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Three new blindsnakes (Squamata: Typhlopidae) from northwestern Australia

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Abstract – Three new species of *Ramphotyphlops* are described from localities in northwestern Western Australia. Two are represented by a single specimen only, the third by four specimens. Each of the new species differs markedly from all previously described members of the genus. The discovery of these new species highlights the very incomplete state of knowledge of the fossorial herpetofauna of northwestern Australia, in particular the Typhlopidae.

INTRODUCTION

The recent description of new species of blindsnakes from Western Australian (Aplin and Donnellan 1990), Queensland (Ingram and Covacevich 1994) and the Northern Territory (Shea and Horner 1997) has drawn attention to the very incomplete knowledge of Australian Typhlopidae, in particular those of northern Australia. In this paper I describe three additional species of typhlopids from localities in the northwest region (see Figure 1), each based on very distinctive specimens collected over recent years.

The head scale terminology and methods of scale counting are as described previously by Aplin and Donnellan (1990), based on those of Waite (1918) and Storr (1981). Vertebral scale counts include the frontal scale and extend back to a point directly opposite the vent. Where such counts are unavailable for certain key species or specimens, I have cited ventral scale counts; these are probably 3–5 higher than the corresponding vertebral scale count in any individual. Subcaudal scale counts were taken between the vent and the tail tip, but not including the terminal spine. Following Shea and Horner (1997), the degree of body elongation is indicated by body width (BW) as a percentage of snout-vent length (SVL). All measurements are given in millimeters (mm).

SYSTEMATICS

Ramphotyphlops splendidus sp. nov.

Figures 2–4

Material Examined

Holotype

R119900 in the Western Australian Museum, an adult female collected on 3 April 1995 by Tom and Nancy Heger at the Ranger's residence, Milyering Well, Cape Range National Park, Western Australia in 22°01'S 113°56'E. Heart and liver frozen in liquid nitrogen and stored in -80°C ultrafreeze at the Western Australian Museum.

Diagnosis

A moderately elongate and stout-bodied *Ramphotyphlops* with 20 midbody scale rows, moderate number of vertebral scales (377), rostrum angular in profile and weakly trilobate in dorsal view, nasal cleft intersecting second labial and terminating just forward of the nostril, and grey dorsum clearly demarcated from white venter.

Description

A moderately elongate and stout-bodied species (see Figure 2).

SVL 498 mm; tail without spine 11 mm, including spine 13.5 mm. Preserved body 11.3 mm (width) by 12.3 mm (depth) anteriorly, and 10.2 mm by 12.7 mm posteriorly. Body width averages 2.16% of SVL.

Vertebral scales 377, counted from behind frontal to above vent. Subcaudal scales 13, excluding conical spine.

Circumferential scale rows 20 along entire length of body.

In life, dorsal surface of head, body and tail dull-grey, abruptly differentiated from all-white venter along jagged boundary (scales along boundary are unicoloured: all-grey or all-white). On body, number of pigmented scale rows 8–9, remaining 11–12 rows immaculate. On neck, pigmented band reduced to 6–7 rows; 13–14 rows immaculate. Dorsum of head pigmented, terminating just forward of eyes. Subocular region and whole of

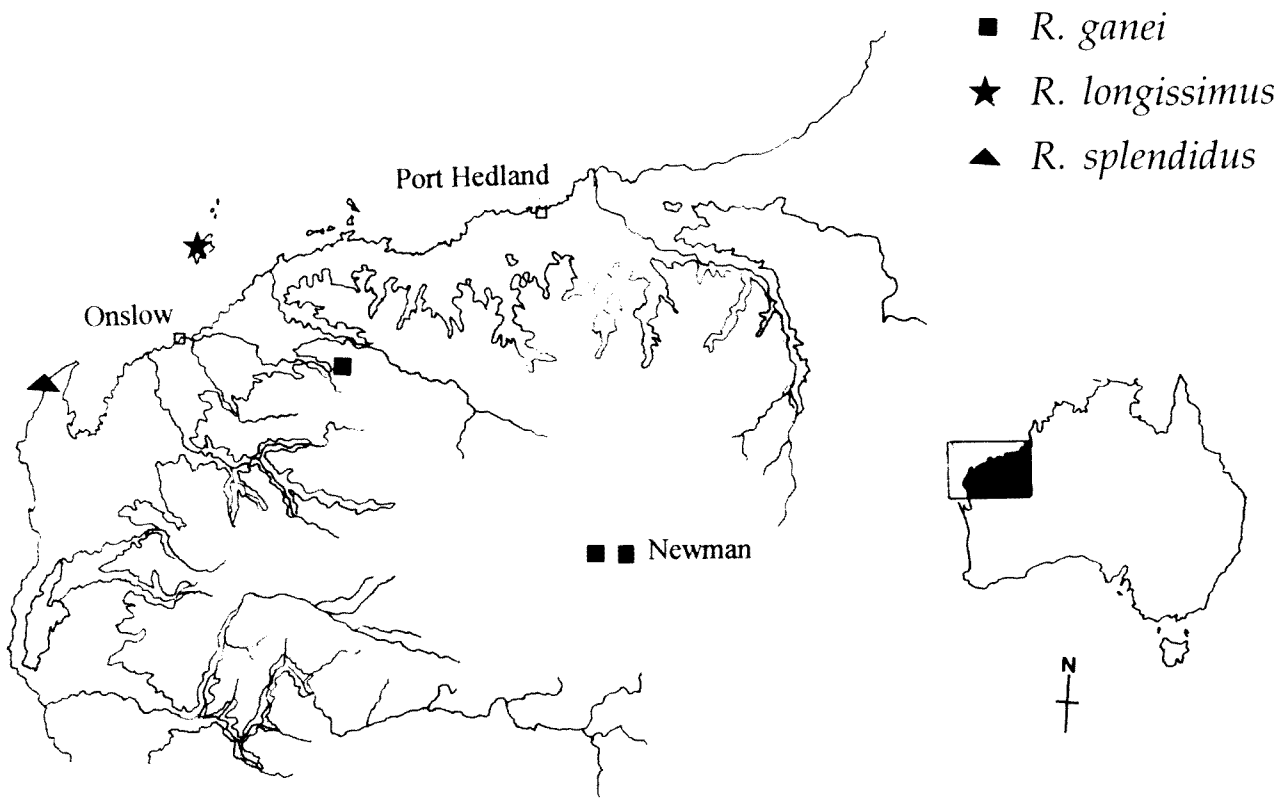

Figure 1 Map of northwestern Australia showing the collecting localities of the three new typhlopid species. The 200 m contour interval is shown to indicate the approximate limits of the Pilbara uplands.

snout unpigmented (see Figure 3a–b). Undersurface and tip of tail immaculate.

General form of head and details of scalation illustrated in Figure 3–4. Head moderately attenuate, with snout bluntly angular in profile and weakly trilobed from above. Eyes relatively large, positioned deep to anterodorsal corner of ocular scale. Rostral measures 5.3 mm from tip to posterior margin; maximum width 4.7 mm on upper surface; terminates just forward of line drawn across front of eyes. Leading edge of rostral angular but not sharp-edged. Nasals separated dorsally by narrow contact between rostral and prefrontal. Nasal cleft originates from anterior end of second supralabial, passes through nostril to terminate halfway between nostril and rostral. Nostrils shielded by dorsolateral narial prominences; nostril and nasal cleft not visible from above. Preocular smaller than nasal and ocular, broadly separated from prefrontal by intervening supraocular. Lower border of preocular broadly overlapping supralabials 2–3. Ocular subequal to nasal in overall size, ventral portion wedged between supralabials 3 and 4. Supralabials increase in size posteriorly; supralabial 4 terminates forward of posterior margin of ocular. Prefrontal considerably longer and slightly wider than body scales; deeply wedged between nasal and supraocular on each side. Supraoculars and parietals larger than frontal which is comparable in size to succeeding vertebral scales.

Microscopic scale organs present but inconspicuous on most head scales; most abundant on ventral and lateral surfaces. Tubular glands inconspicuous owing to lack of contrasting pigment.

Right oviduct elongate but tightly pleated; ovaries with numerous oocytes measuring 3 mm in length. Individual clearly mature and entering active reproductive phase.

Hindgut with short caecum, 23 mm in length, opening into gut 47 mm (39 scale rows) forward of vent.

Etymology

Splendidus (Latin): magnificent!

Comparison with other species

The elongate, stout-bodied form and 20 mid-body scale rows of *R. splendidus* limit meaningful comparisons to only a small number of species. *Ramphotyphlops pinguis* (Waite, 1897) from southwestern Australia has a similar head form and nasal cleft arrangement, but differs from *R. splendidus* in being less elongate (SVL to 491 mm) with lower vertebral scale counts (280–338), and in having a less abrupt transition between the dorsal and ventral colouration and a more extensively pigmented head. *Ramphotyphlops splendidus* also has a slightly larger eye and a slightly more

Figure 2 Holotype of *Ramphotyphlops splendidus* sp. nov. in life (photograph Mr Mark Cowan)

projecting rostral 'beak' than any *R. pinguis* examined. *Ramphotyphlops nigrescens* (Gray, 1845) and *R. proximus* (Waite, 1893) of eastern Australia are similar to *R. splendidus* in body proportions, but have a very different arrangement of the nasal cleft (intersects the first labial and extends well past the nostril onto the dorsal surface of head).

Remarks

R. splendidus is morphologically most similar to *R. pinguis* of southwestern Australia, but with slight differences in head form, meristics and body colouration. However, these represent fairly trivial differences within the broader context of morphological diversity among Australasian typhlopids, and it is likely that the two species are closely related.

The vertebrate fauna of the Cape Range peninsula includes taxa with diverse biogeographic affinities: southern, arid zone and northern (Kendrick 1993). The only currently recognised endemic vertebrate is *Lerista allochira* Kendrick, 1989 which is restricted to the dissected limestone country of the Cape Range anticline. However, several additional endemic lizard species (of *Crenadatylus* and *Diplodactylus*) await description.

With only a single record of *R. splendidus,* it is clearly premature to comment on habitat preference. The Ranger's residence at Cape Range National Park is located on the Tantabiddi Terrace, an emergent coral limestone platform of last interglacial age (Wyrwoll *et al.* 1993). The terrace is mantled by a thin veneer of weakly consolidated sand and supports a degraded coastal complex dominated by *Acacia* spp., *Melaleuca cardiophylla* and/or *Hibbertia spicta* over *Triodia* (Keighery and Gibson 1993). In many areas, introduced Buffel Grass, *Cenchrus ciliaris,* has virtually replaced the original ground cover.

The discovery of a large-bodied typhlopid in northwestern Australia runs counter to the general trend in body size within the genus. In general, northern Australian typhlopids are small to medium-sized animals and they are often exceptionally elongate and slender. The few exceptions, such as *R. ligatus* (Peters, 1879) and *R. polygrammicus* (Schlegel, 1839), come from areas of high seasonal humidity such as the Cape York region of Queensland and the Kimberley. In contrast, many typhlopids from southern

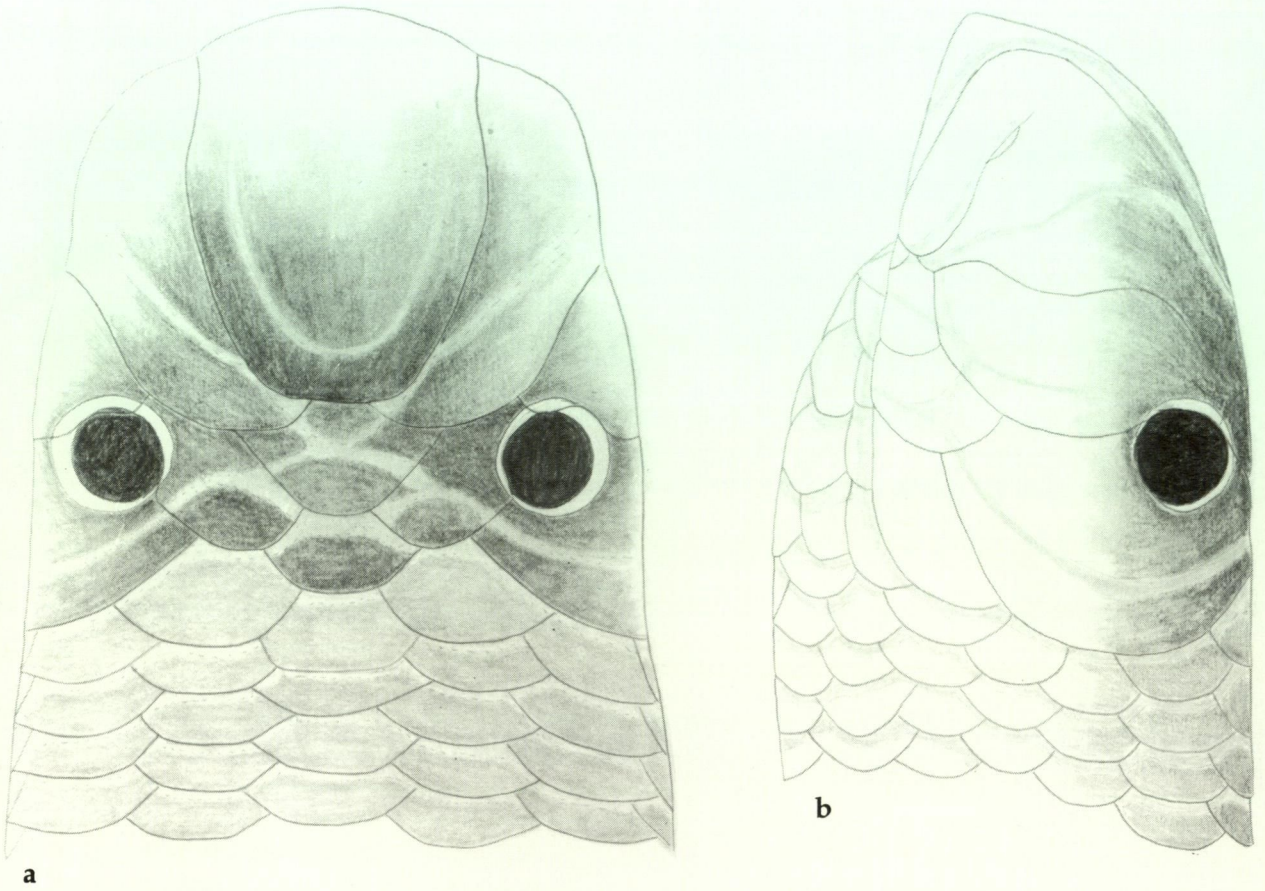

Figure 3 External features of the head of *Ramphotyphlops splendidus* sp. nov., showing basic form and distribution of pigment in relation to scale boundaries and major structural elements in a) dorsal and b) lateral views.

temperate regions are larger and stouter-bodied (e.g., *R. pinguis, R. proximus, R. nigrescens*). It would be of great interest to investigate the physiological and ecological basis of this trend and to further examine the special case of *R. splendidus*.

Ramphotyphlops splendidus rivals *R. pinguis* as the largest typhlopid species recorded in Western Australia. Its discovery on the Cape Range peninsula, in an area visited over the years by many different herpetologists and other naturalists, is noteworthy, and underscores the fact that our knowledge of the terrestrial vertebrate fauna of even the 'better-known' parts of Australia remains incomplete.

The apparent scarcity and potentially restricted distribution of *R. splendidus* give cause for concern regarding its future survival. Although largely protected within a national park, the species presumably depends upon certain taxa of ants for food, and these in turn may be sensitive to changes in groundcover ecology associated with the increasing dominance of Buffel Grass. Further information on the distribution and ecology of *R. splendidus* is urgently required.

Ramphotyphlops longissimus sp. nov.

Figure 5

Material Examined

Holotype

R120049 in the Western Australian Museum, an adult female collected on 22 May 1995 by Mr Lloyd Whitsed at Bandicoot Bay, Barrow Island, Western Australia in 20°54'S 115°22'E. Heart and liver frozen in liquid nitrogen and stored in -80°C ultrafreeze at the Western Australian Museum.

Diagnosis

An exceptionally elongate and slender *Ramphotyphlops* with 16 midbody scale rows, extremely high number of vertebral scales (approx. 750), strongly depressed, rectangular-shaped head with inflated and rounded rostrum, nasal cleft intersecting the second labial scale and terminating just forward of the nostril, and head and body almost completely without pigment.

Description

An extremely elongate and slender-bodied

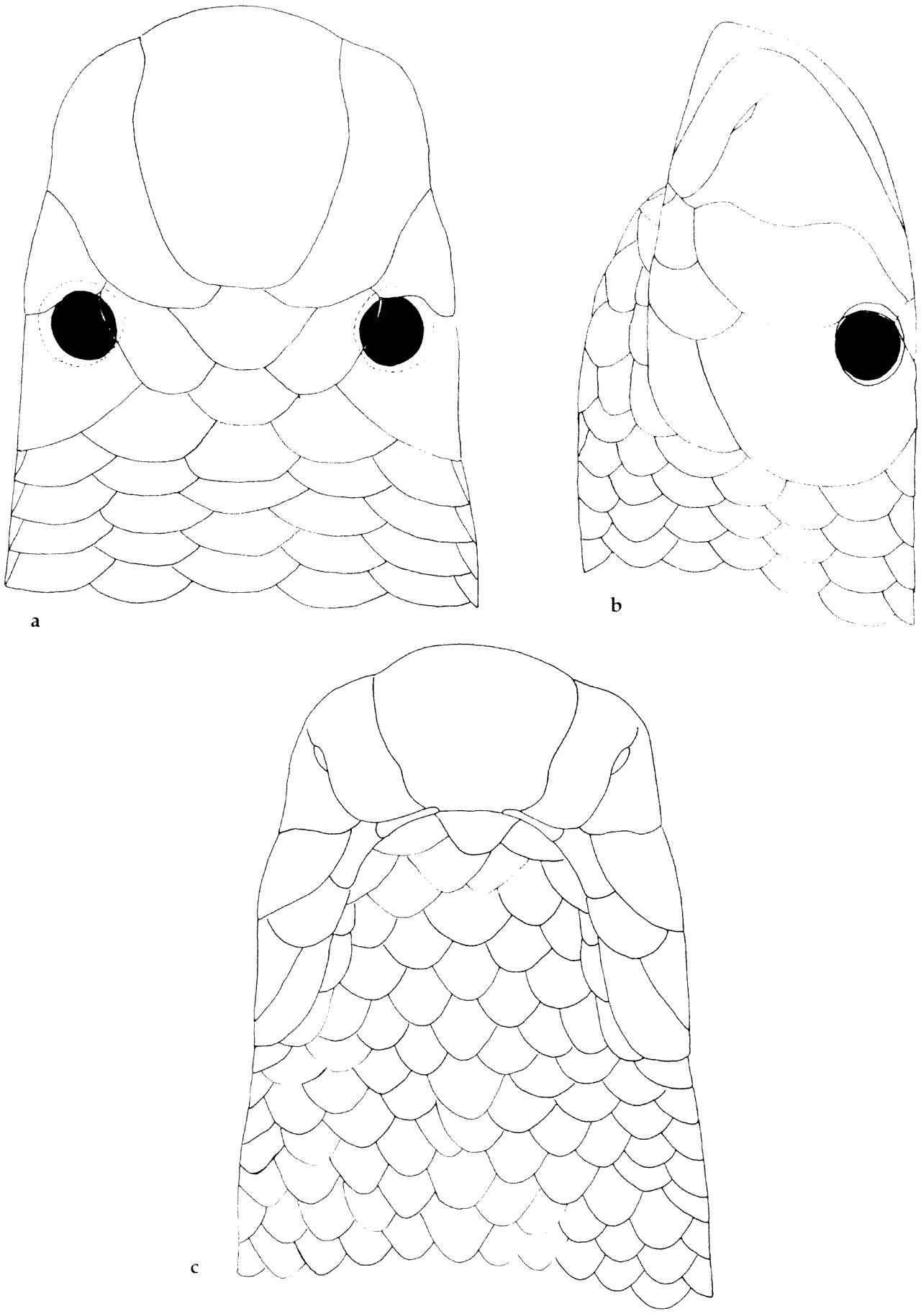

Figure 4 Details of cephalic scalation of *Ramphotyphlops splendidus* sp. nov. in a) dorsal, b) lateral views and c) ventral views.

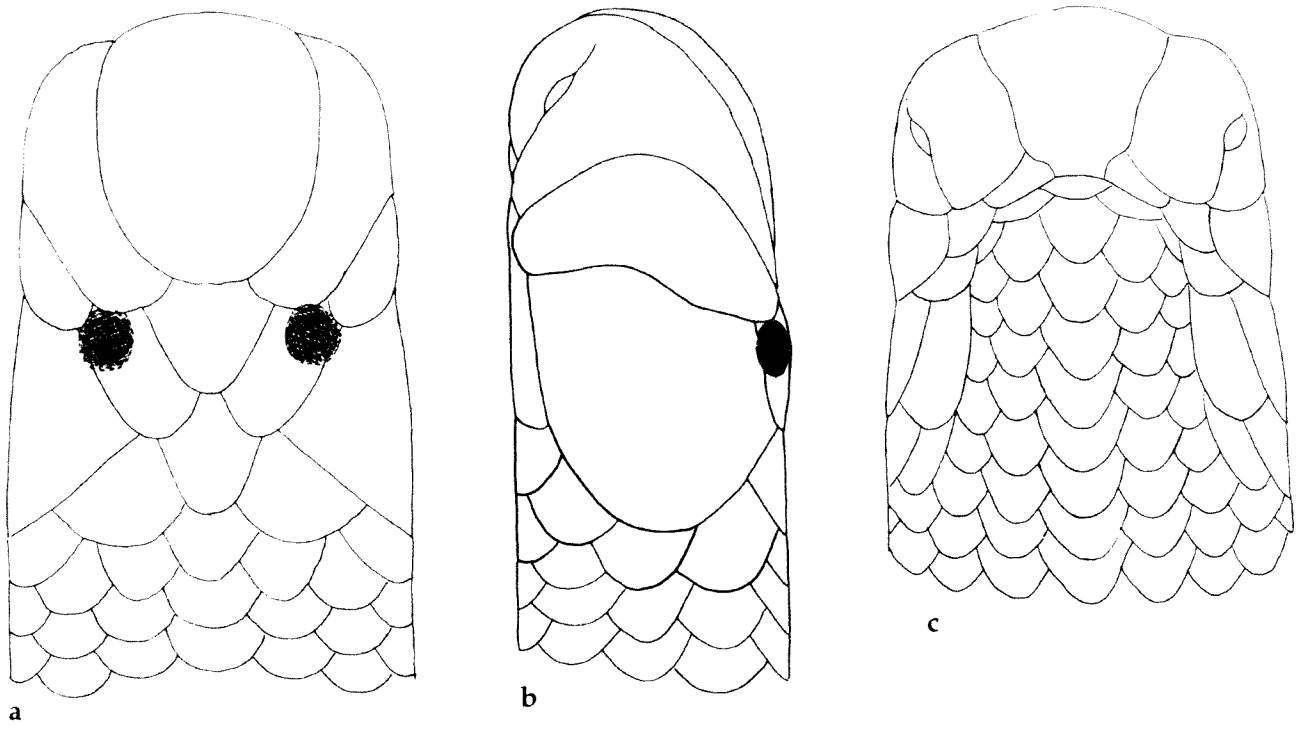

Figure 5 Head of *Ramphotyphlops longissimus* sp. nov. illustrating basic form and details of scalation in a) dorsal, b) lateral and c) ventral views.

species. SVL 266 mm; tail 2.4 mm including minute spine. Preserved body 1.8 mm (width) by 2.1 mm (depth) anteriorly, and 1.8 mm by 2.3 mm posteriorly. Body width averages 0.83% of SVL.

Vertebral scales approximately 750 (two counts yielded 732, 766; very small size and lack of pigment prohibits more accurate determination). Subcaudal scales 15, excluding minute conical spine.

Circumferential scale rows 16 along entire length of body.

In life, body appeared translucent, without any obvious pigment apart from very small eyes. Under magnification, preserved specimen shows no other pigment in anterior body but very faint reticulation ('ghosting' of dorsal scale margins) posteriorly.

General head form and details of scalation illustrated in Figure 5. Head strongly depressed and rectangular as seen from above. Rostrum inflated and rounded in profile. Eyes small but darkly pigmented, positioned on top of head deep to anterolateral corner of mildly bulging supraocular scales. Rostral ovate as viewed from above, slightly longer than wide; terminates forward of eyes. Nasal inflated, projecting anterolaterally to produce rectangular head form. Nostril large, subequal to eye. Nasal cleft originates from second supralabial, passes above nostril before terminating on nasal, well short of rostral. Nostril and nasal cleft not visible from above. Preocular smaller than nasal, broadly separated from prefrontal by intervening supraocular. Anterior border of preocular intersects upper border of second supralabial, just behind nasal cleft. Lower border overlaps supralabials 2–3. Ocular larger than nasal and preocular, ventral portion wedged between supralabials 3 and 4. Supralabials 1–3 subequal, supralabial 4 considerably larger than others of series, terminates well forward of posterior margin of ocular. Prefrontal and frontal subequal, both considerably larger than general body scales; supraocular subequal to prefrontal, in broad contact with nasal anteriorly and narrow contact with parietal posteriorly. Parietal width equivalent to two of body scales.

Microscopic scale organs present on all head scales, most abundant on ventral surfaces.Tubular glands not obvious but entire head is semi-translucent.

Right oviduct narrow, unconvoluted; ovary located 26 mm forward from vent, with numerous small follicles.

Hindgut with very short caecum, 4 mm in length, opens into gut 9 mm forward of vent.

Etymology

Longissimus (Latin): extremely long.

Comparison with other species

Ramphotyphlops longissimus is one of the most distinctive of all Australian typhlopids on account of its exceptionally elongate and slender body form, its unusually inflated rostrum and its almost

complete lack of pigment. It is also unusual within the genus in having a greatly enlarged ocular scale which extends well posterior to the fourth supralabial.

Three other species have 16 midbody scale rows: *R. leptosoma* Robb, 1972; *R. minimus* (Kinghorn, 1929); and *R. nema* Shea and Horner, 1997 [data for latter two species from Shea and Horner (1997)]. *Ramphotyphlops leptosoma* approaches *R. longissimus* in its degree of elongation (BW = 1.0–1.1% of SVL) and correspondingly high vertebral counts (558–720), but differs in having a less depressed head with an acute, chisel-edged rostrum and a nasal cleft that completely divides the nasal scale. *Ramphotyphlops minimus* is much less elongate (BW = 1.42–1.94% of SVL) and has far fewer longitudinal scale rows (381–457 ventral scales), a less depressed head and a complex body pattern, usually including longitudinal stripes. *Ramphotyphlops nema* has a less elongate body form (BW = 1.08–1.75% of SVL), a lower number of longitudinal scale rows (520–589 ventral scales) and a less depressed head.

Several other species of *Ramphotyphlops* have longitudinal scale row counts which approach or even exceed the value in *R. longissimus*. *Ramphotyphlops troglodytes* Storr, 1981 has 641 ventral scales and also has a mildly depressed and bluntly-rounded head form, but it differs from *R. longissimus* in having 20 midbody scale rows and a nasal cleft that completely divides the nasal scale. Members of the *Ramphotyphlops grypus* 'complex' (which most likely contains several species across northern Australia; pers. observ. and G. Shea, pers. comm.), have longitudinal scale row counts that may even exceed the value in *R. longissimus* [Storr (1981) records 790 ventral scales in the holotype of *R. grypus* (Waite, 1918)]. However all members of this group have 18 midbody scale rows and a recurved rostral 'beak', and generally also have a darkly pigmented head and/or tail.

Remarks

Ramphotyphlops longissimus is an extremely distinctive typhlopid which is not obviously allied to any other known taxon. *Ramphotyphlops troglodytes* Storr, 1981 is perhaps most similar to *R. longissimus* in having a mildly depressed head and an extremely elongate body, but the two species differ in midbody scale counts and the configuration of the nasal cleft. The relative importance of these and other characters as phylogenetic indicators within *Ramphotyphlops* is not currently known.

The circumstances of capture of the holotype of *R. longissimus* are worthy of special mention. Apparently, the specimen was one of two individuals that were attached to the outer surface of a section of well-casing pulled from some considerable depth below ground during maintenance of an anode well at Bandicoot Bay on Barrow Island. One specimen was grabbed by Mr Lloyd Whitsed of Whitsed Resources Pty Ltd., while the second 'shot' back down the well and was lost. Because the animal looked more like a worm or eel than a snake, it was placed in a jar of water where it swam around for some time before being rescued by an environmental officer who recognised its true nature. The specimen was delivered several days later, still alive, to the Western Australian Museum.

The surficial geology of Barrow Island is comprised of Miocene limestones which are highly karstic. Drilling operations commonly 'punch' through deep caverns, often partially filled with red sediments; these might conceivably constitute part of the habitat of *R. longissimus*. Air temperatures in Barrow Island caverns are high (X = 28.9° C; range = 26.6–33.1° C, N = 19; W.F. Humphreys, pers.comm.), thus it would presumably be possible for individuals of this species to spend much, if not all, of their time in the subterranean environment. The only other typhlopid recorded from Barrow Island is *R. diversus ammodytes* (Montague, 1914), which is otherwise widely distributed throughout the Pilbara region; it is rarely encountered on the island.

Several of the more unusual features of *R. longissimus* may well be special adaptations to life within a subterranean environment of caverns and fissures. These include the degree of flattening of the head, the extreme slenderness of the body, the degree of reduction of the eyes and the almost complete lack of external pigmentation.

It is of interest to speculate on the possible diet of *R. longissimus*. Ant larvae and pupae form the major prey items of many if not all other Australian typhlopids (Shine and Webb 1990). Hymenoptera are very poorly represented in Australian troglobytic faunas as elsewhere in the world, although surface-dwelling ants may incubate their eggs far below ground in such environments (W.F. Humphreys, pers. comm.). Unfortunately, the hindgut of the only known specimen of *R. longissimus* is empty, presumably as a consequence of the long period of captivity, and it is not possible to determine what the diet of this peculiar species might include.

Ramphotyphlops ganei sp. nov.

Figures 6–8

Material Examined

Holotype

R124835 in the Western Australian Museum, an

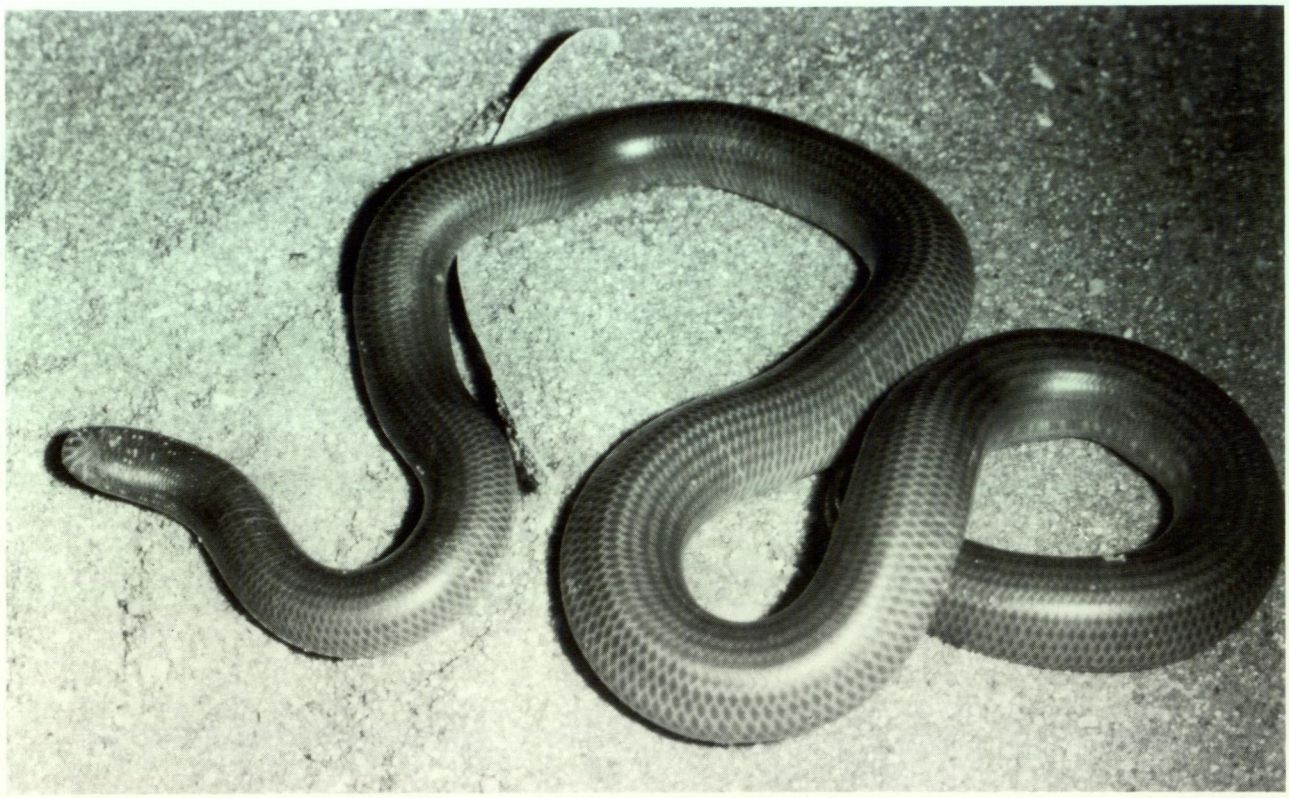

Figure 6 Holotype of *Ramphotyphlops ganei* sp. nov. in life (photograph Mr Brian Bush).

adult female collected on 26 September 1995 by Mr Brian Bush at Cathedral Gorge, 30 km west of Newman, Western Australia, in 23°17'30"S, 119°28'E. Heart and liver frozen in liquid nitrogen and stored in -80°C ultrafreeze at the Western Australian Museum.

Paratypes

Australia: Western Australia: R102111 in the Western Australian Museum, an adult female collected as a road-kill in mid-April 1991 by Mr Lori Gane at Pannawonica in 21°39'S 116°20'E. Head crushed on right side. Heart and liver frozen in liquid nitrogen and stored in –80°C ultrafreeze at the Western Australian Museum. R129556 in the Western Australian Museum, an adult female collected at waste dump on Mt Whaleback in 23°20'57"S 119°41'30"E, by Mr K.J. Walker on 14/12/1985. R129571 in the Western Australian Museum, an adult male collected in Newman Townsite in 23°21'S 119°34'E by Mr K.J. Walker (no date provided but presumed 1985-1986).

Diagnosis

An elongate, moderately stout *Ramphotyphlops* with 24 midbody scale rows, a foreshortened head with snout bluntly rounded in lateral profile and from above, moderately high number of vertebral scales (430–448) and nasal cleft vertically dividing the nasal scale, originating from the second labial scale and terminating at the rostral scale on the dorsal surface of the head.

Description

An elongate and moderately stout-bodied species (see Figure 6).

SVL of females (N=3) 258–335 mm, of male 230 mm; tail length (without spine) of females 4.5–5.3 mm, of male 7.0 mm. Preserved body of female holotype 9.3 mm (width) by 9.5 mm (depth), of male 5.1 mm by 5.0 mm. Body width 2.89%, 2.2% of SVL respectively.

Vertebral scales number 430–448 for females, 432 for male. Subcaudal scales (excluding conical spine) of females 12–13, of male 19.

Circumferential scale rows 24 along entire length of body.

In life, dorsal surface of head, body and tail an intense grey-brown, becoming paler on flanks; lateral colour ends abruptly, giving way to cream venter along jagged boundary. Number of pigmented scale rows is 14–15 along entire body, remaining rows immaculate. Head extensively pigmented. Undersurface of tail immaculate.

General head form and details of pigmentaton and scalation illustrated in Figures 7–8. Head bluntly rounded in profile and from above, preocular region extremely foreshortened. Eyes conspicuous, positioned deep to anterodorsal portion of ocular scale. Rostral measures 3.0/mm from tip to posterior margin; very narrow

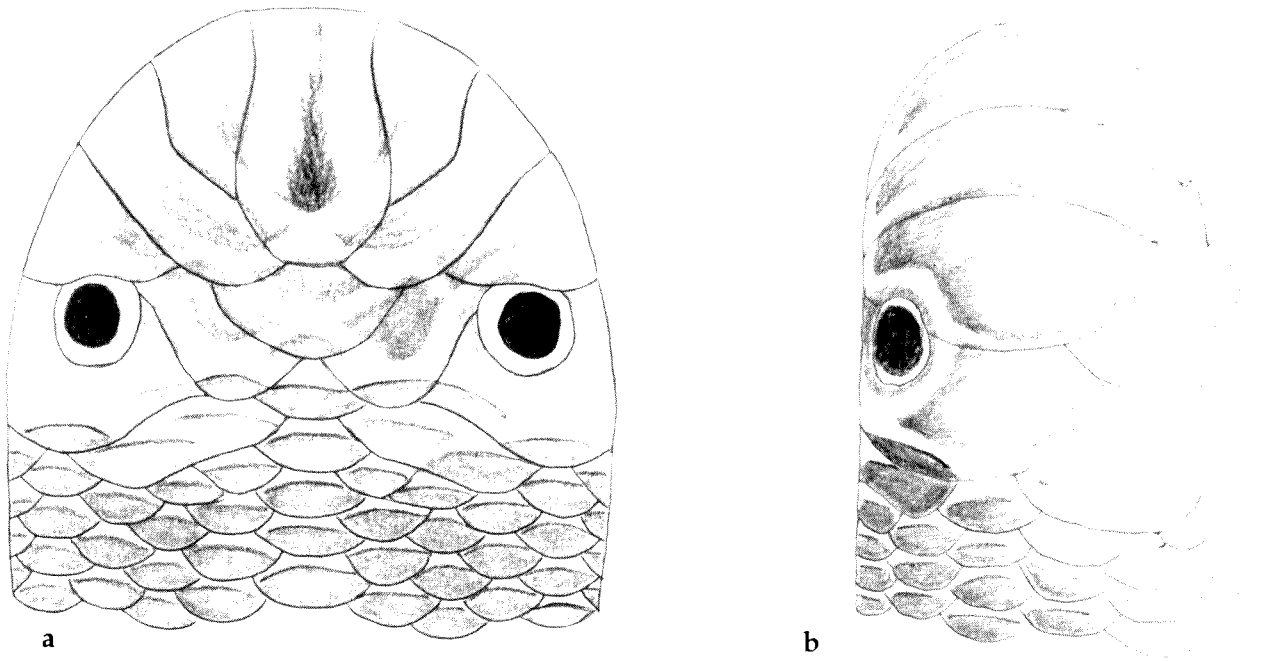

Figure 7 External features of the head of *Ramphotyphlops ganei* sp. nov. (paratype R102111) illustrating basic form and distribution of pigment in relation to scale boundaries and major structural elements in a) dorsal and b) lateral views.

anteriorly and ventrally, expanding posterodorsally to maximum width of 1.6/mm; terminates just forward of line drawn across front of eyes. Nasals large, forming major part of anterior surface of head; broadly separated behind rostral by prefrontal. Nasal cleft originates from anterior end of second supralabial, curves around front of nostril then extends vertically onto upper surface of head, finally swinging posteromedially to contact posterolateral margin of rostral. Nasal scale thus completed divided into subequal anterior and posterior moeities. Preocular smaller than nasal, suequal to ocular, narrowly separated from prefrontal by intervening supraocular. Anterior suture of preocular intersects upper border of second supralabial well behind nasal cleft. Lower border of preocular overlaps supralabials 2–3. Ocular subequal to preocular. Ventral portion wedged between supralabials 3 and 4. Supralabials increase in size posteriorly; supralabial 4 projects behind posterior margin of ocular. Prefrontal large, equal to three body scales; deeply wedged between nasal and supraocular but fails to contact preocular. Supraocular subequal to prefrontal. Frontal not distinguishable from other scales of vertebral series. Parietal wide but strap-like, equal in width to three body scales.

Microscopic scale organs present on all head scales, only slightly more abundant on ventral and lateral surfaces than on dorsum. Tubular glands conspicuous around rostral and labial sutures.

The holotype, collected in late September, is gravid with an undetermined number of eggs. One of these has a length of 13 mm. Specimen R10211, collected in April, has an elongate but straplike right oviduct and a quiescent ovary. The single male specimen is reproductively mature, with a convoluted efferent duct.

Hindgut of female R124835 with short rectal caecum, 13.8/mm in length, opening into gut 17.9 mm (32 scale rows) forward of vent. In male, rectal caecum measures 9.6 mm in length and opens 13.0 mm (36 scale rows) forward of vent.

Male specimen has short, narrow retrocloacal sacs which terminate 4 mm forward of the vent. Hemipenes not investigated.

Comparison with other species

The presence of short retrocloacal sacs in the referred male specimen demonstrates affinity with the genus *Ramphotyphlops* Fitzinger, 1843 as redefined by Robb (1966a,b) on the basis of features of the male reproductive tract. Other features, such as the supralabial imbrication pattern (Wallach 1993) and presence of a rectal caecum (Robb 1966b), further support this placement.

Ramphotyphlops ganei is perhaps most similar overall to *R. ligatus* with which it shares the relatively uncommon features of 24 midbody scale rows and continuation of the nasal cleft onto the upper surface of the snout. *Ramphotyhlops ligatus* [as defined by Storr (1981); work in progress suggests that it is composite, but without affecting the present comparisons] is less elongate than the new species and has fewer vertebral scales (296–355 in females), a less extremely foreshortened

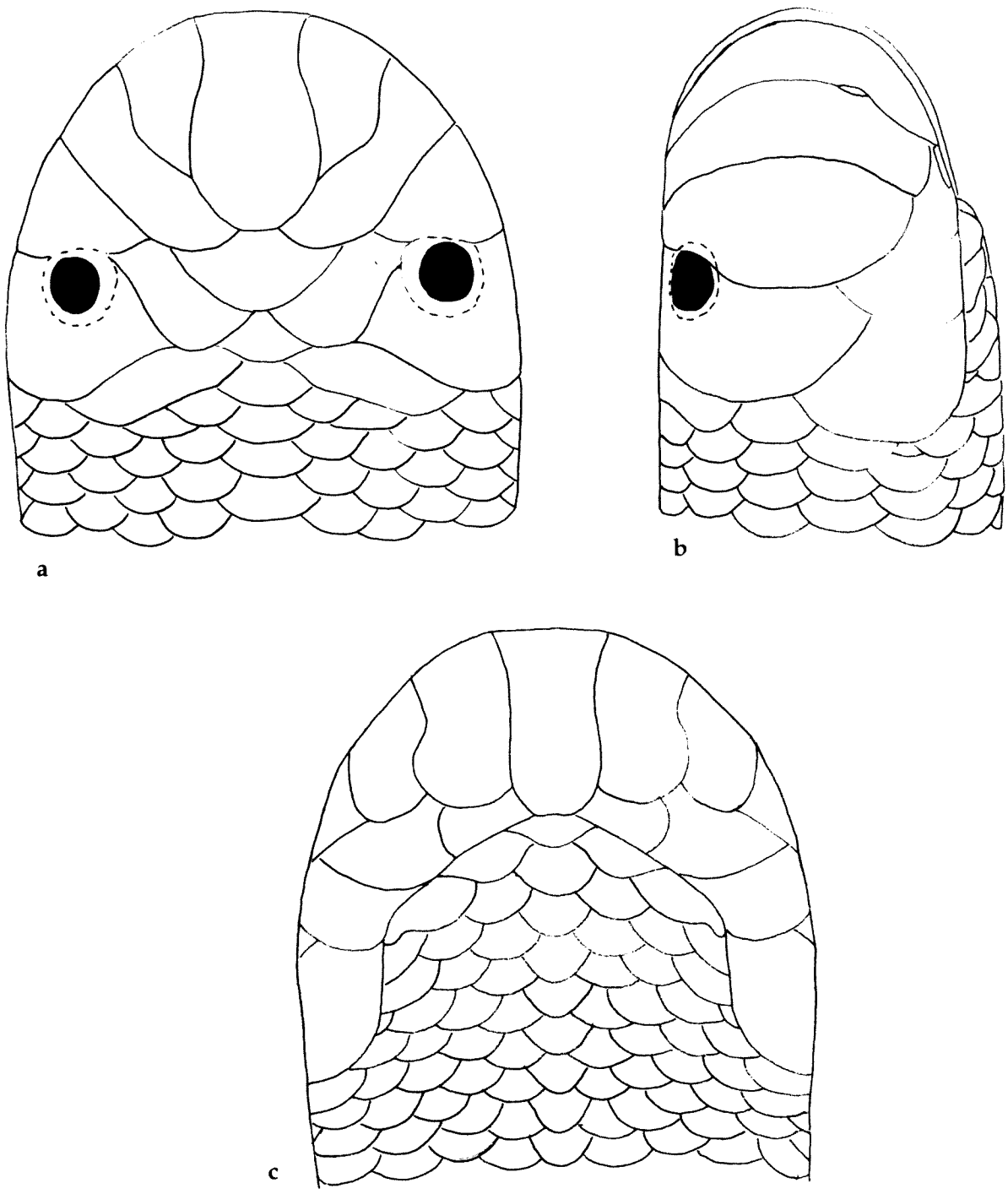

Figure 8 Details of cephalic scalation of *Ramphotyphlops ganei* sp. nov. (paratype R102111) in a) dorsal, b) lateral views and c) ventral views.

head, a broader rostral scale, and a nasal cleft which originates at the first labial scale and terminates well short of the rostral scale. Representatives of the *R. ligatus* complex are found from the West Kimberley across northern Australia and south at least to northern New South Wales.

Three other species of *Ramphotyphlops* with 24 midbody scale rows are *R. yirrikalae* (Kinghorn, 1942) and *R. unguirostris* (Peters, 1867) from tropical Australia and *R. batillus* (Waite, 1894), known only from the holotype, reputedly from Wagga Wagga in New South Wales (see comments in McDowell, 1974). Each of these species is very different from *R. ganei*. *Ramphotyphlops yirrikalae* is a smaller, slender-built animal with a higher vertebral scale count (496; Northern Territory Museum 16855) and a nasal cleft which originates at the first labial scale and terminates at the nostril. *Ramphotyphlops unguirostris* has a very different head form (snout extended into sharp-edged beak, with broad rostral scale) and a nasal cleft which originates from the first labial and passes forwards

through the nostril to contact the rostral scale. *Ramphotyphlops batillus* has a higher number of vertebral scales (557) and a very differently shaped rostrum.

Complete, nearly vertical division of the nasal scale is a rare condition in *Ramphotyphlops*, recorded previously only in *R. erycinus* (Werner, 1901) from New Guinea (McDowell 1974) and as a variant in some Indonesian populations of *R. polygrammicus* (Smith 1927; Mertens 1930). *Ramphotyphlops erycina* differs from *R. ganei* in having a less foreshortened head, fewer midbody scale rows (20) and lower vertebral scale counts (292–319). Other taxa with a similarly oriented but incomplete nasal cleft are *R. ligatus*, *R. kimberleyensis* Storr, 1981, *R. polygrammicus* [possibly including "*R. torresianus*" (Boulenger, 1889)], *R. wiedii* (Boulenger, 1895) and *R. silvia* Ingram and Covacevich, 1994. [Several of these taxa were grouped by McDowell (1974) as his "*Typhlina polygrammica*" Group]. *Ramphotyphlops kimberleyensis* and members of the *R. polygrammicus* complex have 22 midbody scale rows and a less foreshortened head than *R. ganei*, while *R. wiedii* and *R. silvia* have 20 midbody rows. None of these species appears to be closely related to *R. ganei*.

Etymology

Named for Mr Lori Gane, formerly of Pannawonica, schoolteacher, amateur herpetologist and collector of the first known specimen of *R. ganei* in 1991. Also in acknowledgement of his role in the events which lead to the recognition of the Pilbara Death Adder as a distinct species.

Remarks

Ramphotyphlops ganei does not appear to be particulary closely related to any other species in the genus. Probably its closest affinites are with *R. erycinus* and members of the *R. ligatus* and *R. polygrammicus* complexes, but it differs from each of these taxa in significant aspects of cephalic form (e.g., the extreme foreshortening of the preorbital region) as well as in various features of scalation. At any rate, the biogeographic affinities of *R. ganei* appear to be with various northern Australian and New Guinean typhlopids, rather than with any southwestern or southern taxa.

Ramphotyphlops ganei has been collected at opposite ends of the Pilbara uplands, hence the species may occur over a substantial geographic range. However, the fact that it has not previously been collected surely implies either a general scarcity or a very discontinuous distribution. I tend towards the latter opinion and would hazard to suggest that the new species is associated with the moist microhabitats which exist in many of the deeper, better shaded gorges throughout the region.

DISCUSSION

Even though the three new taxa described above are each known from only one or a few specimens, I have no hesitation in describing each of them as a full species. *Ramphotyphlops longissimus* and *R. ganei* are particularly distinctive and cannot be confused with any other species; and while *Ramphotyphlops splendidus* is similar to *R. pinguis* in head morphology, it is readily distinguished by its more elongate body and correspondingly higher longitudinal scale count.

Of the three new species, only *R. ganei* is definitely affiliated with *Ramphotyphlops* on the basis of male reproductive anatomy. However, all three species are consistent with other *Ramphotyphlops* species in the presence of an intestinal caecum (Robb 1966b) and in supralabial imbrication pattern (Wallach 1993). They are also most conservatively placed within *Ramphotyphlops* on biogeographic grounds.

The addition of three new species of *Ramphotyphlops* to the herpetofauna of northwestern Australia almost doubles the number of typhlopid snakes recorded from the wider Pilbara region. It also takes to five the tally of regionally endemic typhlopids [the others are: *R. pilbarensis* Aplin and Donnellan, 1990; and *R. diversus ammodytes* (Montague, 1914)] and further underscores the high level of endemicity of this structurally complex upland subregion of the Australian arid zone (cf. Aplin and Donnellan 1991). The discovery of these new species highlights the very incomplete state of knowledge of the fossorial herpetofauna of northwestern Australia, in particular the Typhlopidae.

Also of special interest is the chance recovery of *R. longissimus* from below ground on Barrow Island, which surely rates as one of the most peculiar events in the history of Australian herpetology.

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