

Revisiting the Australian “White-lipped Snakes” of the genus *Drysdalia* Worrell, 1961, (*sensu lato*) including two new subgenera and two new subspecies (Serpentes: Elapidae).

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ABSTRACT

The crowned snakes of the genus *Drysdalia* Worrell, 1961 have been the subject of numerous taxonomic and phylogenetic studies, notably including those of Coventry and Rawlinson (1980) and Keogh *et al.* (2000). These studies have resulted in both species and generic rearrangements.

Coventry and Rawlinson (1980) synonymised described taxa to reduce the genus to four well-defined species. Keogh *et al.* (2000) transferred the species *coronata* Schlegel, 1837 to the genus *Elapognathus* Boulenger, 1896.

Revisiting the taxonomy of the four species placed by most authors prior to 2000 in the genus *Drysdalia*, the data shows that the following taxonomic actions are warranted. The species *coronata* should in fact be placed within a subgenus of *Elapognathus*, due to a well-defined divergence from the nominate species in the genus. Likewise for the species *rhodogaster* Jan, 1873, which is appropriately placed in a subgenus within *Drysdalia*. Furthermore, the species *mastersii* Krefft, 1866 has long been recognized as having three morphologically distinct regional forms (Ehmann 1992). Molecular analysis (Dubey *et al.* 2010) confirms that these snakes warrant taxonomic recognition at the subspecies level.

As a result, this paper formally describes and names two new subgenera and two new subspecies in accordance with the Zoological Code (Ride *et al.* 1999).

Keywords: Taxonomy; Nomenclature; genus; *Drysdalia*; *Elapognathus*; subgenus; new; *Staszewskius*; *Hawkeswoodelapidus*; *rhodogaster*; *coronata*; subspecies; *mastersii*; *robwatsoni*; *andrewlowryi*.

INTRODUCTION

The genus *Drysdalia* was first proposed by Eric Worrell in 1961 for a group of small elapid snakes with a centre of distribution in Southern Australia, being split off from the large paraphyletic genus *Denisonia* Krefft, 1869. The type species for *Drysdalia* was *Hoplocephalus coronoides* Günther, 1858, and added to the genus were the species *Hoplocephalus mastersii* Krefft, 1866 and *Elaps coronatus* Schlegel, 1837.

However this was expanded by Coventry and Rawlinson (1980) to include the species *Alecto rhodogaster* Jan, 1873.

Coventry and Rawlinson (1980) diagnosed the genus as follows: “Small, rather slender snakes ranging from a minimum total length of 100 mm (snout-vent length 80 mm) to a maximum total length of 650 mm (snout-vent length 550 mm). Nostril in single nasal. Frontal longer than broad, less than one and a half times width of supraocular. Internasals present. Suboculars absent. Dorsal scales smooth, 15 scale rows at midbody, very rarely 17. Lower lateral scales not noticeably enlarged. Ventral scales smooth and unkeeled, range from 123 to 157. Subcaudal scales smooth and undivided and range from 32 to 67. Anal scale undivided. Posterior process of maxillary bone short, 3 to 5 solid maxillary teeth follow the hollow fang.”

Based on a suite of molecular and morphological data, the species *Elaps coronatus* Schlegel, 1837 was removed from *Drysdalia* by Keogh *et al.* (2000) and placed in the genus *Elapognathus* Boulenger, 1896.

Elapognathus Boulenger, 1896 is herein defined as including the species *Elaps coronatus* Schlegel, 1837 and *Hoplocephalus minor* Günther, 1863, and is separated from the genus *Drysdalia* by having either a black band across the nape or if lacking any form of banding across the nape and lacking a distinct white strip across the upper labials, has an upper surface that is uniformly dark except for a pale oblique bar on each side of the neck and without any form of striations in the dorsal colouring.

Besides the detailed taxonomic study of Coventry and Rawlinson (1980) the genera *Drysdalia* and *Elapognathus* have had their taxonomy reviewed by a number of authors, many of whom have merged the genera, including for example Wells and Wellington (1985) and Ehmann (1992).

Various species and subspecies described in the past have been synonymised with the four species named so far.

By way of example, few if any authors have recognized *Elapognathus resolutus* Wells and Wellington, 1985, from the

Recherche Archipelago of Western Australia even though there is limited morphological evidence to recognize the taxon at the subspecies level. Notwithstanding this, Aplin (2002) in Storr, Smith and Johnstone (2002) chose to subsume the taxon within "*Elapognathus coronatus*".

A molecular study would resolve the taxonomic status of the Recherche Archipelago populations one way or other, noting that Wells and Wellington based their description on long-recognized phenotypic differences between this population and others of *Elapognathus coronatus*.

The status of "*Elapognathus orri* Wells and Wellington, 1985" is also worth noting. While not recognized by any authors since the original publication, Dubey *et al.* (2010), provided evidence to show that there were three groups of *Drysdalia coronoides* with deeply divergent genomes and potentially worthy of subspecific recognition.

However they were unable to identify regionally distinct populations from their analysis, with three distinct clades in their results having overlapping distributions and potentially being both sympatric and undistinguishable morphologically.

Hence it is unfortunate that I am not in a position to determine one way or other the validity of the species taxon "*Elapognathus orri* Wells and Wellington, 1985".

The best comment I can make in this regard is that there is a need for a detailed assessment of the status of all *Drysdalia coronoides* to establish species and subspecies boundaries.

However the results of Dubey *et al.* (2010) did show a molecular basis to define known regional races of the species *D. mastersii*.

Because both morphological and molecular data for the three regional forms correspond, it is appropriate that these snakes are recognized taxonomically.

The nominate form from the east side of the Spencer's Gulf is designated as the nominate subspecies of *D. mastersii*, while the two western forms (defined by most authors as the central and western variants) are herein described as new subspecies.

At the genus level, the species *Elaps coronatus* Schlegel, 1837 is in my view quite morphologically distinct from the type species within the genus *Elapognathus*, namely *E. minor* (Günther, 1863).

In fact I view it as being sufficiently divergent to warrant being placed in its own monotypic genus.

However available molecular evidence doesn't support the proposition in full, being somewhat ambiguous. Hence I have taken a conservative position and the species is herein placed in a newly defined subgenus within *Elapognathus*.

The species taxon, *Drysdalia rhodogaster* (Jan, 1873), is also significantly divergent from the other two species within *Drysdalia* and in my view sufficiently so morphologically to warrant division from them.

Molecular evidence published supports this proposition. As a result, a subgenus is herein defined for this taxon.

Important published references in terms of the known species within the genera *Elapognathus* and *Drysdalia* as recognized herein include: Boulenger (1896), Cogger (1979, 2000), Coventry and Robertson (1980), De Vis (1905), Dubey *et al.* (2010), Duméril and Bibron (1835), Ehmann (1992), Fleay (1952), Fry (1915), Glauert (1960), Golay *et al.* (1993), Gray (1841), Gray and Neill (1845), Greer (1997), Günther (1858, 1863), Hoser (1989), Hutchinson (1990), Jan (1863), Jan and Sordelli (1873), Keogh *et al.* (2000), Kinghorn (1924, 1926), Krefft (1866, 1869), Macleay (1887), Maryan (1987), McDowell and Cogger (1967), McGovern (1983a, 1983b), Mengden (1983), Schlegel (1837), Shine (1981, 1986, 1994), Storr (1982), Storr, Smith and Johnstone (2002), Wells and Wellington (1985), Wilson and Knowles (1988), Wilson and Swan (2010) and Worrell (1956, 1961, 1963).

GENUS *DRYSDALIA* WORRELL, 1963.

Type species: *Hoplocephalus coronoides* Günther, 1858.

Diagnosis: Small, rather slender snakes ranging from a minimum total length of 100 mm (snout-vent length 80 mm) to a maximum total length of 650 mm (snout-vent length 550 mm). They are separated from all other elapid genera by the following suite of characters: Nostril in single nasal. Frontal longer than broad, less than one and a half times width of supraocular. Internasals present. Suboculars absent. Dorsal scales smooth, 15 scale rows at mid-body, very rarely 17. Lower lateral scales not noticeably enlarged. Ventral scales smooth and unkeeled, range from 123 to 157. Subcaudal scales smooth and undivided and range from 32 to 67. Anal scale undivided. Posterior process of maxillary bone short, 3 to 5 solid maxillary teeth follow the hollow fang.

Elapognathus Boulenger, 1896 is herein defined as including the species *Elaps coronatus* Schlegel, 1837 and *Hoplocephalus minor* Günther, 1863, and is separated from the genus *Drysdalia* by having either a black band across the nape (*coronata*) or if lacking any form of banding across the nape and lacking a distinct white stripe across the upper labials, has an upper surface that is uniformly dark except for a pale oblique bar on each side of the neck and without any form of striations in the dorsal colouring (*minor*).

Distribution: South-east Australia, from the New England Tableland of NSW, through south-east Australia, including southern NSW, the ACT, Victoria, Tasmania, southern South Australia across the Nullabor region into far south-east South Australia in the region of Eucla.

Content: *Drysdalia coronoides* (Günther, 1858) (type species); *D. mastersii* (Krefft, 1866); *D. rhodogaster* (Jan, 1873).

Key to species of *Drysdalia* (taken from Coventry and Rawlinson (1980)).

1. A. Distinct white stripe edged above by black running along upper labials from below the nostril, under the eye often to the neck ... 2.
- B. Lacking distinct white stripe running along upper labials ... *D. rhodogaster*.
2. A. Distinct pale or dark band (sometimes broken medially) across the nape ... 3.
- B. Lacking band across the nape ... *D. coronoides*.
3. A. Band across the nape black ... *Elapognathus coronata*.
- B. Band across the nape pale yellow-orange ... *D. mastersii*.

SUBGENUS *STASZEWSKIUS* SUBGEN. NOV.

Type species: *Alecto rhodogaster* Jan, 1873.

Diagnosis: The subgenus is monotypic for the species *Drysdalia (Staszewskius) rhodogaster*. It is the only species in the genus *Drysdalia* that lacks a distinct white stripe running along upper labials and this separates this subgenus from the others in the genus.

Scalation is with 15 dorsal mid-body rows, 141-155 ventrals, 41-54 undivided subcaudals and an undivided anal plate.

Colour: Juveniles at birth: Dorsal surface very dark brown, ventral surface orange-red. Head darker than body, snout dark brown, top of head black. Upper lip dark brown with a black stripe from nostril to eye and a broken black stripe from below eye to neck. Distinct light orange band across nape. Adults: Dorsal surface brown to olive-green, ventral surface yellow to orange. Snout same colour as body speckled with black; top of head black. Black stripe from nostril to eye and a broken black stripe from below eye to neck. A distinct light orange to light brown band 2 to 3 scales wide runs across the nape, sometimes reduced to an ill defined lighter coloured patch (Coventry and Rawlinson, 1980).

Distribution: Blue Mountains in New South Wales, more-or less continuously along the eastern edge of the Great Dividing Range south to about Pambula in far southern NSW, on the coast, just north of the Victorian border.

Etymology: *Staszewskius* is named in honour of snake keeper Alex Staszewski from Blacktown, NSW, Australia in recognition of his sterling efforts to breed venomous Australian snakes including Death Adders (*Acanthophis antarcticus*), Coastal Taipans (*Oxyuranus scutellatus*) and Inland Taipans (*Parademansia microlepidota*), noting his immense success in breeding these three and other taxa.

DRYSDALIA MASTERSII KREFFT, 1866.

Type locality: Flinders Ranges, South Australia. Lectotype BM (NH) 1946.1.17.42 in the British Museum of Natural History, from Flinders Ranges, South Australia.

Diagnosis: Scalation is with 15 dorsal mid-body rows, 130-146 ventrals, 32-51 undivided subcaudals and a single anal plate. Colour: Juveniles at birth: Dorsal surface darker than in adults and may be one or other of dark grey, olive grey, olive green, pale grey, greyish brown or yellowish pale brown depending on locality (and subspecies), ventral surface bright orange-red. Head darker than body, with a white stripe running along the upper lip from the nostril under the eye to the neck. Light yellow band across nape.

Adults: Dorsally the adults may be dark grey, olive grey, olive green, pale grey, greyish brown or yellowish pale brown depending on locality (and subspecies), ventral surface orange centrally, grey speckled with black laterally. Head darker than body, sometimes black, a white stripe edged above with black running along the upper lip from the nostril, under the eye to the neck. A light yellow to off white band two to three scales wide runs across the nape. Nape band normally narrowly broken on mid line but often complete (Coventry and Rawlinson, 1980).

Distribution: Drier parts of far western Victoria and nearby parts of South Australia with a somewhat disjunct distribution running from far south-east South Australia across the Nullabor and into far south-east Western Australia.

SUBSPECIES DRYSDALIA MASTERSII MASTERSII KREFFT, 1866.

Diagnosis: In most respects as for the species.

The subspecies *Drysdalia mastersii mastersii* is most easily separated from the other subspecies by dorsal colouration. The back, sides and tail are an overall pale grey in *Drysdalia mastersii mastersii*. The subspecies (in common with the subspecies *Drysdalia mastersii robwatsoni subsp. nov.*) also has a reddish or brownish spot or dash seen on the distal apex or half of the scale producing a striated appearance.

It is separated from *Drysdalia mastersii robwatsoni subsp. nov.* (of the Eyre Peninsula and nearby areas) by dorsal colouration, with *Drysdalia mastersii robwatsoni subsp. nov.* being brownish in colouration dorsally as opposed to greyish.

The subspecies *Drysdalia mastersii andrewlowryi subsp. nov.* (from south-east Western Australia and adjacent parts of far west South Australia) is separated from the nominate subspecies and *Drysdalia mastersii robwatsoni subsp. nov.* by colouration, being a very dark grey and lacking the striated appearance of the nominate subspecies due to the lack of a reddish or brown spot or dash on the distal apex or half of the scale.

Distribution: South-west Victoria and nearby parts of South Australia, east of the Spencer Gulf and including areas near the Flinders Ranges.

DRYSDALIA MASTERSII ROBWatSONI SUBSP. NOV.

Holotype: A specimen number D16496 in the National Museum of Victoria, from Port Lincoln, South Australia, Lat. 34.7199° S, Long. 135.8545° E. The National Museum of Victoria is a government owned facility that allows access to specimens by researchers.

Paratypes: Specimen numbers D16497, D14698, D14699, D14650 in the National Museum of Victoria, from Port Lincoln, South Australia, Lat. 34.7199° S, Long. 135.8545° E. The National Museum of Victoria is a government owned facility that allows access to specimens by researchers.

Diagnosis: In most respects as for the species.

The subspecies *Drysdalia mastersii mastersii* is most easily separated from the other subspecies including *Drysdalia mastersii robwatsoni subsp. nov.* by dorsal colouration. The back, sides and tail are an overall pale grey in *Drysdalia mastersii mastersii*. That subspecies (in common with the subspecies *Drysdalia mastersii robwatsoni subsp. nov.*) also has a reddish or brownish spot or dash seen on the distal apex or half of the scale producing a striated appearance.

Drysdalia mastersii mastersii is separated from *Drysdalia mastersii robwatsoni subsp. nov.* (of the Eyre Peninsula and nearby areas) by dorsal colouration, with *Drysdalia mastersii robwatsoni subsp. nov.* being brownish in colouration dorsally as opposed to greyish.

The third subspecies *Drysdalia mastersii andrewlowryi subsp. nov.* (from south-east Western Australia and adjacent parts of far west South Australia) is separated from the nominate subspecies and *Drysdalia mastersii robwatsoni subsp. nov.* by colouration, being a very dark grey and lacking the striated appearance of the nominate subspecies due to the lack of a reddish or brown spot or dash on the distal apex or half of the scale.

Distribution: Eyre Peninsula in South Australia and immediately adjacent areas.

Etymology: Named in honour of Robert Watson of Stafford Heights, Brisbane, Queensland, Australia, who runs a reptile rescue and relocation service in Brisbane, in recognition of many years work towards conservation of reptiles and educating the public about wildlife and conservation.

DRYSDALIA MASTERSII ANDREWLOWRYI SUBSP. NOV.

Holotype: Specimen number R24644 at the Western Australian Museum, Western Australia, from Eucla, Western Australia, Lat. 31.6750° S, Long. 128.8830° E.

The Western Australian Museum is a government owned facility that allows access to specimens by researchers.

Paratype: Specimen number R18482 at the Western Australian Museum, Western Australia, from Eucla, Western Australia, Lat. 31.6750° S, Long. 128.8830° E.

The Western Australian Museum is a government owned facility that allows access to specimens by researchers.

Diagnosis: In most respects as for the species.

The third subspecies *Drysdalia mastersii andrewlowryi subsp. nov.* (from south-east Western Australia and adjacent parts of far west South Australia) is separated from the nominate subspecies and *Drysdalia mastersii robwatsoni subsp. nov.* by colouration, being a very dark grey and lacking the striated appearance seen in the nominate subspecies and *Drysdalia mastersii robwatsoni subsp. nov.* due to the lack of a reddish or brown spot or dash on the distal apex or half of the scale.

The subspecies *Drysdalia mastersii mastersii* is most easily separated from the other subspecies including *Drysdalia mastersii robwatsoni subsp. nov.* by dorsal colouration. The back, sides and tail are an overall pale grey in *Drysdalia mastersii mastersii*. That subspecies (in common with the subspecies *Drysdalia mastersii robwatsoni subsp. nov.*) also has a reddish or brownish spot or dash seen on the distal apex or half of the scale producing a striated appearance.

Drysdalia mastersii mastersii is separated from *Drysdalia mastersii robwatsoni subsp. nov.* (of the Eyre Peninsula and nearby areas) by dorsal colouration, with *Drysdalia mastersii robwatsoni subsp. nov.* being brownish in colouration dorsally as opposed to greyish.

Distribution: Far south-east of Western Australia in heathlands close to the coast and nearby parts of far south-west South Australia.

Etymology: Named in honour of Andrew Lowry of Cheltenham, Victoria, Australia, formerly of Mentone, Victoria, Australia for his many contributions to herpetology in Australia of three decades.

GENUS ELAPOGNATHUS BOULENGER, 1896.**Type species:** *Hoplocephalus minor* Günther, 1863.**Diagnosis:** This diagnosis is in effect adapted from Keogh *et al.* (2000).

Small terrestrial hydrophiine elapid snakes with anal and all subcaudals undivided; dorsal scales

smooth and matt; head slightly distinct from neck; eye medium to large; pupil round; 0 to 4 noncanaliculate maxillary teeth behind diastema (usually none in *minor*, but one or more specimens known with 3 posterior alveoli); temporal scales usually 2+2+3 (up to 3+3+4 in *coronatus*); preocular contacts undivided nasal and second supralabial; usually 6 supralabials (in *coronatus*, sometimes 7 when temporolabial reaches lip); parietal separated from lower postocular; 7 infralabials. Venom-gland musculature 'Oxyuranus type' (*coronatus*) or *Glyphodon* type (m. adductor externus superacialis secondarily simplified and reduced in *minor*). Body form moderate to somewhat stout, round (or facultatively depressed) in crosssection; ventral scales not extending to lateral surface of

the body and with uniformly curved free edge. Dorsal scale rows 15 on neck and at mid-body, a single bilateral posterior reduction to 13. Ventrals fewer than 160 (*minor* 116-129, *coronatus* 130-153). Iris dark with pale ring around pupil; body reddish or greenish grey or brown; top of head darker and with pale-edged dark collar (in *minor*, only on sides of neck); upper lip pale; dorsal bands or blotches

absent; venter yellow or orange with dark speckles or transverse bars; oral lining pale, tongue dark. SVL less than 600 mm, adult males and females approximately equal in size; viviparous; diet usually includes more frogs than skinks. Tail moderately prehensile, used by both species to climb at least in low vegetation.

Most similar to species of *Drysdalia* (*coronoides*, *mastersii*, *rhodogaster*), but distinguished by the

following apomorphic characters: dorsal laminae of nasal bones more extensive, clasping premaxilla and contacting frontal; anteromedial spine of prefrontal absent; lacrimal foramen may be transversely elongated rather than round; postorbital broad and 'strap-like' distally; adductor crests on parietal not meeting to form a sagittal crest posteriorly; neural spine not overhanging anteriorly; diet mainly frogs; tail prehensile and climbs in low vegetation. *Drysdalia* spp. further differ from *Elapognathus* in the following apomorphies: lower average number of dorsal scale rows at first ventral (range 17-21, vs. 19-23), and posterior reduction further behind mid-body (15 to 13 rows at 76-88% ventral scale, vs. 63-88% in *Elapognathus*); posterior process of vomer subequal in length to capsule of Jacobsen's organ; frontal bones (and overlying scale) long, narrow between the orbits and expanded anteriorly; postorbital crest of parietal reduced; trigeminal foramen (V2) narrowly separated from parietal; retroarticular process in lateral view in line with compound; adductor fossa open laterally; surangular

foramen one-third from anterior end of compound bone; one less pair of macrochromosomes (by fusion); Z sex chromosome modified and differing in relative length ('Group 5' vs. 'Group 1' karyomorph, Mengden, 1985).

Distribution: South-west Western Australia only.**Content:** *Elapognathus minor* (Günther, 1863) (type species); *Elapognathus coronatus* (Schlegel, 1837).**HAWKESWOODDELAPIDUS SUBGEN. NOV.****Type species:** *Elaps coronatus* Schlegel, 1837**Diagnosis:** Because both this subgenus and the nominate subgenus are monotypic, one only needs to separate each of the component species to diagnose each subgenus.

The subgenus *Elapognathus* Boulenger, 1896 is separated from *Hawkeswoodelapidus subgen. nov.* by having a head darker than the body and marked with a distinct "crown" and more than 130 ventrals.

Hawkeswoodelapidus subgen. nov. is separated from the subgenus *Elapognathus* Boulenger, 1896 by having a head colour continuous with that of the body and 129 ventrals or less.

Hawkeswoodelapidus subgen. nov. is further separated from *Elapognathus* Boulenger, 1896 by the lack of striate dorsals seen in the species *coronata*.

Hawkeswoodelapidus subgen. nov. is further diagnosed by the following suite of characters: The distinct "crown" on the head consists of a black streak on the side of the head and a black bar across the neck, as well as a white streak through the lips. *Hawkeswoodelapidus subgen. nov.* is further separated from *Elapognathus* Boulenger, 1896 by its more elongate snout and lower subcaudal count 39-52 (versus 53-61).

The following traits further identify *Hawkeswoodelapidus subgen. nov.*: The head is not distinct from the neck, no canthus rostralis; internasals present; frontal longer than wide, straight-sided, anterior and posterior corners angular; parietals much larger than frontal; preocular usually in broad contact with nasal and widely separated from frontal; 2 postoculars, 2+2 temporals, 6 supralabials, 7 infralabials; moderately large eye with a dark brown iris and a pale sector at the top.

The top of the head is grey, olive or blackish, edged with black (by a streak from lore to temple, usually continuous with a bar across neck). Remaining upper surfaces olive-grey, olive brown or blackish-grey. Black loreo-temporal streak edged below by a white streak, sometimes continuous with narrow pale brown bar immediately behind black bar on neck. The underside is yellow, orange, or orange-red, partly suffused with grey and peppered with black (dark pigment concentrated at the base of the ventrals).

Distribution: Confined to south-west Western Australia (Storr, Smith and Johnstone 2002).**Etymology:** Named in honour of Dr Trevor Hawkeswood, of New South Wales, Australia in recognition for his numerous contributions to the biological sciences, in particular the taxonomy of beetles and other invertebrates, including through the publication of his excellent scientific journal *Calodema*.**Content:** *Hawkeswoodelapidus coronatus* (Schlegel, 1837).**REFERENCES CITED**

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CONFLICT OF INTEREST

The author has no conflicts of interest in terms of this paper or conclusions within.

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