



FAUNA *of* AUSTRALIA



32. FAMILY TYPHLOPIDAE

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Pl. 7.1. *Ramphotyphlops australis* (Typhlopidae): a small, worm-like, burrowing snake; small, black spots indicate the eyes in these blind snakes; found in the drier parts of southern Australia. [H. Cogger]

DEFINITION AND GENERAL DESCRIPTION

Typhlopids are small, so-called ‘blind’ snakes which are highly specialised for a subterranean life. The rigid, cylindrical body bears uniform cycloid scales dorsally and ventrally, and each eye is covered with at least one large head scale which extends well beyond the eye’s posterior rim. The mouth is small, crescent-shaped and ventrally located, and the dentition is reduced to a few short, recurved teeth on the maxilla of the upper jaw. The very short tail usually terminates in an obtuse spine. All 31 species of typhlopids in Australia and its territories are placed in the genus *Ramphotyphlops*.

HISTORY OF DISCOVERY

The first typhlopids described from Australia were *Ramphotyphlops australis*, as *Anilios australis* (the type series was composite) and *R. nigrescens*, as *A. nigrescens* (Gray 1845). The two specimens of the former type series (one *R. australis* and one *R. endoterus*) are from the type locality ‘Australia’, whereas the type locality of *R. nigrescens* is Parramatta (Cogger, Cameron & Cogger 1983a). Between 1839 and 1898, 11 typhlopid species, including the Christmas Island endemic *R. exocoeti*, were described by European taxonomists. This type material is held in European museums (see Cogger *et al.* 1983a for complete citations of all species descriptions). Until the mid-1860s, the known Australian species were placed in up to eight different genera. Jan & Sordelli (1864) placed all species in the genus *Typhlops*.

Krefft (1869) provided the first insight into their natural history, and noted that ‘blind snakes burrow in search of their food, which consists chiefly of ants and their eggs and larvae’. This record was probably based on his personal observations of *R. nigrescens*, a species abundant around Sydney where Krefft worked.

Waite (1894) described five additional species of Australian typhlopids; the types of four of these are lodged in Australian museums. His natural history observations of Australian blind snakes (Waite 1918) have been widely accepted, restated and condensed, and subsequent authors have added little that is new until 1990 (Shine & Webb 1990; Webb 1990; Ehmann 1992).

The Australian typhlopids were removed from *Typhlops* by Robb (1966b) on the basis of hemipenial morphology. Since the issue of Opinion 1207 by the ICZN, which suppressed use of *Typhlina*, her resurrected name *Ramphotyphlops* has applied to these snakes.

McDowell (1974) discussed the relationships of 14 Australian species in his systematic study of the Typhlopidae of New Guinea and surrounding islands. This included a thorough analysis of the hemipenes, supralabial condition and distribution of cutaneous glands on the head in three of the Australian species.

The most recent phase in the taxonomy of Australian typhlopids was completed by Storr (1981) when he described six new species in a review of the genus in Western Australia. Two further species were described subsequently by Storr in 1984. All of Storr’s type material is held in the Western Australian Museum.

MORPHOLOGY AND PHYSIOLOGY

External characteristics

Adult typhlopids range in length from 150 to 750 mm. The body is nearly cylindrical and is remarkably rigid in cross section; both characteristics are mechanical adaptations for a subterranean life (Pl. 7.2). Adults, especially of larger species, are slightly thinner anteriorly than posteriorly. The overall appearance of the body of a typhlopids can be expressed as the length divided by the diameter (l/d). Expressed in this form, the greatest range in shape within a single species is 60 to 135. Young (or small) individuals have stouter bodies than old (or large) individuals of the same species (see Gillam 1979a).

In the process of burrowing, typhlopids clear or expand spaces in the soil with movements of the head and neck. This has led to the evolution of unusual head shapes and scale arrangements in many species. The snout may be rounded and blunt, slightly wedged and blunt, wedged with a transverse edge, or noticeably hooked (Fig. 32.1). These features are subject to some individual and geographic variation, presumably in response to particular local substrates. The snout and head shape of each species becomes more characteristic with an increase in size, small individuals often having more rounded head outlines. The shape of the snout of preserved specimens is also variable. The snout, in particular the upper labial area, is somewhat flexible and changes its shape when the mouth is distended (for example, during feeding). This generally unnoticed mobility may affect the profile and probably also the relative position of some of the scale margins, especially the so-called nasal cleft (Ehmann pers. obs.).

The tail of all Australian species is very short (less than 5% of the total length), rounded at the end and with a short, obtuse conical spine directed backward and downward. This spine 'caps' the terminal caudal vertebra (Ehmann pers. obs.).

Between species, colour varies from black, brown, buff and grey to salmon pink, but there is much less variation within a species. The body is darker above and on the sides. The transition to the paler belly is usually consistent within each species, and can be ragged and abrupt, irregular and abrupt, straight and abrupt, graded over a short distance or graduated through the entire lower side. The colour of the head and snout shields is consistent within each species. The tail may be characteristically pigmented in some species and in some species the anterior body is slightly paler.

Body Wall

The scales of blind snakes are glossy, smooth and rigid. Each headshield and body scale has a long, free margin so that consecutive and adjoining scales overlap significantly (Fig. 32.2) and provide a tubular structure that strongly 'encases' the body. The length of the scales also provides considerable leeway for frequent rather deep scratches that can 'fray' the outer edge of a scale without causing damage to its more delicate inner structure (Fig. 32.3). All of these features reduce friction and are adaptive for burrowing.

Cutaneous glands are present under the proximal margins of the head and neck scales (Haas 1932; McDowell 1974), and their evidence or obscurity are characteristic at the species level. These glands secrete a sebaceous substance which probably acts as an interscale lubricant and probably also promotes the resilience of the scales to cracking and abrasion. These cutaneous glands are very pale in some dark species and can easily be mistaken for scale margins. The surface of each head scale (especially the rostral scale) has numerous microscopic pustulate glands which probably also exude a sebum-like substance (Fig. 32.4).

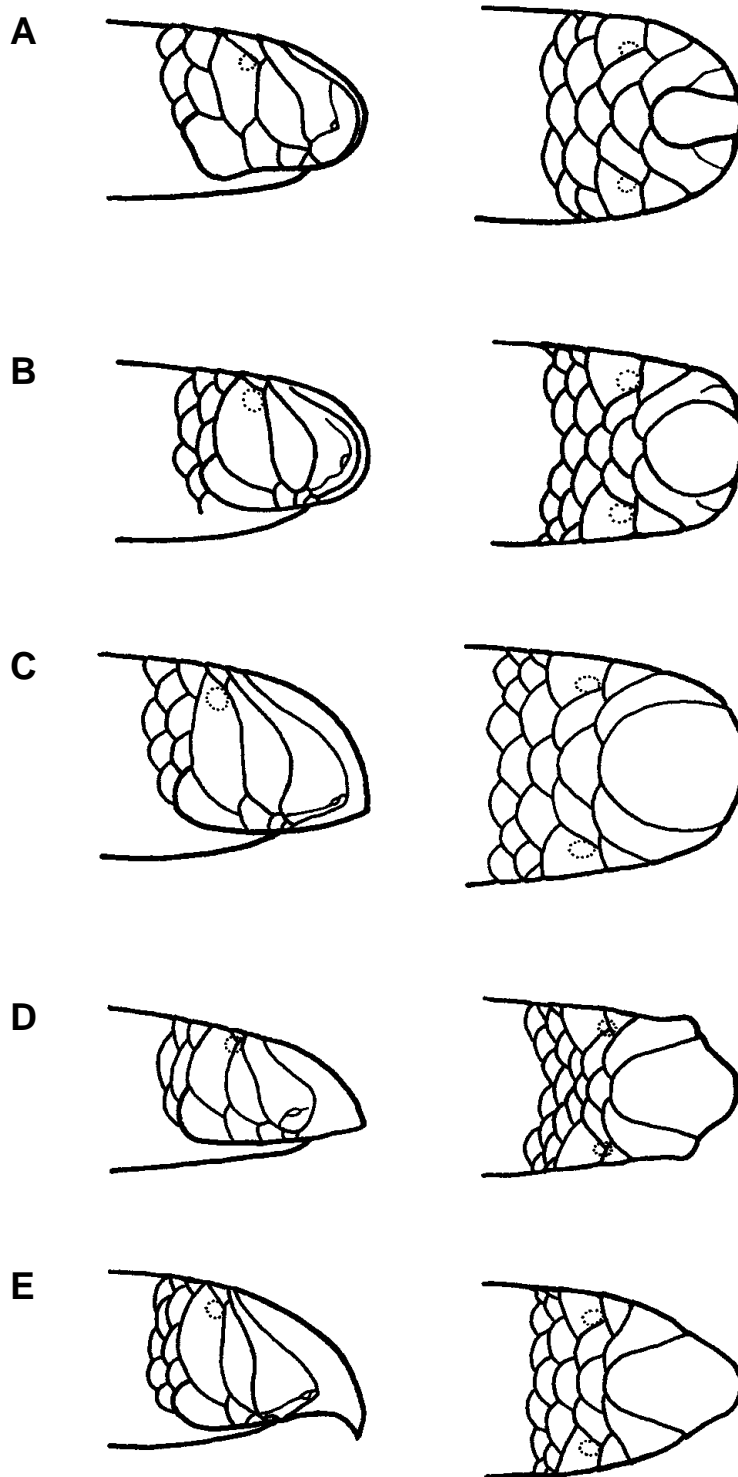


Figure 32.1 Lateral and dorsal views of the head of Australian *Ramphotyphlops*, arranged in order of increasing snout specialisation. The snout shapes of some blind snakes may be adaptations to soil characteristics such as particle size, moisture content and penetrability. **A**, *R. braminus*, sandy or loamy soils with regular hydration; **B**, *R. wiedii*, sandy, clay-loam or loamy soils with fairly predictable year-round hydration; **C**, *R. affinis*, self-mulching loamy or clay soils with unpredictable soil hydration all year; **D**, *R. bituberculatus*, sandy soils, often with calcareous inclusions or clay with unreliable winter hydration; **E**, *R. grypus*, sandy or sandy loam soils with unreliable summer soil hydration. [H. Ehmman]

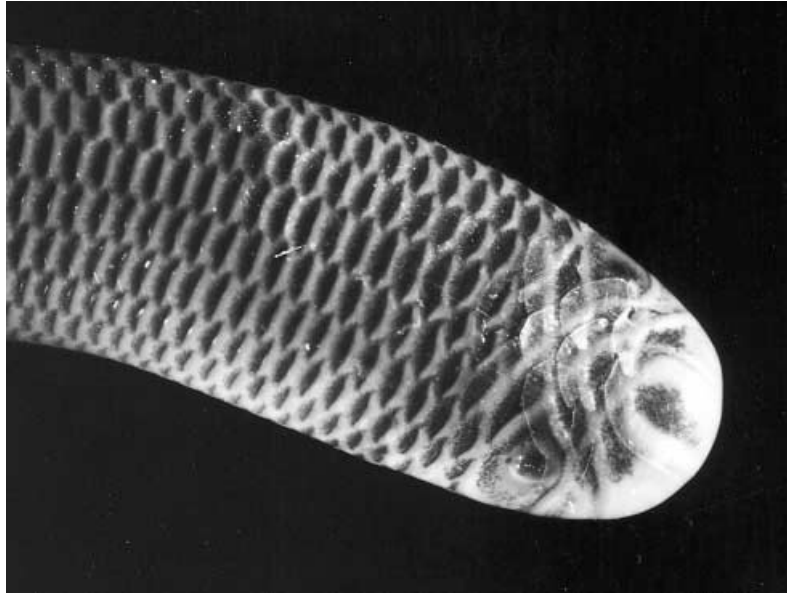


Figure 32.2 Dorsal view of head of *Ramphotyphlops nigrescens* showing overlapping scale margins, cutaneous glands, semitransparent scales. [Photo by D. Frith & H. Ehmann]

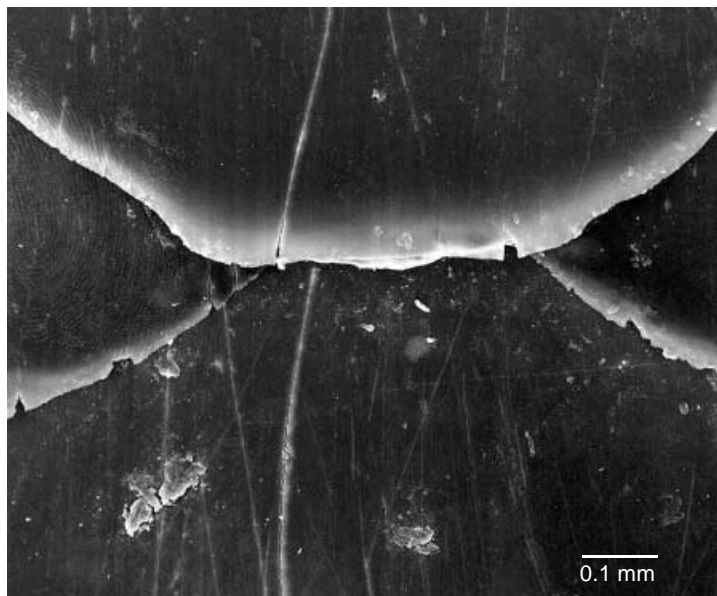


Figure 32.3 Scanning electron micrograph of scales of *Ramphotyphlops nigrescens*, showing frayed edges and deep scratches. [Photo by D. Frith & H. Ehmann]

The midbody scale rows can be difficult to count because they are translucent and overlap extensively (see Fig. 32.3). The number of rows, which varies from 16 to 24, is generally thought to be constant within a species although Storr (1981) reported variation in *R. leptosoma*.

Australian blind snakes shed their epidermis within the substratum by crawling forward through a tight-fitting soil hole. The consecutive, rigid rings of scale epidermis may telescope together to form a fairly tight ball or short tube (Ehmann pers. obs.).

Skeletal System

The skeletal structure of typhlopids differs from that of other snakes in several aspects. The skull is simple with few distinct bones, and the snout bones and prefrontals are firmly sutured to the brain case (List 1966). Only about three short, weakly recurved and sharp primary teeth are located distally on the maxilla and no teeth occur on the dentary of the lower jaw. The pelvis is represented by a single bone on each side (Waite 1918). The caudal vertebrae curve downward distally and the tip of the terminal vertebra fits into the back of the terminal spine (Ehmann pers. obs.). The vertebrae have strong accessory processes (metapophyses or mamillary processes) which project laterally to the articular facets of the prezygapophyses and the ribs have strong tubera costae projecting backward from the head (McDowell 1974).

The osteology of Australian blind snakes is poorly studied. In *R. australis*, a small ectopterygoid-like bone is present (Waite 1918), though this element is generally considered to be lacking in typhlopids (McDowell 1974).

Locomotion

Blind snakes use lateral undulation to move quickly on the surface and rectilinear, lateral undulation and concertina motion to crawl more slowly on the surface or through insect tunnels and galleries (Ehmann pers. obs.). Gans (1974) discussed these locomotory methods in detail.

Feeding

Ingestion has been studied in detail for *R. nigrescens* by Webb (1990) and a photograph by John Weigel of ingestion of ant pupae in the same species was published by Wilson & Knowles (1988). The pupae and larvae appear to be rapidly 'sucked' into the widely-gaping mouth. During ingestion, the two maxillae probably move rapidly in unison, rather than alternating as in other snakes. The transverse alignment (rather than longitudinal as in other snakes) of the maxillary teeth, the closeness of the left and right maxillae, and the large channelling coronoid processes on the lower jaw's dentary all support this conclusion. At least one typhlopid, *R. nigrescens*, is able to follow scent trails of worker ants of four species (Webb & Shine 1992), and *R. diversus* may be able to forage under water (Ehmann 1992).

Temperature Regulation

Typhlopids are not known to be surface active during the day or to bask in the sun but, since soil temperatures tend to be moderate or relatively high (particularly in warmer months), they can obtain heat from their surroundings and are thigmothermic (see Rawlinson 1974a). The desert species, *R. bituberculatus*, which is active at night on the cool ground surface, burrows down into warmer sub-surface layers and then re-emerges to continue surface activity (Ehmann 1992). When *R. wiedii* is heat-stressed (35°C) on a warm, impenetrable surface, it gapes its mouth, salivates and elevates the head vertically while continuing to crawl along in search of a softer penetrable substrate or other shelter (Ehmann pers. obs.). Head elevation in this situation may serve to keep the head from over-heating.

There are no data on temperature preferences among typhlopids.

Respiration

The external nares of blind snakes are located at the junction of snout scales in the nasal cleft. The cleft is the distal margin of a scale, which forms a partial baffle-like cover over the front of the naris in all species (Fig. 32.4). This provides a narrow slot through which inhaled air must pass before entering the naris, and thus the slot can hold back some soil particles. Furthermore, the external nares are directed ventrally and backward under the snout so that soil particles cannot be forced into them. Air is therefore drawn from below the burrowing head and the snake can form a small, ventral air cavity in soil by raising the snout. *Ramphotyphlops* possesses an anterior tracheal lung and a posterior right lung; there is no left lung (Robb 1960).

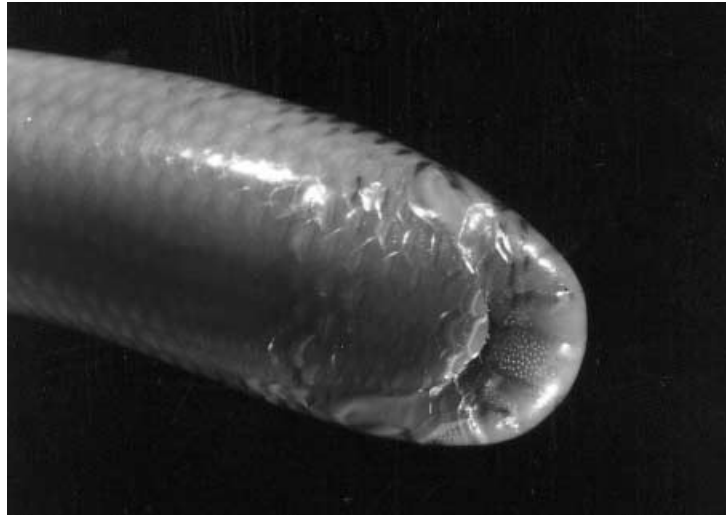


Figure 32.4 Ventral view of head of *Ramphotyphlops nigrescens* showing pustulate glands on the rostral scale, the underslung mouth, and the baffle-like margin of the nasal cleft over anterior half of the external, ventrally directed naris. [Photo by D. Frith & H. Ehmann]

Excretion

Blind snakes excrete nitrogenous wastes as a blob of white uric acid paste with a rather wet suspension of faecal material. Their subterranean habitation with relatively high humidity, the high moisture content of their food and restriction of nocturnal surface activity to periods of moist weather conditions combine to minimise the risk of dehydration for typhlopids. The strong smelling cloacal contents are evacuated as a smear when a blind snake is held firmly or roughly handled. The cloacal pouches (Robb 1966a) may also be involved in the storage of some fluids for defence (see Exocrine glands).

Sense Organs

The eyes of typhlopids are small and deeply set in the head (Fig. 32.2). The ocular scale and its dermis overlying the eye are transparent. The eye of *R. ligatus* has an iris, lens and pigmented retina (Ehmann pers. obs.). Typhlopids are probably able to determine light levels and form some visual images (see also Embryology and Development). Like all snakes, typhlopids lack external ear apertures, but a well-developed inner ear is present (McDowell 1974). They respond to vibrations when on or in the ground or in water (Ehmann pers. obs.). John Mitchell (in Schwaner, Miller & Tyler 1985) noted that *R. australis* emits an audible squeak when handled roughly. The olfactory sense of blind snakes is well developed and both surface and subsurface activity is characterised by an almost constant flicking of the small, pale, bifid tongue (Ehmann pers. obs.).

Exocrine Glands

The head shields of many Australian blind snakes have prominent cutaneous glands (see Body Wall). Robb (1960, 1966a) found a median cloacal gland and paired scent or anal glands. Maryan (1988) reported ‘the foul smelling odour ... from the anal glands was quite strong’ in 26 day old *R. australis*, supporting the view that these odours may be used for defence.

Reproduction

The left oviduct is generally considered to be lost in typhlopids (McDowell 1974), but Cogger, Sadler & Cameron (1983b) reported a female *R. exocoeti* with a well developed left ovary and oviduct. The solid, distal portion of the hemipenis of *Ramphotyphlops* is permanently everted, and is sheathed by the proximal portion when the hemipenis is retracted (McDowell 1974). This contrasts with the eversion of the entire hemipenis, as in all other snakes. The hemipenes may be supplied with sperm stored in the male’s cloacal pouches (Robb 1960, 1966a). The sexes are similar in most respects, but on average females are larger and relatively shorter-tailed than males (Shine & Webb 1990) and some become noticeably distended when gravid. Mating has not been observed and probably occurs below the surface. *Ramphotyphlops braminus* is known only from females and is the only snake known that is presumed to be parthenogenetic (McDowell 1974; Nussbaum 1980). All Australian species are believed to produce soft-shelled eggs. Shine & Webb (1990) found ‘that most species have highly seasonal reproductive cycles, with vitellogenesis in spring (September to November) and oviposition in summer (December to February)’. In a comparison of nine species, and within *R. nigrescens*, mean clutch size was highly correlated with mean adult female body size. Clutch sizes vary from one to 34 in 11 species with species means from three to 13 (Shine & Webb 1990). There are two accounts of captive females ‘lying on’ or ‘coiled around’ their recently laid eggs (Fleay 1981; Maryan 1988) which may indicate at least early parental care.

Embryology and Development

The elongate, white, thick parchment-shelled eggs of *R. nigrescens* absorb moisture from the surroundings throughout the incubation period. As a result, they increase in diameter and slightly in length, and undergo a 2.2 fold increase in weight (Ehmann pers. obs.). *Ramphotyphlops nigrescens* lays eggs in an advanced stage containing well-developed embryos with large, fully pigmented eyes. Incubation times range from 47 to 51 days at 25°C and 30 to 35 days at 30°C, with a reasonable indication that temperature dependent sex-determination does not occur (Shine & Webb 1990). Hatchlings of *R. australis* remain within the egg cases for about one day after pipping. The earthworm-pink dorsum of the emergent hatchling darkens to a purplish-pink in 26 days; the venter is white (Maryan 1988).

NATURAL HISTORY

Life History

Males reach maturity at a significantly smaller size than females in 11 species, a dimorphism that is more pronounced in larger species (Shine & Webb 1990). Age at sexual maturity and longevity are not known. The elapid, *Vermicella annulata*, preys exclusively on typhlopids (Shine 1980e). Few other data on predators are available, although feral cats are known predators of typhlopids.

Ecology

John Mitchell noted the abundance of *R. bituberculatus* in casuarina country (in Schwaner *et al.* 1985) and Swanson (1981) reported on the preference of *R. braminus* for gardens. *Ramphotyphlops braminus* has also been found in arboreal locations, such as the compressed leaf-bases in the trunks of banana plants (Bamford pers. obs.). Typhlopids are usually not encountered on agricultural land subject to ploughing or intense grazing (Ehmann pers. obs.), but they do survive in remnant ungrazed bushland in agricultural regions in the wheatbelt of Western Australia. For example, *R. australis* may be present in patches of bushland as small as one hectare (Bamford pers. obs.).

Soil characteristics, in particular penetrability, longer-term moisture content, particle sizes, the nature and extent of cracking, and presence of invertebrate prey and burrowing invertebrates are probably essential features of the habitat for typhlopids. Many species probably selectively use ant and termite galleries, cavities and holes in decaying stumps, invertebrate burrows and deep soil cracks. When regularly used by adults, such sites usually have a lesser network of locally enlarged galleries, suggesting active enlargement and maintenance by the snake (Ehmann pers. obs.).

Large individual typhlopids enter nests of bull-dog ants, *Myrmecia*, and feed on their pupae and larvae (MacColloch 1909, Shine & Webb 1990); small ones probably do likewise in the nests of smaller ants. This suggests that one snake in its lifetime may utilise a range of ant species' nests. Thus, similarly sized individuals of sympatric typhloid species could compete. Typhlopids inhabiting and feeding in ant nests appear to be tolerated (Ehmann pers. obs.). Perhaps they provide some benefit or produce a pacifying pheromone.

Mitchell (1961) found earthworms, grubs, weevils, woodlice, ants and termites in stomachs of two South Australian species, and Ehmann (1992) found worms and leeches in a species from New South Wales rainforests.

Aggregations of *R. nigrescens* have been reported. Hoser (1980) found seven and 35 individuals together in January, one female occurred with one to three adult males from September to January inclusive (Shine & Webb 1990), and two females with five males were found together in September (Ehmann pers. obs.). Seven juveniles of *R. wiedii* were noted in August (Hoser 1980) and one female with one to three males in October (Shine & Webb 1990). Springtime aggregations are probably related to mating activity. The well-developed olfactory system of typhlopids, coupled with their likely capacity to produce attractant pheromones, probably assists aggregation.

Behaviour

Typhlopids are most often seen on the surface at night during or after rain or floods or in warm, humid weather. During very wet weather many species take temporary shelter near the surface under rocks, fallen timber, loose soil and leaf litter (Ehmann 1992). Bamford (pers. obs.), however, has recorded *R. australis* and *R. hamatus* active on the surface at night in very dry weather.

Economic Significance

Typhlopids are not known to have economic significance, but forestry, agricultural and grazing practices and predation by feral cats and foxes may affect them significantly. *Ramphotyphlops braminus* is believed to be a recent (1968) arrival in Australia, at Darwin, as a stowaway in pot plants or soil (Storr 1968a). It was discovered in gardens at Katherine by 1978 (Boyd pers. comm.) and it is uncertain whether it could compete with or displace native species. The endemic, rare and similarly sized Christmas Island blind snake, *R. exocoeti* may be affected by *R. braminus*. The status, biology and conservation needs for the

16 species known from about 20 or less specimens should be determined quickly. Amongst this group, *R. affinis*, *R. broomi*, *R. exocoeti*, *R. guentheri*, *R. leptosoma*, *R. pinguis*, *R. tovelli* and *R. unguirostris* are most important because each occurs in areas with the risk of major habitat loss or change.

BIOGEOGRAPHY AND PHYLOGENY

Distribution

There are approximately 40 species in the genus *Ramphotyphlops*, which occurs from India through South-East Asia—Malaysia, the Philippines and Indonesia—and New Guinea to Australia and the western Pacific islands. Thirty species occur within Australia and one on Christmas Island. One species, *R. braminus*, has been spread by human transportation and now occurs in India, Australia, South Africa, Madagascar, much of South-East Asia and western Mexico. There are no typhlopids in Tasmania or in Australian alpine areas.

Distribution maps and ranges for some Australian species are based on very few, often old, collecting records.

Affinities with other Groups

The Typhlopidae is one of three small families of snakes in the infraorder Scolecophidia. All are referred to as blind snakes. The typhlopids are distinguished by the absence of teeth on the lower jaw. This infraorder is the most ancient living snake group and it occurs on all continents and many temperate and tropical islands. Relationships between the Typhlopidae, Leptotyphlopidae and Anomalepididae are unclear, but some aspects of anatomy and morphology show that the typhlopids retain more ancient characteristics than the other two families (McDowell 1987). Because of their small size and fine, brittle bones, these snakes are poorly represented as fossils, and the earliest scolecophidian fossil is known from the early Eocene of Europe. The fossil *Typhlops grivensis* was described from the French mid-Miocene, and *T. cariei* was described from the sub-Recent of Mauritius Island (Rage 1987). Archer, Hand & Godthelp (1991) reported Australian fossil typhloid material from the Riversleigh deposits.

Affinities within the Taxon

The two genera that comprise this family can be distinguished reliably only by dissection of the paired cloacal pouches in the male (Robb 1966b). McDowell (1974) and Storr (1981) placed some of the Australian species in species groups on the basis of morphology. Cytogenetic and molecular data may provide more accurate determination of intrageneric relationships.