%; MP = 87.2%) shorter than left (3.2%; MP = 89.7%), total gonad MP = 88.5%. Left ovary containing one developing ovum (4.5 × 0.5 mm). Right adrenal MP = 89.0%, left adrenal MP = 91.1%, total adrenal MP = 90.0%. Kidneys are short, creased and smooth, each supplied by a single renal artery. Right and left kidneys identical in length (2.8%; MP = 92.3/93.7%), total kidney MP = 93.0%; both kidney-vent interval (9.1%) and kidney-vent gap (4.9%) short. Left systemic arch joins aorta 0.40 heart length caudad of anterior tip. Gap between left and right systemic arch junctions is 0.20 heart length. No trace of a rectal caecum.

DISCUSSION

Typhlops mcdowelli is closely related to *T. depressiceps*, with which it shares the following characters that distinguish the pair from other members of the *T. ater* group: rostral with transverse keel (beak-like in lateral view) and ventral concavity, posterior scale row reduction of at least two rows, second infralabial largest (consisting of fused second and third), and a recessed gular region with lower jaw invisible in lateral view. Reduction in scale row number from midbody to precloacal region is at least two in both *T. mcdowelli* and *T. depressiceps* (four in the type of the latter). All other members of the *T. ater* group that have been examined (*T. ater*, *T. beddomii*, *T. bisubocularis*, *T. ceylonicus*, *T. floweri*, *T. hedraeus*, *T. mirus*) lack both anterior and posterior scale row reduction except for two specimens of *T. inornatus* having a 24-22-22 (MCZ 140724) and 22-22-21 (MCZ 175100) pattern. Except for *T. floweri* and *T. fredparkeri*, *T. mcdowelli* and *T. depressiceps* are the only members to have more than 430 total middorsals (*T. inornatus* approaches them with 295 – 434 middorsals). *Typhlops mcdowelli* is distinct from *T. depressiceps* in number of middorsals, dorsal rostral shape, angle of preoral snout, position of rostral keel, length/width ratio, and form of terminal spine. *Typhlops depressiceps* is unusual in having an expanded, flattened spade-like spine, oriented at 90° to the body's axis and directed ventrally like a hook, whereas in *T. mcdowelli* a typical needle-like spine is directed posteriorly along the body axis.

Typhlops fredparkeri agrees with McDowell's (1974) *T. ater* group in the imbrication of the second and third supralabials, presence of a subocular, lateral nostril positioned adjacent to rostral with horizontal superior suture, and absence of a rectal caecum. *Typhlops fredparkeri* is unusual in its scale row formula (16-16-16). Sixteen midbody scale rows are the minimum number found in the Typhlopidae, the only other species having such a low number being *Ramphotyphlops minimus* and some *R. leptosomus* of Australia, some *Typhlops minuisquamus* of Amazonian South America, some *T. granti* of Puerto Rico, and *T. oligolepis* of Nepal, only the latter of which is a member of the *T. ater* group. McDowell (in lit.) examined the type specimen and indicated that it was "*Typhlops*, probably new species closest to *T. depressiceps*." However, in having a rounded head profile, the ocular separated from the supralabials by a subocular, the preocular larger than the ocular, the nasals not in contact along the midline, and a higher number of middorsals, *T. fredparkeri* more closely resembles *T. inornatus* than *T. depressiceps*. The internal data (Table 3) support a close affinity of *T. fredparkeri* to *T. inornatus* in the following characters: number of tracheal rings, paucicameral tracheal lung, position of heart, length of liver, liver-gall bladder gap, length of right lung, right bronchus length, kidney-vent interval, and kidney lengths and midpoints. However, based upon external data, *T. fredparkeri* is most similar to *T. oligolepis*; it can be separated from *T. oligolepis* by number of subcaudals, length/width ratio, tail length/width ratio, number of postoculars, presence of a subocular, and indistinctness of eye.

The unique character that defines the *Typhlops ater* group is presence of head glands under the central portions of the anterior head shields. Other characters that are consistent within the group, but not exclusive to it, include: 1) second supralabial overlapping preocular or subpreocular, 2) projecting mental

shield that fits into notch of upper lip, 3) gular region and lower jaw scarcely visible in lateral view, and 4) rectal caecum vestigial (< 1.0% SVL) or absent. Derived conditions appear to be the low number of longitudinal scale rows (Thomas, 1976), high number of transverse scale rows, and the absence of a rectal caecum (McDowell, 1974). There appear to be two evolutionary trends of longitudinal scale rows within the *T. ater* group; a low number of scale rows appears to be derived in one group (correlated with the presence of multiple suboculars) and a high number of scale rows with scale row reduction in another group (correlated with the development of a corneal beak and high number of middorsals). *Typhlops fredparkeri* and *T. mcdowelli* represent the extremes of these two patterns of development. Two SIP patterns are present in the *T. ater* group: with only a single exception (*T. floweri*), a T-V pattern is found in all species

TABLE 3. Visceral data on the *Typhlops ater* species group

	ater	*beddomii*	*bisubocularis*	*depressiceps*	*floweri*
SVL	114 – 153	88 – 96	111	321	178 – 186
N/S	2M/1F	2M/2F	1M	1F	1M/1F
TMP	16.3 – 19.1 (17.7)	16.8 – 18.6 (18.1)	16.4	16.9	14.5 – 14.7 (14.6)
TBMP	22.6 – 24.3 (23.5)	23.4 – 25.3 (24.4)	22.1	26.2	19.8 – 20.9 (20.4)
TLMP	18.4 – 21.6 (20.1)	21.2 – 22.4 (21.9)	19.0	18.8	17.0 – 17.3 (17.1)
HMP	29.9 – 34.3 (32.2)	33.3 – 35.3 (33.9)	30.3	31.0	26.6 – 27.2 (26.9)
RLMP	41.5 – 45.4 (43.1)	42.9 – 45.3 (43.7)	39.9	44.3	37.1 – 38.4 (37.7)
LMP	45.6 – 48.7 (47.6)	47.9 – 49.5 (49.0)	47.9	49.5	41.9 – 47.9 (44.9)
GBMP	68.0 – 70.9 (69.2)	66.6 – 71.8 (68.9)	76.1	70.0	63.4 – 70.9 (67.2)
RGMP	79.2 – 81.8 (80.6)	76.4 – 82.0 (79.2)	87.3	80.7	79.9 – 83.8 (81.9)
LGMP	83.6 – 84.1 (83.9)	80.7 – 85.5 (83.5)	89.2	83.6	83.1 – 85.7 (84.4)
RAMP	81.8 – 83.4 (82.6)	78.3 – 83.2 (81.3)	87.8	82.0	84.2 – 86.0 (85.1)
LAMP	85.4 – 86.6 (86.0)	82.6 – 85.9 (84.7)	88.5	83.8	86.3 – 87.9 (87.1)
RKMP	87.1 – 90.0 (88.2)	86.4 – 90.0 (88.5)	92.5	87.9	87.8 – 90.0 (88.90
LKMP	89.8 – 92.2 (91.3)	90.5 – 93.5 (91.8)	95.1	89.3	91.0 – 92.1 (91.6)
TBL	43.8 – 45.9 (44.9)	44.6 – 48.3 (46.5)	42.2	51.1	38.4 – 40.7 (39.6)
NTR	190 – 230 (205)	153 – 208 (178)	215	374	269
TLL	19.1 – 20.4 (19.7)	16.9 – 20.6 (19.4)	19.3	19.8	15.4 – 16.6 (16.0)
RLL	15.9 – 19.0 (17.4)	14.1 – 20.7 (17.4)	16.0	22.0	16.3 – 19.8 (18.0)
RBL	10.5 – 12.6 (11.5)	9.8 – 15.2 (12.6)	12.2	18.5	10.5 – 12.4 (11.4)
RB/RL	60.5 – 72.2 (66.3)	69.2 – 73.3 (72.0)	76.5	84.1	52.9 – 75.9 (64.40
RLPT	50.4 – 54.1 (51.8)	50.0 – 54.7 (52.4)	47.9	55.3	45.2 – 48.3 (46.7)
HLG	(–1.4) – 0 (–0.8)	(–1.1) – 0 (–0.5)	–0.9	–1.3	0 – 0.6 (0.3)
LL	30.1 – 35.4 (33.0)	25.0 – 27.7 (26.4)	33.8	35.1	25.6 – 37.9 (31.8)
ALE	16.2 – 27.9 (22.5)	6.5 – 9.8 (7.9)	23.6	4.6	9.1 – 10.4 (9.7)
PLT	2.7 – 28.8 (12.5)	3.9 – 12.2 (6.7)	20.8	5.5	25.0 – 34.8 (29.9)
LGBG	1.4 – 4.5 (3.4)	3.8 – 8.1 (5.8)	10.3	2.2	3.4 – 8.1 (5.8)
LGBI	35.4 – 40.0 (37.8)	30.4-36.6 (33.9)	46.0	38.7	34.9 – 42.7 (38.8)
TKL	6.4 – 14.2 (10.8)	7.6 – 13.6 (10.7)	8.0	8.0	7.0 – 8.7 (7.9)
KVI	13.3 – 15.9 (14.6)	12.0 – 16.8 (14.3)	9.4	14.1	11.8 – 14.2 (13.0)
KVG	4.4 – 8.6 (6.0)	3.8 – 10.3 (6.8)	2.8	8.6	6.2 – 6.7 (6.4)
RCL	0.9 – 1.4 (1.2)	0.5 – 0.6 (0.5)	1.4	0.003	0.8 – 1.2 (1.0)
TLT	P^2	P^2	P^2	U3	M3
TLC	8 – 20 (15.3)	8 – 12 (10.0)	7	—	17 – 20 (18.5)

Note. Range (mean), ALE) anterior liver extension, GBMP) gall bladder midpoint, HLG) heart-liver gap, HMP) heart midpoint, KVG) kidney-vent gap, KVI) kidney-vent interval, LGBI) liver-gall bladder interval, LGMP) left gonad midpoint, LKMP) left kidney midpoint, LL) liver length, LLS) left liver segments, LMP) liver midpoint, NS) sample size and sex (M – male, F – female), NTR) number of tracheal rings/10% SVL, PLT) posterior liver tail, RBL) right bronchus length, RB/RL) right bronchus/right lung, RCL) rectal caecum.

with 20 or more midbody scale rows (*T. depressiceps*, *T. inornatus*, *T. mcdowelli*), all of which are endemic to New Guinea, while a T-II pattern is exhibited by all forms having 18 or fewer midbody rows, inhabiting India to the Philippines and Indonesia (Table 1). While the imbrication pattern is usually diagnostic of species groups (Wallach, 1993a), the problematic *T. floweri* from Thailand (with a T-V SIP but only 18 midbody rows) prevents the recognition of two separate groups. *Typhlops floweri* differs from all other members of the *T. ater* group in having a multicameral tracheal lung. The projecting mental shield is confirmed in the two new forms plus *T. andamanensis*, *T. ater*, *T. beddomii*, *T. bisubocularis*, *T. depressiceps*, *T. floweri*, *T. hedraeus*, *T. inornatus*, *T. mirus*, *T. oligolepis*, and *T. tindalli*. It has only been reported thus far in one other typhlopid species, *Typhlops grandidieri* of Madagascar (Wallach and Ineich,

	fredparkeri	*hedraeus*	*inornatus*	*mcdowelli*	*mirus*
SVL	149	119 – 134	142 – 227	90 – 189	134 – 140
N/S	1F	1M/2F	3F	1M/1F	1M/2F
TMP	13.6	15.2 – 18.2 (16.9)	16.1 – 21.8 (19.1)	15.5 – 19.2 (17.3)	15.2 – 16.6 (15.9)
TBMP	18.2	20.5 – 23.6 (21.7)	26.8 – 28.5 (27.6)	23.5 – 28.9 (26.2)	22.2 – 23.6 (22.9)
TLMP	16.1	18.6 – 20.9 (20.1)	17.4 – 24.8 (21.2)	17.4 – 21.7 (19.6)	18.5 – 19.8 (19.2)
HMP	24.8	27.9 – 32.9 (30.8)	29.2 – 39.9 (34.8)	27.9 – 35.6 (31.8)	27.8 – 30.0 (28.8)
RLMP	32.9	37.1 – 42.9 (40.0)	46.6 – 50.3 (48.5)	40.3 – 48.3 (44.3)	38.8 – 42.3 (40.2)
LMP	38.8	41.6 – 44.9 (43.6)	49.3 – 54.0 (52.2)	47.5 – 54.7 (51.1)	44.6 – 50.0 (48.2)
GBMP	68.5	64.0 – 68.1 (65.8)	69.0 – 72.6 (70.7)	66.6 – 76.1 (71.3)	62.0 – 77.4 (70.2)
RGMP	87.2	74.2 – 82.2 (78.2)	81.4 – 83.5 (82.5)	79.2 – 82.2 (80.7)	89.1
LGMP	89.7	79.1 – 85.7 (82.4)	82.6 – 85.1 (83.6)	82.4 – 84.4 (83.4)	90.7
RAMP	89.0	78.7	82.6 – 85.4 (84.0)	81.2 – 83.3 (82.3)	82.2 – 85.8 (84.0)
LAMP	91.1	86.2	83.2 – 87.2 (85.3)	84.0 – 85.0 (84.5)	84.9 – 88.4 (86.7)
RKMP	92.3	85.3 – 89.2 (87.7)	87.6 – 91.6 (89.9)	84.8 – 86.9 (85.9)	89.1 – 89.6 (89.3)
LKMP	93.7	88.0 – 92.2 (90.5)	89.2 – 92.8 (91.2)	87.3 – 88.9 (88.1)	91.8 – 96.1 (93.6)
TBL	35.0	39.5 – 44.4 (41.5)	51.0 – 56.1 (53.5)	44.3 – 54.4 (49.4)	43.0 – 45.7 (44.2)
NTR	333	228 – 333 (276)	305 – 322 (314)	259 – 284 (272)	169 – 255 (219)
TLL	14.0	15.2 – 19.6 (17.3)	18.5 – 25.5 (22.2)	17.2 – 23.3 (20.3)	14.0 – 15.7 (14.8)
RLL	12.6	12.9 – 15.6 (14.4)	16.1 – 29.9 (22.4)	21.2 – 23.3 (22.3)	15.5 – 20.0 (18.4)
RBL	9.1	7.8 – 10.7 (9.7)	10.1-24.9 (17.0)	15.9 – 19.4 (17.7)	12.3 – 15.5 (14.0)
RB/RL	72.2	60.0 – 71.5 (66.7)	62.5 – 83.3 (73.9)	75.0 – 83.3 (79.2)	70.4 – 100.0 (89.0)
RLPT	39.2	44.5 – 50.7 (47.3)	58.4 – 61.5 (59.7)	50.9 – 60.0 (55.5)	46.5 – 52.2 (49.4)
HLG	0	(–0.9) – 2.0 (0.4)	(–0.5) – (–0.7) (–0.6)	(–2.2) – 1.1 (–0.6)	(–1.6) – 0 (–0.8)
LL	24.5	19.6 – 23.3 (20.9)	23.5 – 36.2 (31.1)	33.4 – 38.3 (35.9)	30.2 – 40.7 (35.9)
ALE	22.9	2.0 – 40.7 (20.3)	4.4 – 11.3 (10.0)	7.3 – 10.3 (8.8)	9.1 – 13.1 (11.7)
PLT	2.9	1.9 – 9.8 (6.2)	2.9 – 10.9 (6.3)	1.5 – 14.3 (7.9)	10.3 – 14.6 (13.7)
LGBG	16.8	8.4 – 12.9 (10.8)	0.7 – 2.7 (1.7)	1.6 – 1.7 (1.6)	1.5 – 5.9 (3.0)
LGBI	42.7	29.8 – 36.2 (33.6)	28.5 – 40.3 (35.1)	36.6 – 41.1 (38.9)	33.3 – 48.9 (40.8)
TKL	5.6	7.8 – 8.9 (8.2)	8.1 – 9.1 (8.6)	7.7 – 9.4 (8.6)	7.8 – 8.5 (8.2)
KVI	9.1	12.9 – 16.9 (14.4)	10.4 – 14.6 (12.1)	15.6 – 17.2 (16.4)	8.9 – 12.7 (11.3)
KVG	4.9	5.9 – 9.8 (7.5)	5.0 – 8.4 (6.6)	8.9 – 10.9 (9.9)	1.9 – 6.0 (4.2)
RCL	0	0 – 0.4 (0.1)	0.2 – 0.7 (0.5)	0.6	0 – 3.1 (1.5)
TLT	P^2	U^2	P^2	P^2	U^2
TLC	35	—	21 – 29	22 – 24	–

length, RGMP) right gonad midpoint, RLS) right liver segments, RKMP) right kidney midpoint, RLL) right lung length, RLMP) right lung midpoint, RLPT) right lung posterior tip, SVL) snout-vent length (mm), TAMP) total (left + right) adrenal midpoint, TBL) trachea + bronchus length, TKL) total (left + right) kidney length, TLC) tracheal lung chambers, TLL) tracheal lung length, TLMP) tracheal lung midpoint, TLT) tracheal lung type, TMP) trachea midpoint, TBMP) trachea + bronchus midpoint.

1996). *Typhlops grandidieri*, with a T-0 pattern, 20 midbody scale rows, and a beak-like snout, has certain resemblances to the *depressiceps-mcdowelli* forms but overall evidence suggests it is most closely related to *Rhinotyphlops simoni* of southwestern Asia (Wallach, 1994).

The addition of two new species now brings the total number of typhlopids known from Papua New Guinea to thirteen species in three genera: *Acutotyphlops infralabialis* (Waite, 1918), *A. kunuaensis* (Wallach, 1995), *A. solomonis* (Parker, 1939), *A. subocularis* (Waite, 1897), *R. braminus* (Daudin, 1803), *R. depressus* (Peters, 1880), *R. erycinus* (Werner, 1901), *R. leucoproctus* (Boulenger, 1889), *R. polygrammicus* (Schlegel, 1839), *Typhlops depressiceps* (Sternfeld, 1913), *T. fredparkeri* n. sp., *T. inornatus* (Boulenger, 1888), and *T. mcdowelli* n. sp. (McDowell, 1974; Hahn, 1980; Parker, 1982; Whitaker et al., 1982; Wallach, 1995, 1996). Several other undescribed species from Papua New Guinea are currently under investigation (A. H. Wynn and V. Wallach, in preparation).

Artificial key to the Typhlopidae of Papua New Guinea

1a	Midbody scale rows 16	*T. fredparkeri*
1b	Midbody scale rows 18-36	2
2a	Midbody scale rows 26-36 (*Acutotyphlops*)	3
2b	Midbody scale rows 18-24	6
3a	Preocular single; snout rounded in dorsal view	4
3b	Preocular divided; snout pointed in dorsal view	5
4a	Supranasals present; ocular single; SIP T-0	*A. subocularis*
4b	Supranasals absent; ocular divided; SIP T-III	*A. solomonis*
5a	Midbody scale rows 26-28	*A. infralabialis*
5b	Midbody scale rows 30-36	*A. kunuaensis*
6a	Glands confined to sutures between head shields; SIP T-III (*Ramphotyphlops*)	7
6b	Glands evenly dispersed beneath head shields; SIP T-V (*Typhlops*)	12
7a	Midbody scale rows 18; snout blunt in lateral view; ventral rostral concave	*R. affinis*
7b	Midbody scale rows 20-24; snout rounded in lateral view; ventral rostral not concave	8
8a	Midbody scale rows 20	9
8b	Midbody scale rows 22-24	11
9a	Superior nasal suture not extending onto dorsum of snout	*R. leucoproctus*
9b	Superior nasal suture extending onto dorsum of snout	10
10a	Inferior nasal suture contacts preocular; tail/total length < 3.5%	*R. braminus*
10b	Inferior nasal suture contacts first supralabial; tail/total length > 3.5%	*R. erycinus*
11a	Superior nasal suture not visible dorsally	*R. depressus*
11b	Superior nasal suture extending onto dorsum of snout	*R. polygrammicus*
12a	Snout rounded in lateral view; middorsals < 435	*T. inornatus*
12b	Snout beak-like in lateral view; middorsals > 430	13
13a	Middorsals < 500; apical spine needle-like	*T. mcdowelli*
13b	Middorsals > 600; apical spine spade-like	*T. depressiceps*

MATERIAL EXAMINED

Typhlops a. ater. INDONESIA. Tomohon, 1° 19′ N, 124° 49′ E, NMBA 979; West Java, ZMA 17737.
T. a. suturalis. INDONESIA. Ambon: Waai, 3° 33′ S, 128° 18′ E, FMNH 142108; Halmahera: Soakonora, 1° 48′ N, 127° 49′ E, MCZ 33505.
T. beddomii. INDIA. Travancore Hills, 760 – 1220 m, ca. 9° 30′ N, 76° 50′ E, MCZ 22372 [syntype]; Madras, 13° 05′ N, 80° 17′ E, MCZ 3913, 3929, 175867; Ponmudi, 8° 45′ N, 77° 04′ E, FMNH 217694.
T. bisubocularis. INDONESIA. Java: Bogor, 6° 35′ S, 106° 47′ E, USNM 43455.
T. ceylonicus. SRI LANKA. Peradeniya, 7° 15′ N, 80° 36′ E, BMNH 1946.1.11.62 [holotype].
T. depressiceps. "New Guinea." ZMB 23986 [holotype]. PAPUA NEW GUINEA. Panaete Is., 10° 41′ S, 152° 22′ E, USNM 195953; Trobriand Is., 8° 40′ S, 150° 55′ E, MCZ 145954.
T. floweri. THAILAND. CAS 101599; MCZ 181198; Bangkok, 13° 45′ N, 100° 31′ E, USNM 72709, 76163. VIETNAM. Cochinchine, NMBA 328.
T. fredparkeri. PAPUA NEW GUINEA. Korobosea, 9° 29′ S, 147° 11′ E, MCZ 142651 [holotype].
T. hedraeus. PHILIPPINES. Bohol: Abacjanan Barrio, 9° 50′ N, 124° 20′ E, USNM 229285; Luzon: Lasam, 18° 05′ N, 121° 32′ E, USNM 498958; Negros: Dumaguette, 9° 18′ N, 123° 18′ E, MCZ 17578.
T. inornatus. PAPUA NEW GUINEA. Afore, 9° 09′ S, 148° 23′ E, MCZ 140724; McDonald's Corner, 9° 23′ S, 147° 25′ E, USNM 213488; Menemsore, 5° 53′ S, 141° 14′ E, MCZ 175100; Sangara, 8° 45′ S, 148° 12′ E, MCZ 140728; Tabubil, 5° 16′ S, 141° 13′ E, UPNG 8572; Tomba, 5° 50′ S, 144° 01′ E, 2438 m, PNGM 22798.
T. mcdowelli. PAPUA NEW GUINEA. Hombron's Bluff, 9° 23′ S, 147° 20′ E, UPNG 7502 [holotype]; Port Moresby, 9° 29′ S, 147° 11′ E, PNGM 24604 [paratype]; Taurama Barracks, 9° 30′ S, 147° 14′ E, UPNG 5978 [paratype].

T. mirus. SRI LANKA. MCZ 18377–78; USNM 297494; Namonukula, 6° 52′ N, 81° 07′ E, FMNH 123533.

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