

INVITED ARTICLE



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The distribution and identification of dangerously venomous Australian terrestrial snakes

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The identification of dangerous Australian snakes is important in instituting therapy for envenomation. Despite the availability of a number of identification guides with varying degrees of generality, identification can be problematic for several reasons. These include a diversity of common names, many of which are inappropriate or regionally applied to different species, identification keys that focus on variable features, intraspecific variation and interspecific convergence in colouration, and recent changes in scientific nomenclature of species and genera. Geographic distribution of the dangerously venomous species can be a useful aid to identification, by limiting the range of options in a region. However, delineation of the limits of distribution relies on fine scale mapping beyond the resolution of most identification guides. This article provides a summary of the geographic limits of the dangerously venomous Australian snakes, with particular emphasis on major population centres, and clarifies some problems in identification, particularly among brown-coloured snakes.

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Snakes are a prominent component of the Australian terrestrial fauna, with 142 named species currently recognised. Of these, 92 species possess venom glands and fangs, all but one (the Brown Tree Snake, *Boiga irregularis*) of which belong to a single family, Elapidae. However, only a small proportion of these venomous species produce venom of sufficient toxicity to cause significant morbidity, and fewer still have produced fatalities in humans or domestic mammals. Because of the variation in venom toxicity and clinical effects between the venomous snake species, as well as the availability of specific antivenoms, the identification of the species responsible for bites to domestic species is of importance. It is possible to use venom detection kits to identify venom residue at the bite site, although these are rarely used by veterinarians.¹ Such kits are only designed to identify the snakes likely to cause mortality in humans, and not the additional less venomous species reported to cause mortality in companion animals. Further, it may not be possible to identify the bite site in companion animals, due to the hair coat masking the site and the propensity for bites to occur when the animal is not under observation. However, pets playing with snakes will often bring the dead or injured snake home, allowing it to be identified.

The identification of Australian snakes should be a simple matter, with recent identification keys, photographic guides and descriptions available for the entire Australian fauna,²⁻⁷ as well as at the state or regional level (south-eastern Australia,⁸ south-eastern high country,⁹ New South Wales,¹⁰ Victoria,¹¹ Western Australia^{12,13}), and even for major cities (Brisbane,^{14,15} Sydney,¹⁶ Melbourne,¹⁷ Perth¹⁸).

Despite this, Australians still have problems identifying snakes.¹⁹ Part of the problem is related to the plethora of common names inconsistently applied to Australian snakes, many of which are misleading. Further adding to the problem is variation within species, particularly in colouration, which can make use of keys difficult. Finally, the scientific nomenclature of Australian snakes has been subject to extensive change, mostly due to changes in the generic name applied to species, reflecting varying opinions as to the relationships among species,^{20,21} leading to inconsistencies between reference books. Even available keys are of little use by people faced with a large living snake in active conflict with a pet, as they rely on close examination of features of scalation. Hence, the practitioner is often faced with a descriptive statement of colouration, such as brown snake, black snake or tiger snake, which may not reflect the true identity of the snake (Figures 1 to 3).



Figure 1. Six dangerously venomous Australian elapids with banded colour patterns. A. Common Death Adder (*Acanthophis antarcticus*); B. Eastern Tiger Snake (*Notechis scutatus*); C. Western Brown Snake (*Pseudonaja nuchalis*); D. Ringed Brown Snake (*Pseudonaja modesta*); E. juvenile Eastern Brown Snake (*Pseudonaja textilis*); F. Stephens' Banded Snake (*Hoplocephalus stephensi*). Photos courtesy of P Harlow (A,B), J Weigel (E,F).

This article has two purposes: to highlight several specific problems in venomous snake identification, and to provide a summary of recent data on the geographic distribution of the venomous species which are known or thought to be potentially dangerous to humans, livestock and pets. Such data can be useful in identification by reducing the number of possible candidates in an area. Although broad Australia-wide distribution maps are provided in many

general texts, these are often inaccurate, and because of the small size of reproduction, are of little use at the local level. The distributions as described in this paper are derived from museum records,^{10,11, 13, 22-24} and are hence verifiable.

Death Adders (*Acanthophis*)

Three species of Death Adder are currently recognised in Australia: the Common Death Adder (*A antarcticus*)

(Figure 1A), the Desert Death Adder (*A pyrrhus*) and the Northern Death Adder (*A praelongus*). Studies in progress at the Western Australian Museum indicate that additional species await description. Death Adders as a genus are readily differentiated from all other Australian snakes by available identification keys, although differentiation of the species within the genus may be difficult.

Death Adders occur widely in all Australian states except Victoria (the

only Victorian record is from the region of Lake Boga, collected last century¹¹) and they are absent from Tasmania. In New South Wales, almost all records are from the eastern coast and adjacent ranges.¹⁰ In Queensland, most records are from the south-east, as far west as Charleville, and from a narrow band along the eastern coast and ranges, north to Cape York, although there are a few isolated records from the western part of the state.²² Death Adders occur over most of the Northern Territory.²³ They also occur over much of Western Australia, but are absent from the west coastal plain south of the Cape Range, and from the south-western corner.¹³ In the Perth region, they are restricted to the Darling Range.¹⁸ In South Australia, the Common Death Adder is restricted to the Adelaide region, southern Flinders Ranges, Yorke Peninsula, Eyre Peninsula, and the south-western coast, while there are a few records of the Desert Death Adder from the north-western interior.²⁴

Copperheads (*Austrelaps*)

Three species of Copperhead have been recognised by Rawlinson,²⁵ although earlier publications only recognise one. All three species have a characteristic barred pattern on the scales of the upper lip, with the anteroventral corner of each scale pale, contrasting with the darker colour of the rest of the scale (Figure 2A). Copperheads are cold-climate snakes restricted to south-eastern Australia, particularly in swampy areas, although the name has also been locally applied to Whip Snakes and Brown Snakes in arid parts of central and northern Australia.

The Highland Copperhead (*A ramsayi*) occurs at high altitudes from east of Melbourne, north to the Blue Mountains, with isolated populations in the Barrington Tops region and on the New England plateau.^{10,11} The Lowlands Copperhead (*A superbis*) replaces the Highland Copperhead at lower altitudes in southern and eastern Victoria, and the adjacent extreme south-eastern corner of South Australia.^{11,24,25} It is also present throughout Tasmania.²⁶ The Pigmy Copperhead (*A labialis*) is a much smaller species restricted to the southern Mt Lofty Ranges and Kangaroo Island.²⁵ A key to the species is provided by Rawlinson.²⁵

Tiger Snakes (*Notechis*)

Tiger Snakes (Figure 1B) can be most readily differentiated from other snakes by the combination of a broad frontal scale about as wide as long, but shorter than the temporolabial scale (Figure 4, A and B), and unpaired subcaudal scales. Although most identification guides give a range of 17 to 21 midbody scales as a differentiating character, Tasmanian populations are more variable, with 13 to 19 scales recorded.²⁷

Tiger Snakes are very variable in size and colouration,²⁷ and their taxonomy is still not resolved. Rawlinson²⁵ recognises two species, the Eastern Tiger Snake (*N scutatus*) and Black Tiger Snake (*N ater*), although other authors^{27,28} recognise only one species. Variation in venom toxicity and size led Worrell²⁹ to recognise several subspecies on islands, although these have not been recognised by most recent authors.

Despite the name, not all Tiger Snakes are strongly marked with alternating pale and dark bands. Many individuals, particularly in the west and south of the range, lack or nearly lack transverse markings, with body colour varying from yellow to glossy black (Figure 2B), although not all Black Tiger Snakes are black. Red-bellied individuals of otherwise black Tiger Snakes are superficially confusable with Red-bellied Black Snakes (*Pseudechis porphyriacus*), and have been responsible for erroneous records of the latter species from Kangaroo Island and Tasmania.^{27,30}

Tiger Snakes are restricted to the wetter parts of southern and eastern Australia. In Queensland, Tiger Snakes are patchily distributed in the south-east, with records from Carnarvon Gorge National Park, the Bunya Mountains, Beerwah and Caloundra.^{15,22} They are more continuously distributed in the eastern half of New South Wales, occurring at higher altitudes north of the Hunter Valley, and along the coast and ranges to the south,¹⁰ although they are uncommon around Sydney. Populations also extend west along the Lachlan, Murrumbidgee and Murray River systems.¹⁰ In Victoria, the species is only absent from the dry north-west of the state.¹¹ Tiger Snakes are present over much of Tasmania and on many Bass Strait islands.²⁷ In South Australia, they are patchily distributed, occurring in the southern Flinders Ranges,

southern Mt Lofty Ranges, southern Yorke and Eyre Peninsulas, on Kangaroo Island, along the Murray River, and in the extreme south-eastern corner of the state, as well as on several small islands around Eyre Peninsula.²⁴ Western Australian populations are restricted to the south-west, from Jurien south-west to Point Malcolm, with island populations on Carnac and Garden Islands.¹³

Local names potentially confusable with Tiger Snake include 'Downs Tiger', sometimes applied to the Speckled Brown Snake (*Pseudonaja guttata*), 'Night Tiger', commonly applied to northern Australian populations of the Brown Tree Snake (*Boiga irregularis*), and 'Swamp Tiger', applied to Brisbane populations of the Freshwater Snake (*Tropidonophis mairii*).^{4,6,15} North Queensland populations of the Western Brown Snake (*Pseudonaja nuchalis*), with strongly banded colouration (Figure 1C), are also referred to as Tiger Snakes.³¹

Taipans (*Oxyuranus*)

The Coastal Taipan (*O scutellatus*) is distributed coastally from the northern New South Wales border region, northwards along the east and north coasts of Queensland, with rare records from the Top End of the Northern Territory and Kimberley, west to Koolan Island.^{13,22,23} There are unconfirmed reports from extreme north-eastern New South Wales (Woodenbong).¹⁰ A second species, the Inland Taipan (*O microlepidotus*), also known as the Fierce Snake or Small-Scaled Snake, was until recently³² placed in a distinct genus, *Parademansia*. The Inland Taipan is presently known from western Queensland, south of Boulia and west of the Grey Range, and north-eastern South Australia, as far south as Goyders Lagoon.³³ The species was reported last century from northern New South Wales and north-western Victoria (Fort Bourke, and junction of Murray and Darling Rivers),^{10,11} although there is only one unconfirmed sighting from far north-western New South Wales this century.

The two Taipan species are superficially similar to Brown Snakes (*Pseudonaja*) occurring at the same area (Figure 3, A and B), but may be differentiated by possessing a distinct temporolabial scale (fused to the last supralabial in Brown Snakes, Figure 4, C and D), in having generally more

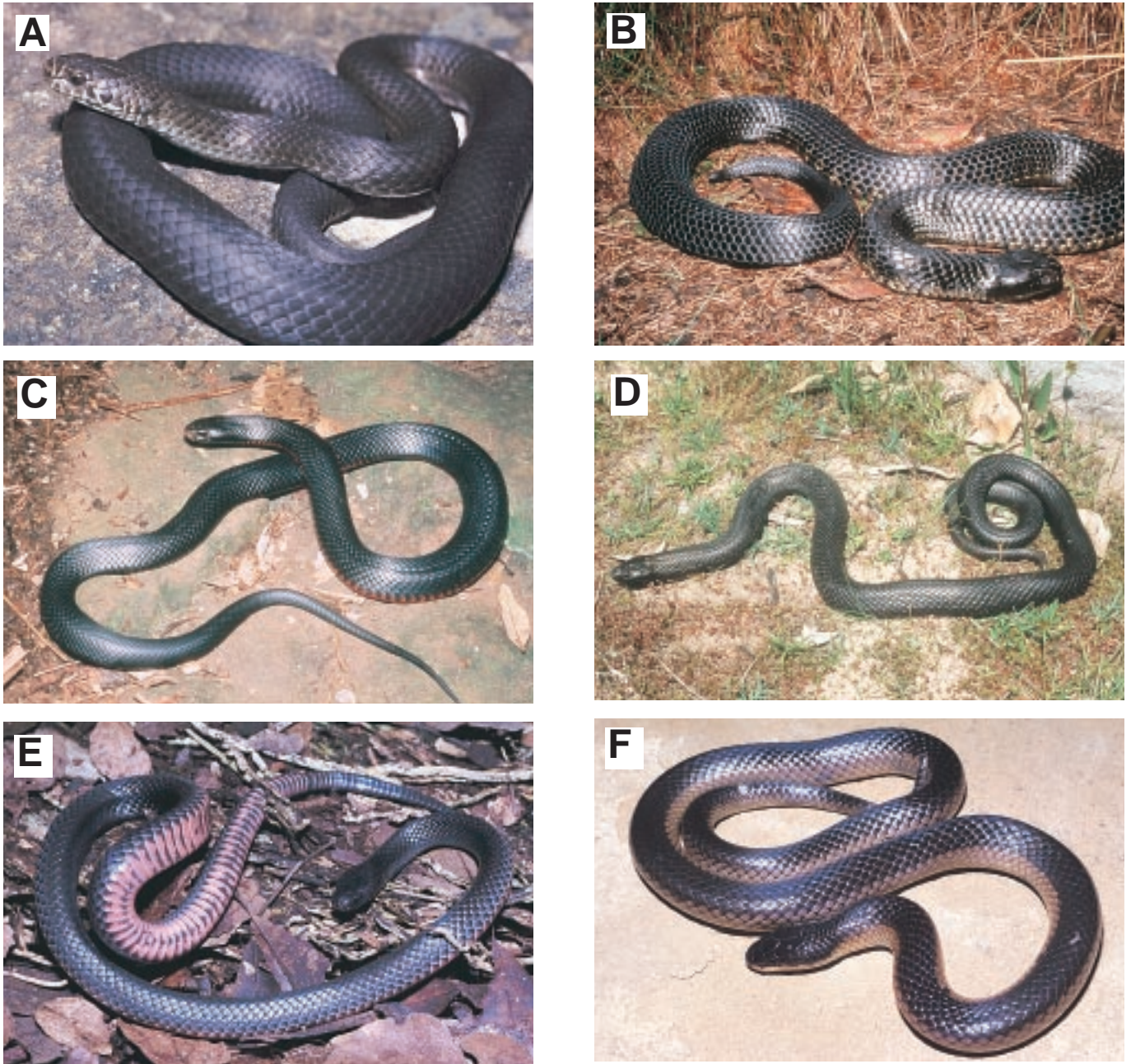


Figure 2. Six Australian elapids with predominantly black colouration. A. Pygmy Copperhead (*Austrelaps labialis*); B. Black Tiger Snake (*Notechis ater*); C. Red-bellied Black Snake (*Pseudechis porphyriacus*); D. Blue-bellied Black Snake (*Pseudechis guttatus*); E. Small-eyed Snake (*Rhinoplocephalus nigrescens*); F. Black-backed Snake (*Suta nigriceps*). Photos courtesy of J Weigel (B), S Wilson (C,D).

midbody scales (21 to 23 vs 17 to 19, rarely 21), and a single anal scale (vs usually paired). The high midbody scale count will also distinguish them from King Brown Snakes (*Pseudechis australis*) in the same areas, which have 17 midbody scales.

Despite persistent folklore, there is no evidence for hybridisation of Taipans with other snake species.

Black Snakes (*Pseudechis*)

Six species of Black Snake are recorded from Australia, although one of these, the Papuan Black Snake (*P papuanus*) has only recently been reported from an Australian territory, Saibai Island in northern Torres Strait.³⁴ The common name for the group is unfortunate, as only one species, the Red-bellied Black Snake (*P porphyriacus*, Figure 2C), is

consistently uniformly black above. The Blue-bellied or Spotted Black Snake (*P guttatus*, Figure 2D) is black to dark grey dorsally in the south of its range, but commonly has variably expressed pale spots in the centre of each scale in the north, which can result in a generally pale (cream to dull grey or red-brown) dorsum. Similarly patterned is Butler's Black Snake (*P butleri*). Collett's Snake



Figure 3. Six Australian elapids with predominantly brown colouration. A. Eastern Brown Snake (*Pseudonaja textilis*); B. Taipan (*Oxyuranus scutellatus*); C. King Brown or Mulga Snake (*Pseudechis australis*); D. Little Whip Snake (*Suta flagellum*); E. Swamp Snake (*Hemiaspis signata*); F. Bardick (*Echiopsis curta*). Photos courtesy of P Harlow (A), S Wilson (B), J Weigel (C,E).

(*P colletti*) is more reddish, blotched or irregularly banded with tan, red and grey. The King Brown or Mulga Snake (*P australis*, Figure 3C) provides an even more confusing common name. Although it is brown in colour (but varying from tan to almost black, the latter in the south of the range), it is unrelated to the Brown Snakes, and has a venom most similar to that of other

Black Snakes and which is neutralised by Black Snake antivenom, not Brown Snake antivenom. While it has been recommended that the common name Mulga Snake be preferentially used to avoid this problem,^{4,35} this name is also inappropriate, as the species occurs in a wide range of habitats, not just mulga woodlands. Further complicating the issue is the generally very similar scala-

tion and colouration of the King Brown Snake and the Brown Snake species that co-exist with it over its entire range (see Brown Snakes, below). Because of the difficulties in differentiating King Brown Snakes from Brown Snakes, colloquial usage is to refer to any large Brown Snake as a 'King Brown', even in regions outside the range of the King Brown.

Although the King Brown Snake is widespread in arid and tropical Australia, it is absent from densely populated areas of southern Australia,²³ and hence local reports of 'King Browns' from the vicinity of Brisbane, Sydney, Melbourne and Adelaide will be based on misidentifications. The south-eastern limit of King Brown Snake distribution is a line from just south of Gladstone, Queensland, through Gayndah, Dalby, the Warrumbungles, south-west to Condobolin and the Balranald region, then west to Port Pirie in South Australia.^{10,11,22,24} The south-western limit of its distribution is a line through the Perth region, Narrogin, Kalgoorlie and across the northern Nullarbor Plain to the Ceduna district.^{13, 24} Because the cheaper Tiger Snake antivenom can be used to treat bites from the Red-bellied Black Snake and Blue-bellied Black Snake,³⁵ it is not necessary to keep supplies of Black Snake antivenom outside the range of the King Brown Snake.

Most keys to the identification of Australian snakes differentiate the Black Snakes, including the King Brown Snake, by two characters, the presence of subcaudal scales unpaired at the base of the tail and paired distally, and a divided anal scale. However, the number of unpaired scales is individually variable, and occasional snakes may have all or almost all subcaudals single³⁶ (because the tip of the tail is often missing in snakes, pairing of only the distal few subcaudals may be missed). Similarly, the anal scale may be single. Individuals with these variants can be misidentified if diagnostic keys are relied upon as the sole method of identification. Black Snakes that have all subcaudals single will key to *Hemiaspis* in keys provided by Cogger,³ and if the anal is also single will key to *Drysdalia*. From the former genus, the Black Snakes can be differentiated by colouration, particularly the pattern on the head, and by having more than 170 ventral scales, and from the latter genus by having 17 to 19 midbody scales (vs 15). For further difficulties with keys, see Brown Snakes below.

Keys to the species of Black Snakes provide accurate identifications once the correct genus is reached. However, distribution may aid identification. The Red-bellied Black Snake occurs along the eastern coast and ranges from the

Cooktown area south.^{10,22} From south-eastern Queensland south into Victoria, it also occurs on the western and northern slopes of the Great Dividing Range, following the rivers into the interior.^{10,22} In Victoria, the species is apparently absent from the area between Wilsons Promontory and just east of Melbourne, from the dry north-west, and along the coast west of Geelong.¹¹ In South Australia, the species is restricted to the region between Adelaide and the lower Murray River.²⁴

The Blue-bellied Black Snake is distributed from Bundaberg through south-eastern Queensland and extreme north-eastern New South Wales, then south along the western slopes of the Great Dividing Range, to the western Hunter Valley, and south-west to the vicinity of Grenfell and Lake Cargelligo.^{10,22} Collett's Snake is restricted to central Queensland, from Cloncurry and Hughenden south-east to Charleville,²² while Butler's Black Snake is restricted to a small area of inland Western Australia, from the Yalgoo district to Laverton and Leonora.¹³

The name 'Yellow-bellied Black Snake' has been colloquially applied to dark-coloured individuals of three snakes unrelated to the Black Snakes: Copperheads in south-eastern Australia, the Tiger Snake in south-western Australia³⁷ and the harmless Green Tree Snake (*Dendrelaphis punctulatus*) around Brisbane.¹⁵

Brown Snakes (*Pseudonaja*)

Seven species of Brown Snake are currently recognised,³ although genetic studies have demonstrated that the Western Brown Snake (*P nuchalis*) is a composite of several different species,³⁸ the venoms of which await study. The species of Brown Snake are often difficult to distinguish by keys, due to individual variation in colouration (both hue and pattern), which also changes with age. Juveniles of most species have dark heads and superficially resemble the less venomous Black-headed Snakes (*Suta*, Figure 3D), while juveniles (and occasional adults) of some species, particularly the Ringed Snake (*P modesta*, Figure 1D), some forms of the Western Brown Snake (Figure 1C) and eastern populations of the Eastern Brown Snake (*P textilis*, Figure 1E), have narrow dark bands over the body, and

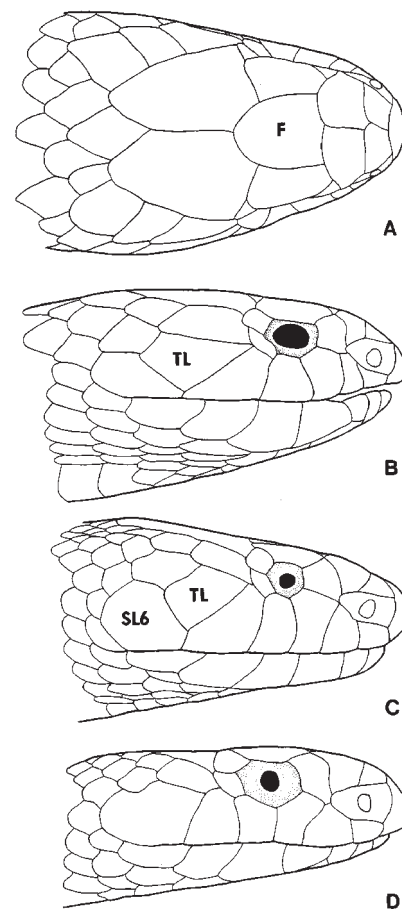


Figure 4. A. dorsal, and B. right lateral view of head shields of Tiger Snake (*Notechis scutatus*); C. right lateral view of head shields of King Brown Snake (*Pseudechis australis*); D. right lateral view of head shields of Eastern Brown Snake (*Pseudonaja textilis*). Note shape of frontal and relative size of frontal (F) and temporolabial (TL) in Tiger Snake, and fusion of temporolabial with sixth supra-labial (SL6) in Eastern Brown Snake.

can be mistaken for Tiger Snakes by inexperienced persons. All species of Brown Snake are considered potentially dangerously venomous^{3,4,35} and, as the venom of all is neutralised by Brown Snake antivenom,³⁵ it is of little clinical importance to accurately identify the species, although there are some differences between the toxins of the various species.³⁵ Brown Snakes occur over most of Australia (but not Tasmania),^{10,11,13, 22,23,39} and are among the most common venomous snakes in all mainland capital cities, although they seem to be absent from two small areas of Victoria,

between Westernport Bay and Wilson's Promontory, and along the Otway Ranges south-west of Melbourne.¹¹

Most Brown Snakes readily key to the correct genus in available identification keys, which generally rely on the presence of more than 35 divided subcaudals, a divided anal scale and 17 or more midbody scales as major discriminating features of the genus. However, occasional Eastern Brown Snakes have a few basal subcaudal scales single, and may incorrectly key to *Pseudechis*, and hence to the King Brown Snake.^{11,40} The two species may be differentiated by the fusion of the temporolabial scale to the last (sixth) supralabial scale in the Eastern Brown Snake (Figure 4D), while the two scales are distinct in the King Brown Snake.⁴¹

Rough-scaled Snake (*Tropidechis carinatus*)

The single species of Rough-scaled Snake is restricted to the eastern coast and ranges of Australia, particularly in closed or wet forests, from the Port Douglas region of northern Queensland south to Barrington Tops in New South Wales, although there is a break in the distribution in mid-Queensland, with no records between Paluma and Fraser Island.^{10,22,42} The species is also known as the Clarence River Snake, after the locality of the first individual described.⁴³

Although there are relatively few human deaths or animal bites attributed to this species,^{1,35,44} it has a very nervous temperament and bites readily when disturbed.⁴⁴ Its distribution extensively overlaps with the superficially similar but harmless Freshwater Snake (*Tropidonophis mairii*) and, because of the banded pattern, it may also be confused with the Tiger Snake. It may be differentiated from both by the high number of midbody scales (23 vs 15 to 17 and 13 to 21, respectively) and additionally from the former by the single (vs divided) anal and subcaudal scales, and absence of a loreal scale, and from the latter by the strongly keeled (vs smooth) body scales. Tiger Snake antivenom is recommended for treating bites by the Rough-scaled Snake.³⁵

Other species

In addition to the species listed above, which are those most commonly listed

as the dangerously venomous species, several other species of Australian snake have caused mortalities in companion animals, or are likely to, based on the clinical signs following bites in humans.

Grey Snake (*Hemiaspis daemeli*)

A fatality in an adult dog resulting from a bite by this poorly known species has been reported,³⁵ although the species has usually been regarded as of little medical significance.¹⁵ The Grey Snake occurs on the western slopes and adjacent plains of southern Queensland and New South Wales, from Rockhampton to the lower Lachlan River, and including the western suburbs of Brisbane.^{10,15,22} Polyvalent antivenom is recommended for bites by this species,³⁵ in the absence of studies on the venom.

Broad-headed Snakes (*Hoplocephalus*)

There are three species in the genus, the Broad-headed Snake (*H bungaroides*), Stephens' Banded Snake (*H stephensi*, Figure 1F) and the Pale-headed Snake (*H bitorquatus*), all of which differ from other venomous snakes in having a notch laterally along the caudal border of each ventral scale. The Broad-headed Snake is restricted to sandstone areas in the Sydney region, from Nowra north to the Blue Mountains, Bathurst and Mudgee, although it is becoming increasingly rare due to habitat destruction.¹⁰ Bites to humans by this species have required hospitalisation.⁴⁵

There are few data on the effects of bites from the other two species, although Stephens' Banded Snake attains similar sizes to the Broad-headed Snake, and fatalities in experimental rabbits occurred following venom injections of quantities less than the yields from some venom milkings.⁴⁶ It is probable that bites from all three could kill small companion animals.

Tiger Snake antivenom has been recommended for bites from these species.³⁵

Stephens' Banded Snakes occur from south-eastern Queensland (Kroombit Tops) south along the coast and adjacent high-rainfall parts of the ranges, to the Gosford area.^{10,15,22,42} Pale-headed Snakes are more widespread, from the Atherton Tableland south through the eastern half of Queensland, to Tuggerah and Dubbo in New South Wales.^{10,15,22}

Small-eyed Snake (*Rhinoplocephalus nigrescens*)

This eastern Australian species, which was previously placed in the genus *Cryptophis*, has been responsible for one human fatality, and caused myolysis in experimentally envenomated dogs.^{47,48} The species is uniformly dark grey to black dorsally, and hence is superficially similar to some Black Snakes. Further enhancing the similarity to the Red-bellied Black Snake is the pink flush to the belly of some individuals (Figure 2E).⁴¹ They may be differentiated by the lower number of midbody scales (15 vs 17) and single anal (vs usually divided) of the Small-eyed Snake. The species is continuously distributed along the coast and ranges from just south of Cooktown to just west of Melbourne, although there are no records from the coastal strip between Westernport and Wilson's Promontory.^{10,11,22} Hence, there is broad overlap in the distributions of the two species. Tiger Snake antivenom has been recommended for bites by this species.^{35,48}

Curl Snake (*Suta suta*)

The Curl Snake, sometimes placed in the genus *Denisonia*, is a widespread species of arid eastern and central Australia, occurring in the Northern Territory, Queensland, New South Wales, Victoria and South Australia, approaching the eastern coast at Rockhampton and Townsville, and the southern coast around Adelaide, Port Augusta and Ceduna. It is present in Western Australia only in the extreme eastern Kimberley.^{10,11,13,22,23,49} The facial pattern of this species is not readily confused with any other snake within its range, and has been illustrated by a number of authors.^{6-8,10,11}

A small Curl Snake was responsible for the death of a cat at Alice Springs, and venom yields from large individuals greatly exceeded the LD₅₀ value in mice of 1 mg/kg.^{35,50} In the absence of studies, polyvalent antivenom has been recommended for treatment of bites from this species.³⁵

Relative frequency of snake bites

A recent survey of the relative frequency of snake bites to domestic animals found that the vast majority of bites (76%) were attributed to Brown Snakes, with Tiger Snakes, Black Snakes

and Taipans also implicated, in decreasing order.¹ No indication was given as to how King Brown Snakes were treated in the survey form. Just over 6% of bites were from unidentified snakes. However, it is likely that a number of the identified species were misidentified. For example, 11 bites were attributed to Tiger Snakes in Queensland, despite the extreme rarity of the species in that state. Such misidentifications and lack of identifications may have been responsible for a number of mortalities despite treatment with antivenom.¹ Conversely, misidentifications of the several species of small, mildly venomous brown-coloured snakes (Figures 3, E and F) as 'Brown Snakes' may be responsible for the relatively high percentage of companion animals, particularly cats (75%), that survived without the administration of antivenom.

Acknowledgments

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