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The Australian Scincid Lizard Genus *Calyptotis* De Vis: Resurrection of the Name, Description of Four New Species, and Discussion of Relationships

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ABSTRACT. Five species of small cryptozoic skinks from the woodlands and forests of eastern Australia are diagnosed as a monophyletic group and given generic rank. The name *Calyptotis* De Vis 1886 is resurrected from the synonymy of *Sphenomorphus* for the genus. Four of the species are described as new and the one previously described species—*C. scutirostrum* W. Peters 1873—is reviewed. Information is provided on distribution, ecology and reproduction for each species. The interspecific and intergeneric relationships of *Calyptotis* are discussed. A key to the species is provided.

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Abbreviations and Symbols

AM:	Australian Museum
BMNH:	British Museum (Natural History)
CAS:	California Academy of Sciences
MVZ:	Museum of Vertebrate Zoology, University of California, Berkeley
NMV:	National Museum of Victoria
QM:	Queensland Museum
QNP:	Queensland National Parks and Wildlife collections
SAM:	South Australian Museum
SD:	standard deviation
SVL:	snout-vent length

WAM: Western Australian Museum

X̄: statistical mean

ZMB: Zoologisches Museum, Berlin

*, **,
***: the .05, .01 and .001 levels of significance for statistical tests

The *Sphenomorphus* group is a major lineage of lygosomine skinks that comprises approximately 16 genera and 385 species. It ranges from south-eastern Europe and southern Asia east through the Indo-Australian Archipelago to the Solomon Islands and south into Australia; representatives of the group also occur in south-eastern North America and Middle America. The genera currently recognized in this group are *Ablepharus, Anomalopus, Ateuchosaurus, Ctenotus, Eremiascincus, Hemiergis, Isopachys, Lerista, Lipinia, Lobulia, Notoscincus, Prasinohaema, Saiphos, Scincella, Sphenomorphus* and *Tropidophorus* (Greer, 1979).

Most of these genera represent monophyletic groups with well-defined morphologies and ecologies. The outstanding exception, however, is *Sphenomorphus*, a widely distributed group of approximately 180 species allied primarily on the basis of primitive traits and including animals as different as long-legged, diurnal climbers and reduced-limbed, cryptozoic burrowers. Several lineages are evident within *Sphenomorphus* but their formal taxonomic recognition is handicapped by a bewildering amount of variation, some of which is due to tight morphoclines among closely related species and some to convergence between distantly related species.

Recent work on *Sphenomorphus* has shown that there is a group of five species in eastern Australia that appears to be quite distinct within the *Sphenomorphus* group as a whole and which can be reasonably assigned to a separate genus. One purpose of this paper is to diagnose this taxon and to resurrect the name *Calyptotis* De Vis for it. Of the five species referable to *Calyptotis*, one only—*C. scutirostrum*—has been described, and it remains poorly known. A second purpose of this paper, therefore, is to describe the remaining four and review the one named species and to give details of the biology of all five. Finally, many of the characters that distinguish the species of *Calyptotis* both individually and as a group are amenable to phylogenetic analysis and hence provide a basis for inferring the intra- and intergeneric relationships of the group. A third purpose of this paper is to develop this analysis and to discuss some of its implications.

Resurrection of the Genus *Calyptotis* De Vis

The five eastern Australian species to be discussed here—*Sphenomorphus scutirostrum* and its four undescribed relatives—appear to be unique in the *Sphenomorphus* group (Greer, 1979) in possessing the following combination of derived character states (see Appendix for character analysis): palatal rami of pterygoids roughly triangular in shape (narrow anteriorly and broad posteriorly) and separated to varying degrees by posteriorly extending processes from posteromedial corners (Fig. 21); phalanges in fourth toe of manus four; postmental in contact with only one infralabial; loreal single; and fourth supralabial subocular (Figs 2, 5, 8, 11, 13). The five species also share the following more difficult-to-interpret features: small size (maximum SVL 59 mm or less); low number of longitudinal scale rows at midbody (19–24); and bright coral pink to red colour on the ventral surfaces of the posterior part of the body and the tail (in at least four of the five species).

As it is construed here the group occurs disjunctly on Thornton Peak in north-eastern Queensland and then more or less continuously from the Clarke Range in central-eastern Queensland south to the area just north of the lower Hunter River Valley in central-eastern New South Wales (Fig. 14). Within this area the group is confined to the woodlands and forests of the coastal plain and adjacent highlands. Nowhere does it occur more than 170 kilometres inland.

The species in the group have the ecological distinction of being one of the most abundant lizards in the habitats they occupy, especially in the southern part of the distribution. The animals are cryptozoic but may be readily collected by turning over logs and rocks and quickly pouncing on uncovered individuals before they wriggle into the leaf litter and loose soil. In size, microhabitat and escape behaviour they are very similar to the terrestrial, woodland salamanders of the genus *Plethodon* in North America.

The morphological and ecological similarity of these species plus their more or less contiguous distribution suggests that they are a monophyletic group. Furthermore, I think the morphology of the group is distinctive enough to accord it separate generic rank and hence propose that the name *Calyptotis* De Vis 1886 (type species, by monotypy: *Calyptotis flaviventer* De Vis = *Lygosoma scutirostrum* Peters) be resurrected from the synonymy of *Sphenomorphus* for it.

In the following section I review the one previously described species—*C. scutirostrum*—and describe the four new species: *C. ruficauda, C. lepidorostrum, C. temporalis* and *C. thorntonensis*. The species are discussed roughly in the order of their increasing number of derived character states.

THE SPECIES OF *CALYPTOTIS*

Calyptotis ruficauda n.sp.
Figs 1, 2

Holotype. Australian Museum R 52338; Portion 14, Parish of Dingle, Shire of Bellingen, N.S.W. Altitude c.165 m. Collected by H.G. Cogger. The type locality is just west of Brinerville which is approximately 50.5 km W of Bellingen Post Office by the road through Thora. The coordinates of the type locality are 152°33′E, 30°28′S.
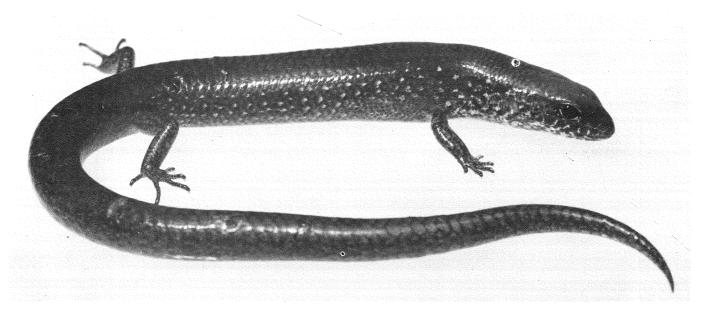
Fig. 1. *Calyptotis ruficauda* (AM R 62876) from the vicinity of Brinerville, NSW.

Paratypes. All localities are in New South Wales.

American Museum of Natural History 120298-303: Same locality data as holotype; 120304-5: 10 km SSW of Macksville via Hwy 1.

Australian Museum R 4804: Manning River; R 6283: Gurravembi, near Macksville on the Nambucca River; R 15526-15529: Boolambayte; R 16024: Laurieton; R 18650, 18653: Middle Brother Mountain; R 20522-20531, 26011, 27732: Bulahdelah; R 35186: between Five Day and Branch Creeks, near Comara; R 38216, 38267, 38269, 38300-38303, 52339-52343, 54600-54601, 57531-57532, 61173-61195, 62876-62877, 71429-71432: Portion 14, Parish of Dingle, Shire of Bellingen; R 53164-53165: junction of Pacific and Oxley Highways; R 53166—53167: ranges W of Wingham; R 54749-54750, 90316-90330: 1.7 km W of Pacific Highway via road to lookout on Middle Brother Mountain; R 57845-57850: 11 mi S of Coffs Harbour; R 61205-61208: 12.0 km W of Wauchope Post Office via road to Bellangry; R 60387-60389: Wallingat State Forest near Forster; R 66590: Cape Hawke new Forster; R 66623-66627: Park Beach, Coffs Harbour; R 66628: Moonee Beach; R 68477-68481, 75971: Rochester Fire Trail, 5 km N of Nabiac; R 69541-69551: approximately 0.5 km W of Pacific Highway along Louise's Ridge Road, just S of Warrel Creek; R 70317, 84993-84995: Sea Acres Fauna Sanctuary, Port Macquarie; R 71237: just S of Barrington Guest House, Chichester State Forest; R 90607-90608: Black Scrub Track, Bellinger River State Forest; R 92305: Bellbrook; R 92912: compartment 134, Middle Brother State Forest.

Northern Territory Museum: R 4697-4703: Dongdingalong Estate, Burnt Ridge Road, South Kempsey.

Queensland Museum: J 26024: O'Sullivan Gap.

Diagnosis. *Calyptotis ruficauda* differs from its congeners in possessing prefrontal scales and a well-developed external ear opening with a scaleless tympanum.

Description. *Calyptotis ruficauda* is a medium-sized (maximum SVL = 55 mm) light to dark brown skink with nonoverlapping, pentadactyl limbs and a rather

uneven dark brown dorsolateral streak that is most distinct on the head and neck (Fig. 1).

Snout moderately short and deep; rostral projecting slightly between nasals; frontonasal wider than long; prefrontals present, well developed but almost invariably separated medially; frontal considerably longer than wide, shorter than midline length of frontoparietals and interparietal; supraoculars four, anterior two (or rarely three) in contact with frontal; frontoparietals distinct, each equal to or slightly larger than interparietal in total area; interparietal distinct, with small clear parietal eye spot posteriorly; parietals in broad contact behind interparietal; each parietal bordered posterolaterally by upper secondary temporal, anteriormost nuchal (which is always transversely enlarged) and usually a slightly smaller scale intercalated between the two.

Nasal moderate in size, widely separated from its fellow, with nostril centrally located; loreal single, equal to or slightly larger than nasal; preoculars two; supraciliaries six to eight (mode = seven), first and last largest; postoculars two; subocular series complete, comprising five scales, third of which is small and partly in eyelid; lower eyelid scaly; supralabials six, fourth below centre of eye; primary temporal single; secondary temporals two, dorsal much larger than ventral, which is about equal in size to primary temporal; external ear opening large, more or less vertically oval; tympanum slightly recessed, scaleless, only slightly pigmented if at all; infralabials four, first only in contact with postmental; mental followed by postmental and a pair of chin scales in medial contact (Fig. 2).

Transversely enlarged nuchals 1-4 ($\overline{X}$ = 2.5, mode = 2) on each side; body scales smooth, in 20-24 ($\overline{X}$ = 22.1, mode = 22) longitudinal rows at midbody; scales in paravertebral rows slightly to moderately wider than scales in more lateral rows, 51-59 ($\overline{X}$ = 53.9) in
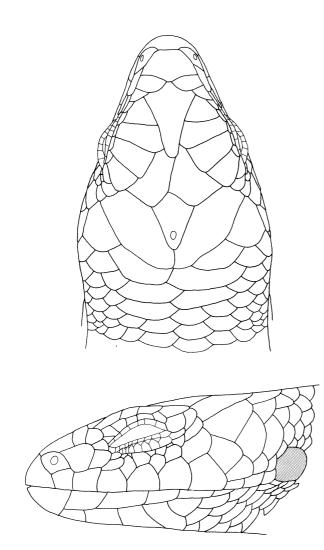
Fig. 2. Dorsal and lateral views of the head of *Calyptotis ruficauda* (AM R 90329) from Middle Brother Mountain, NSW.

a single row[1]; medial pair of preanals greatly enlarged; each preanal overlaps the preanal lateral to it and is in turn overlapped by the preanal medial to it; medial row of subcaudals slightly wider than more lateral rows.

Digits moderate in length; fourth toe slightly to appreciably longer than third, covered by two longitudinal rows of scales for most of length (except for two most distal scales which are single); subdigital lamellae on fourth toe with keels that begin as rounded tubercles basally, become obtuse ridges over middle length and are lost distally, 10–15 ($\overline{X}$ = 12.8, mode = 13).

Snout–vent length 21–53 mm; tail length 1.13–1.53 times SVL; front leg .17–.25 and rear leg .24–.33 times SVL.

[1]The paravertebral scales are counted from the first scale that falls behind an imaginary line connecting the back side of the thighs, when they are held perpendicular to the long axis of the body, forward to and including the anteriormost nuchal.

Presacral vertebrae 26; phalangeal formulae for manus and pes 2-3-4-4-3 and 2-3-4-5-3 respectively.

Colour in preservative. The dorsum is light to medium dark brown usually with darker brown flecks on the head and dark brown spots aligned linearly through the centres of the four dorsalmost scale rows. These dorsal spots are generally strongest and most likely to be coalesced into continuous stripes on the nape and anterior part of the body. In some specimens, however, the dark dorsal spots are totally lacking.

An uneven but usually distinct dark brown dorsolateral streak begins just before the eye and passes posteriorly onto the body. This streak is generally most distinct on the head, neck and anterior part of the body.

The flanks are light brown to grey with scattered dark brown spots which are usually larger and more coalesced than the dorsal body spots. The lateral dark spots are most distinct on the neck and often grade into the diffuse lower edge of the dark dorsolateral streak, especially on the mid and posterior parts of the body. Diffuse light spots are scattered over the flanks and are generally most distinct in the dark dorsolateral streak and the darker upper areas of the flanks. Dark pigment edges the labial scales (Fig. 1).

There is often dark spotting on the chin, throat and anterior part of the chest, but there was no sexual dimorphism in the intensity of the spotting (X^2 = .11 NS, N = 54). There is often fairly even fine spotting on the underside of the tail, but the intensity of this spotting, as judged on the base of the tail where it is most variable, also showed no sexual dimorphism (X^2 = .16 NS, N = 52).

Colour in life. Detailed colour notes were taken on 17 specimens collected on Middle Brother Mountain, NE of Taree, New South Wales on 15 March 1976 and on 23 specimens collected in the vicinity of Brinerville, New South Wales on 20 April 1977. These notes provide the basis for the following assessment of colour in life.

All the Middle Brother Mountain specimens were recorded as having pale yellow colour on the venter of the body from the level of the forelegs back to the pelvic area. The smallest specimen, an unsexed obvious hatchling with an SVL of 21 mm, showed no pink colour anywhere, but all other specimens, which comprised seven females of SVL 34–47 mm and nine males of SVL 34–46 mm, had coral pink colour on the underside of the tail.

Notes on the intensity of the pink tail colour were made for 14 of the 16 specimens with tail colour. This subset comprised six females of SVL 34–45 mm and eight males of SVL 34–46 mm. The single smallest individuals of both sexes in this group, both of 34 mm SVL, were not noted as having intense tail colour. The remaining seven males, which had SVLs of 35 (2), 38, 41, 42, 43 and 46 mm, all had intense tail colour, but of the five remaining females only two, both of 43 mm SVL, had intense colour, whereas three with SVLs of 35, 35 and 45 mm, did not. When tail colour is intense, it extends across the vent and onto the undersides of the thighs.

After 10 months in preservative, only four of the five largest males of the 16 specimens with any tail colour in life retained any trace of this colour.

The four smallest specimens (SVL 23–27 mm) of the 23 collected in the Brinerville area on 20 April lacked all ventral colours. The remaining 19 specimens (11 females of SVL 31–53 mm and eight males of SVL 38–55 mm) were a pale yellow colour on the underside of the body and pink on the underside of the tail. Of these, the two smallest males (SVL 38 and 42 mm), the five smallest (SVL 31–48 mm) females and two of the remaining females (SVL 51 and 52 mm) had only pale pink tail colour while the five remaining and largest males (SVL 45–55 mm) and four of the six largest females had intense pink tail colour.

These data suggest the following: (1) all but perhaps the youngest individuals have some pink colour on the underside of the tail; (2) the colour tends to be expressed intensely at smaller sizes more often in males than in females; (3) the colour is expressed intensely more often in males than in females in any size class, and (4) the colour is more durable in preservative in males than in females.

Details of holotype. The holotype (AM R 52338) is a male with a snout–vent length of 51 mm and a tail length of 63 mm, of which 24 mm is regenerated; supraciliaries 7/7; enlarged nuchals 2/4; midbody scale rows 22; paravertebrals 53, and subdigital lamellae 13/13.

Etymology. The name *ruficauda* is intended to call attention to the coral pink underside of the tail in many of the larger individuals of the species.

Size. There is some indication in the large series from Brinerville that males may attain larger size than females. Thirty-nine of the 46 animals from this locality can be sexed and measured accurately and the largest of the 21 males is 55 mm SVL while the largest of the 18 females is only 53 mm.

Distribution. *Calyptotis ruficauda* is restricted to the lowlands of the central north coast of New South Wales in the area between Brinerville and Moonee Beach in the north and Barrington Guest House and Bulahdelah in the south (Figs 3 and 14).

Calyptotis ruficauda is the most southern of the five species of *Calyptotis*. Its nearest neighbour is *C. scutirostrum*. The two species are separated by the Dorrigo Plateau, an eastern spur of the Dividing Range. *C. ruficauda* occurs in the Bellinger River Valley on the south side of the Plateau and on the coastal plain just to the east, and *C. scutirostrum* occurs on the north-western slopes of the Plateau. In the south *C. ruficauda* reaches the limit of its range in the foothills of the Dividing Range on the north side of the Hunter River Valley and in the adjacent coastal plain.

Habitat. Information on the habitat associations of *C. ruficauda* are most complete for two areas: Middle Brother Mountain and Brinerville. At Middle Brother Mountain the species was found abundantly under logs in fairly open, but moist, sclerophyll forest both on flat areas and on the sides of fairly steep slopes. Other species collected in the same habitat at the same time were *Pseudophryne coriacea* and *Lampropholis delicata*.

In the Brinerville area the species is found under rocks and logs in habitats ranging from the edge of rainforest to fairly open dry sclerphyll forest—but always in moist microhabitats.

These plus other more incidental observations suggest that *C. ruficauda* occurs largely in the moister parts of both dry and wet sclerophyll forest and at the edge of rainforest. There appear to be no records from the interior of moist rainforest but this habitat is only poorly represented within the range of *C. ruficauda*. The species does, however, occur in seasonably dry coastal vine thickets, e.g., Sea Acres Fauna Sanctuary.

Reproduction. There are ten gravid females in the available sample: four contain ovarian eggs and were collected in the period 5 September–17 December in various years and the remainder contain oviducal eggs and were collected in the period 10 November–12 January (Table 1). The oviducal eggs are surrounded by a thick shell, which suggests that the species is oviparous. The mean SVL of the gravid females is 48.5 mm and their mean clutch size is 3.3. There is a significant positive correlation between the SVL of the females and their clutch size ($r = .79^{**}$, $N = 10$).

Table 1. Summary of information on the gravid specimens of *Calyptotis ruficauda*. The superscript "o" indicates enlarged ovarian eggs (in contrast to oviducal eggs) and the letters "R" and "L" indicate right and left ovaries or oviducts, respectively. All localities are in New South Wales.

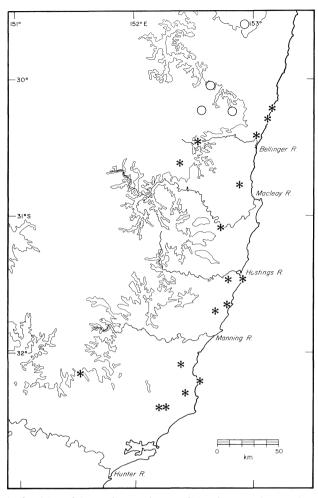| Specimen	Locality	Date	SVL (mm)	Brood Size
AM R 53167	W of Wingham	?	51	IR-3L = 4°
AM R 54600	Brinerville	5 Sept 1972	52	3R-1L = 4°
AM R 60387	Wallingat State Forest	10 Nov 1977	48	1R-2L = 3°
AM R 69542	Just S of Warrel Ck.	17 Dec 1977	48	1R-1L = 2°
AM R 60388	Wallingat State Forest	10 Nov 1977	52	4R-2L = 6
AM R 69541	Just S of Warrel Ck.	17 Dec 1977	48	2R-1L = 3
AM R 69543	Just S of Warrel Ck.	17 Dec 1977	47	2R-1L = 3
AM R 69546	Just S of Warrel Ck.	17 Dec 1977	47	1R-1L = 2
AM R 57849	11 mi S of Coffs Harbour	27 Dec 1940	42	1R-1L = 2
AM R 66625	Coffs Harbour	12 Jan 1969	50	2R-2L = 4

Fig. 3. Map of the north-central coast of New South Wales showing the distribution of *Calyptotis ruficauda* (asterisks) and the extreme southern part of the distribution of *C. scutirostrum* (open circles). The contour line is 500 m.

A large series of *C. ruficauda* from the vicinity of Brinerville, collected on 20 April 1977, contains eight females as large as or larger than the smallest known gravid *C. ruficauda* (SVL = 42 mm). As none of these specimens is gravid, it is probable that the females in this population were reproductively quiescent at the time of collection.

Sex ratio. The population in the vicinity of Brinerville, N.S.W. has been collected more thoroughly than any other and thus provides the best insight into sex ratios in the species. Of the 39 specimens collected from this population, 33 can be accurately sexed, and of these 17 are males and 16 females, a ratio not significantly different from 1:1.

Comparison with other *Calyptotis*. *Calyptotis ruficauda* differs from *C. lepidorostrum* in having the external ear represented by a moderately recessed, naked tympanum instead of a scaly, conical depression; more midbody scale rows (20-24, $\overline{X}$ = 22.1, N = 59 vs 20-24, $\overline{X}$ = 20.6, N = 87; t = 10.31***); fourth toe appreciably longer than third instead of only slightly longer; more subdigital lamellae on the fourth toe

(10-15, $\overline{X}$ = 12.8, N = 61 vs 8-14, $\overline{X}$ = 11.0, N = 88; t = 9.13***); and fewer presacral vertebrae (26 vs 29).

Calyptotis ruficauda differs from *C. scutirostrum* in having prefrontals present instead of absent; the external ear represented by a recessed, naked tympanum instead of a scaly, conical depression; more midbody scale rows (20-24, $\overline{X}$ = 22.1, N = 59 vs 19-24, $\overline{X}$ = 20.7, N = 107; t = 8.95***); fourth toe appreciably longer than third instead of only slightly longer; more subdigital lamellae on the fourth toe (10-15, $\overline{X}$ = 12.8, N = 61 vs 7-13, $\overline{X}$ = 10.0, N = 103; t = 16.13***); and fewer presacral vertebrae (26 vs 29-30).

Calyptotis ruficauda differs from *C. temporalis* in having the posteriorly projecting process from the posteromedial corner of the palatal ramus of the pterygoid short instead of long; prefrontals present instead of absent; secondary temporals two instead of one; tympanum perhaps slightly more deeply recessed; more midbody scale rows (20-24, $\overline{X}$ = 22.1, N = 59 vs 20-22, $\overline{X}$ = 20.6, N = 8; t = 5.82***); fourth toe appreciably longer than third instead of subequal; phalanges in fourth toe of pes five instead of four; more subdigital lamellae on the fourth toe (10-15, $\overline{X}$ = 12.8, N = 61 vs 8-10, $\overline{X}$ = 9.0, N = 8; t = 11.28***) and more paravertebrals (51-59, $\overline{X}$ = 53.9, N = 28 vs 46-50, $\overline{X}$ = 47.8, N = 8).

Calyptotis ruficauda differs from *C. thorntonensis* in having the head and body moderately deep instead of depressed; external ear represented by a recessed, naked tympanum instead of a scaly, discoidal depression (scaly, superficial tympanum); postorbital bone present instead of absent; possibly fewer midbody scale rows (20-24, $\overline{X}$ = 22.1, N = 59 vs 24, N = 5); fourth toe appreciably longer than third instead of subequal; phalanges in fourth toe of manus four instead of three; phalanges in the fourth and fifth toes of pes five and three respectively instead of four and four, and fewer subdigital lamellae (10-15, $\overline{X}$ = 12.8, N = 61 vs 8-10, $\overline{X}$ = 8.8, N = 5).

For a tabular comparison of various meristic, mensural and proportional characters in *Calyptotis* see Table 5.

Calyptotis lepidorostrum n.sp.
Figs 4, 5

Holotype. Queensland Museum J 33612: Bulburin State Forest, Queensland. Altitude 540 m. Site No. 1 in the Australian Museum and Queensland Museum's joint faunal survey of the eastern Australian rainforests (Anonymous, 1976 and Broadbent and Clark, 1976), or more approximately c. 8.5 km E of Builyan, Qld. The coordinates of the type locality are 24°31'S, 151°29'E.

Paratypes. All localities are in Queensland.
Australian Museum: R 47511, 47640, 47645, 47676, 47680: Bulburin State Forest; R 59243: 0.5 km E of Mary Cairncross Park, Blackall Range; R 59244: Eungella area; R59245-59246, 76221-76223: 2.5 km S of the main forestry road via the Mt. Gerald-Sunday Creek road, Conondale Range, Jimna State Forest; R 76147: 2.3 km SW of junction of Mosman and
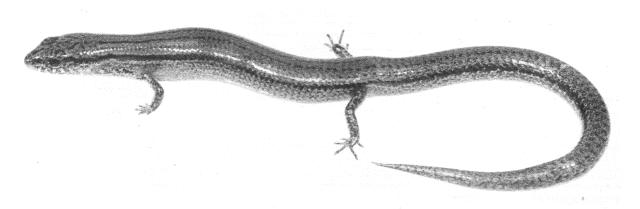
Fig. 4. *Calyptotis lepidorostrum* from Bundaberg, Qld. Photo: H.G. Cogger.

Boyne roads via the Boyne road, Bulburin State Forest; R 76188-76212: vicinity of the forestry camp, Bulburin State Forest; R 91082-91099, 90300-90315: along Poona Lake road, Cooloola State Forest.
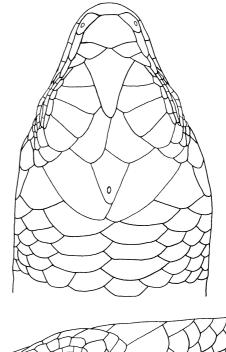
Queensland Museum: J 22067: near forestry airstrip, Ungowa, Fraser Island; J 22274: shores of Coomba Lake, Fraser Island; J 22472-22473, 25397: Cooloola; J 23810, 24133, 29093, 33610, 33613-33615: Bulburin State Forest; J 33737: forestry camp, Bulburin State Forest; J 33752: Granite Creek, Bulburin State Forest; J 24373: Mackay; J 30229, 30236: Big Tuan Creek via Maryborough; J 30231: near Missings Bridge, Tinana Creek; J 31575: Fraser Island National Park, Fraser Island; J 32653-32655, 32671, 32673, 32707-32716, 32721-32722, 32734-32738: Crediton; J 35309, 35879, 35881-35882: Tuan State Forest via Maryborough; J 35878: Missing's Camp, Tuan State Forest via Maryborough; J 35880: Cooper's Gully, Tuan State Forest.

Queensland National Parks and Wildlife Service: 5, 87: Lake Poona, Cooloola National Park; 11286, 11295: Eungella National Park.

Diagnosis. *Calyptotis lepidorostrum* differs from its congeners in the following combination of characters: prefrontals present instead of absent; external ear represented by a scaly, conical depression instead of a recessed naked tympanum or a shallow, scaly, discoidal depression, and head and body moderately deep instead of depressed.

Description. *Calyptotis lepidorostrum* is a medium sized (maximum SVL = 55 mm) light to dark brown skink with nonoverlapping limbs and a dorsal colour pattern comprising a thin dark brown dorsolateral streak, which is especially well developed on the head, neck and anterior body, and often a line of dark spots or dashes through each of the four dorsalmost scale rows (Fig. 4).

Snout moderately short and deep; rostral projecting slightly between nasals; frontonasal wider than long; prefrontals usually present, rarely in contact (see below); frontal considerably longer than wide, slightly shorter than midline length of frontoparietals and interparietal together; supraoculars four, anterior two in contact with frontal; frontoparietals distinct, each equal to or slightly larger than interparietal in total area; interparietal distinct, with a small clear parietal eye spot posteriorly;
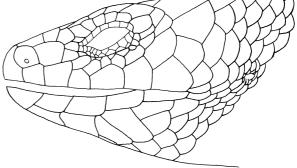

Fig. 5. Dorsal and lateral views of the head of *Calyptotis lepidorostrum* (AM R 59243) from the Blackall Range at Maleny, Qld.

parietals in broad contact behind interparietal; each parietal bordered posterolaterally by large upper secondary temporal, anteriormost nuchal (which is always transversely enlarged) and usually a slightly smaller scale intercalated between the two.
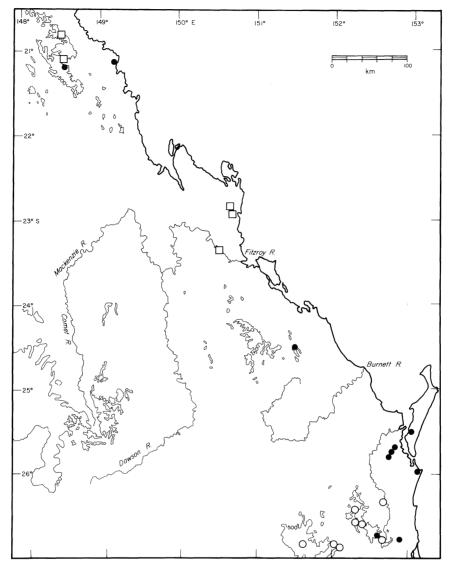
Fig. 6. Map of central eastern and south-eastern Queensland showing the distribution of *Calyptotis lepidorostrum* (black dots) and *C. temporalis* (open squares) and the extreme northern part of the distribution of *C. scutirostrum* (open circles). The contour line is 500 m.

Nasal moderate, widely separated from its fellow, with nostril centrally situated; loreal single, equal to or larger than nasal; preoculars two; supraciliaries six to eight (mode = seven), first and last largest; postoculars two; suboculars series complete, comprising five scales, third of which is small and partially incorporated into eyelid; lower eyelid scaly; supralabials six, fourth below centre of eye; primary temporal single; secondary temporals two, dorsal much larger than ventral, which is about equal in size to primary temporal; external ear opening absent, represented by scaly conical depression; infralabials four, only first in contact with postmental; mental followed by postmental and single pair of chin scales in medial contact (Fig. 5).

Transversely enlarged nuchals 1-5, ($\overline{X}$ = 2.6, mode = 3) on each side, body scales smooth, in 20-24 ($\overline{X}$ = 20.6, mode = 20) longitudinal rows at midbody; scales in paravertebral rows slightly to appreciably wider than those in more lateral rows, 50-63 ($\overline{X}$ = 55.7) in a single row; medial pair of preanals greatly enlarged; each preanal overlaps preanal lateral to it and is in turn overlapped by preanal medial to it; medial row of subcaudals slightly wider than more lateral row.

Digits moderate in length; fourth toe only slightly longer than third and covered by two longitudinal scale rows for most of length (two most distal scales are single); subdigital lamellae on fourth toe with keels that begin as rounded tubercles basally, become obtuse ridges over the middle length and are lost distally, 8-14 ($\overline{X}$ = 11.0, mode = 11).

Snout-vent length 23-55 mm; tail length 30-69 mm; tail length 1.17-1.50 times SVL; front leg .14-.23 and rear leg .21-.29 times SVL.

Presacral vertebrae 29; phalangeal formulae for manus and pes 2-3-4-4-3 and 2-3-4-5-3 respectively.

Colour in preservative. Dorsum light to dark brown with darker brown spots and blotches scattered more or less randomly on the head and tail but generally aggregated into stripes through the centres of the four dorsalmost scale rows on the body. These stripes are especially distinct and continuous anteriorly but become more diffuse and discontinuous posteriorly. A dark dorsolateral stripe begins in front of the eye and extends posteriorly onto the tail. The stripe is most distinct on the nape and shoulder and becomes diffuse posteriorly. Flanks pale brown to light grey, often with darker brown spots and blotches scattered evenly throughout and a few white spots scattered along the neck and shoulder. Sides of head and labial areas generally with dense dark spots and streaks, although the centres of the labials are generally clear.

There is coarse brown spotting on the sides of the chin and throat in a few of the larger specimens, but there appears to be no sexual difference in its distribution (X^2 = 0.26 NS, N = 74). There is often fine brown spotting on the underside of the tail and this is more frequent in females than in males (X^2 = 13.14***, N = 70).

Colour in life. Large individuals of this species usually have bright ventral colours comprising a yellow on the underside of the body and in some individuals a bright coral pink or red on the underside of the tail and thighs and over the vent.

There are very few notes on the individual occurrence of yellow ventral colour in this species. I made notes on 17 animals collected at Cooloola State Forest on 2-3 May 1976. These show that the three smallest specimens (SVL = 23-27 mm) plus a large female (SVL = 43 mm) apparently had no yellow colour in the venter; four of the five remaining females (SVL = 30-45 mm) had pale yellow colour while the fifth female (SVL = 44 mm) and all the remaining specimens, all of which were males (SVL = 40-47 mm), had slightly stronger yellow colour. These results suggest that juveniles lack yellow ventral colour but that larger individuals generally have some yellow colour and in these the intensity is generally greater in males than in females.

Fairly detailed colour notes are available on the occurrence of the coral red tail colour in an expanded sample (N = 37) collected at Cooloola State Forest on 2-3 May 1976. These show that no individual smaller than 37 mm SVL (N = 9) had appreciable pink colour in the tail but that 11 males larger than 37 mm SVL (40-47 mm) had intense coral pink colour while only five of the 14 females larger than 37 mm (38-48 mm) had similarly intense pink colour. The difference in the frequency of intense colour between the sexes in the larger animals is significant (P<.001, Fisher Exact Probability Test). The pink colour apparently also persists better in preservative in males than in females, for after 10 months in preservative all nine males

Table 2. Snout-vent length in mm of the largest individual of each sex of *Calyptotis lepidorostrum* at three different localities. Numbers in parentheses are sample sizes.

	Males	Females
Crediton (920 m)	50 (12)	51 (8)
Bulburin (540-580 m)	52 (8)	54 (6)
Cooloola (near sea level)	47 (14)	48 (17)

retained this colour in the tail but none of the females did.

Details of holotype. The holotype (QM J 33612) is a male with a snout-vent length of 52 mm and a tail length of 61 mm, of which 15 mm is regenerated; prefrontals present and separated; supraciliaries 7/7; enlarged nuchals 3/3; midbody scale rows 20, paravertebrals 54 and subdigital lamellae 11/11.

Etymology. The name *lepidorostrum* derives from the Greek word for scale (*lepidos*) and the Latin word for snout (*rostrum*) and calls attention to the presence of distinct prefrontal scales in contrast to their absence in the closely related *C. scutirostrum*.

Size. There is some indication that females attain a slightly larger size than males in *C. lepidorostrum*. The evidence for this comes from the three largest samples available: Crediton, Bulburin and Cooloola. In all three the largest females are 1-2 mm longer than the largest males (Table 2).

It is interesting to note that individuals from the two montane populations at Crediton and Bulburin appear to attain a slightly larger size than individuals from the lowland population at Cooloola (Table 2). They also appear to be somewhat darker in colour.

Variation in prefrontal scales. Variation in the presence of prefrontals (the sole diagnostic trait separating this species from *C. scutirostrum*) is minimal. Distinct prefrontals are present in all specimens except two from Bulburin State Forest near the centre of the species' distribution: QM J 33752 has the left prefrontal completely fused to the frontonasal and AM R 76194 has the right prefrontal partially fused.

The prefrontals are almost invariably separated from each other (.95, N = 88) and in the few cases (.05) in which they do meet, the contact is usually very narrow.

Distribution. *Calyptotis lepidorostrum* ranges along the coast and eastern highlands of central and southeastern Queensland from the vicinity of Mackay and Eungella National Park south to the Conondale and Blackall Ranges (Figs 6, 14). In the south the range overlaps slightly or interdigitates with the range of *C. scutirostrum*. In the north the range appears to overlap broadly the range of *C. temporalis,* but there are very few localities known as yet for either species in this area and the local distribution patterns remain to be determined.

Habitat. This species appears to be largely, but not exclusively, an inhabitant of rainforest. The species has been collected in fairly large numbers at three sites

representing different localities and elevations in the species' total distribution.

In the northern part of its distribution, *C. lepidorostrum* was encountered at the Crediton site in the Australian Museum and Queensland Museum's joint faunal survey of eastern Australian rainforest. This site—number 7 in the survey—lies at an altitude of 920 m and is covered in wet complex notophyll vine forest on basalt. *C. lepidorostrum* (identified as "*scutirostrus*" in the survey reports) was scored as "abundant" while the only other skink encountered, an undescribed *Lampropholis* in the *delicata* group, was scored as "very abundant" (Anonymous, 1976 and Broadbent and Clark, 1976).

The species was also found near the centre of its range at the two geographically close survey sites in Bulburin State Forest. These sites—numbers 1 and 3—in the survey lie at 540 and 580 m and are covered by wet complex notophyll vine forest and moist low microphyll vine forest respectively. *C. lepidorostrum* (again identified as "*scutirostrus*") was scored as "very abundant" at the first site and "common" at the second. Seven other species of skink were also taken in association with *C. lepidorostrum* at the combined localities: *Anomalopus ophioscincus, A. verreauxi, Egernia frerei*, a *Lampropholis* of the *delicata* group, *Sphenomorphus quoyi, S. tenuis* and *Tiliqua gerrardi* (Anonymous, 1976 and Broadbent and Clark, 1976).

Near the southern end of the its range the species has been encountered in large numbers at Cooloola State Forest in the near sea level vine forests on the white sands for which the area is famous. A single *Anomalopus ophioscincus* and several individuals of a *delicata* species group *Lampropholis* were also encountered in association with *Calyptotis lepidorostrum* (pers. obs.)

The southern end of the species' range appears to be in the area of the Blackall and Conondale Ranges south of Gympie. Here the distribution appears to either overlap or interdigitate with that of *C. scutirostrum*. In a published account of this area, Czechura (1976) suggested that the two species occurred sympatrically in the rainforests of the Conondale Range. Further

work, however, has shown that habitat separation is virtually complete at the local level with *C. lepidorostrum* inhabiting rainforest and *C. scutirostrum* open (sclerophyll) forest. *C. scutirostrum* may, however, occur "in and around margins of rainforest where it abuts open forest formations", and both species may also occur together in the Blackall Ranges in the small remnant pockets of rainforest. It is interesting to note, however, that in the Gallangowan State Forest which is just north of the Conondale and Blackall Ranges and also just north of the northern limit of the range of *C. scutirostrum, C. lepidorostrum* occurs in wet sclerophyll forest (Czechura, pers. comm.).

The apparent nearly complete habitat separation in the small area of moderately undisturbed habitats where *C. lepidorostrum* and *C. scutirostrum* both occur plus the lack of any evidence of morphological intergradation in the same area are the reasons for treating these two very similar forms as species.

Reproduction.   There are ten gravid females among the available specimens. Eight of these contain only enlarged ovarian eggs. One of these eight lacks a specific date of collection but the others were collected on 23(1) and 27(6) September 1978. The remaining two females contained shelled oviducal eggs, which indicates that the species is oviparous. These two females were collected on 13 October and 14 December (Table 3). The mean SVL of the ten females was 48.5 mm and their mean brood size 3.2. The correlation between SVL and brood size is not significant ($r = .48$, NS, $N = 10$).

There is a large series of specimens from Crediton collected in the period 15–22 April 1975 and another from Cooloola collected on 2–3 May 1976. Both series contain a number of females, seven and 12, respectively, as large as or larger than the smallest known gravid female for the species (39 mm), but none is gravid. These data suggest that the females in these populations were reproductively quiescent at the time of collection.

Sex ratio.   The two most thoroughly collected populations are those at Bulburin and Crediton. The numbers of males and females at these two localities were 22 and 17 and 15 and 18, respectively. In neither case does the sex ratio differ significantly from 1:1.

Table 3.   Summary of information on the gravid specimens of *Calyptotis lepidorostrum*. The superscript "o" indicates enlarged ovarian eggs (in contrast to oviducal eggs) and the letters "R" and "L" indicate right and left ovaries and oviducts respectively. All localities are in Queensland.

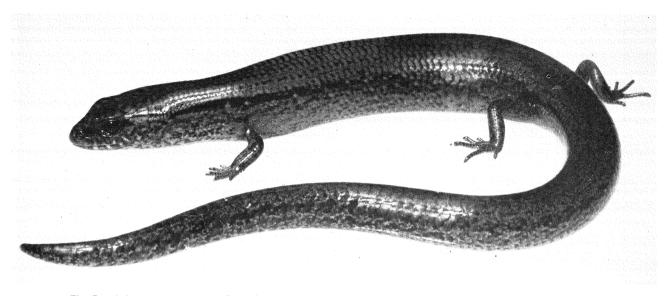| Specimen	Locality	Date	SVL (mm)	Brood Size
AM R 76222	Jimna Forest, Conondale Ra.	23 Sept 1978	50	1R-1L = 2°
AM R 76296	Bulburin State Forest	27 Sept 1978	47	1R-2L = 3°
AM R 76297	Bulburin State Forest	27 Sept 1978	48	2R-2L = 4°
AM R 76299	Bulburin State Forest	27 Sept 1978	50	2R-2L = 4°
AM R 76200	Bulburin State Forest	27 Sept 1978	54	2R-2L = 4°
AM R 76201	Bulburin State Forest	27 Sept 1978	55	2R-2L = 4°
AM R 76202	Bulburin State Forest	27 Sept 1978	51	2R-2L = 4°
QM J 31575	Fraser I. Nat. Park	13 Oct 1978	40	2R-1L = 3
QM J 35878	Tuan State Forest	14 Dec 1977	51	1R-1L = 2
QM J 22274	Coomboo Lake, Fraser I.	1972	39	1R-1L = 2°

Fig. 7. *Calyptotis scutirostrum* from the Conondale Ranges, south-eastern Queensland.

Comparison with other *Calyptotis*. Comparison between *C. lepidorostrum* and *C. ruficauda* has been made on p. 34.

Calyptotis lepidorostrum is very similar to *C. scutirostrum* except that it possesses prefrontals instead of lacking them.

Calyptotis lepidorostrum differs from *C. temporalis* in having the posteriorly projecting process from the posteromedial corner of the palatal ramus of the pterygoid short instead of long; prefrontal scales present instead of absent; external ear indicated by a scaly conical depression instead of a naked tympanum; secondary temporals two instead of one; fourth toe slightly longer than third instead of subequal; phalanges in the fourth toe of the pes five instead of four; more subdigital lamellae on the fourth toe (8-14, $\overline{X}$ = 11.0, N = 88 vs 8-10, $\overline{X}$ = 9.0, N = 8; t = 4.15***); more paravertebrals (50-63, $\overline{X}$ = 55.7, N = 46 vs 46-50, $\overline{X}$ = 47.8, N = 8) and more presacral vertebrae (29 vs 26).

Calyptotis lepidorostrum differs from *C. thorntonensis* in having the external ear opening indicated by a scaly, conical depression instead of a scaly, discoidal depression (scaly, superficial tympanum); postorbital bone present instead of absent; fewer midbody scale rows (20-24, $\overline{X}$ = 20.6, N = 87 vs 24, N = 5); fourth toe slightly longer than third instead of subequal, and phalanges of fourth and fifth toes of pes five and three, respectively, instead of four and four.

Additional comparisons are provided in Table 5.

Calyptotis scutirostrum (W. Peters, 1873)
Figs 7, 8

Lygosoma scutirostrum W. Peters, 1873: 743. Type locality: Port Bowen.

Cophoscincus obscurus O'Shaughnessy, 1874:35. Type locality: Queensland.

Calyptotis flaviventer De Vis, 1886:57-58. Type localities: Breakfast Creek and Macleay Island, Moreton Bay.

Diagnosis. *Calyptotis scutirostrum* differs from all other species of *Calyptotis* in combining the absence of prefrontal scales with the presence of a scaly, conical auricular depression.

Description. Although the original descriptions of *Calyptotis scutirostrum* and its synonyms are fairly good by modern standards, a redescription of the species and a figure of the head (Fig. 8) will facilitate comparisons with the other species described in this paper.

Calyptotis scutirostrum is a medium-sized (maximum SVL-59 mm), light to dark brown skink with non-overlapping, pentadactyl limbs and a dorsal colour pattern comprising a rough-edged, dark dorsolateral stripe on the neck and shoulder and a line of dark spots and dashes along the centre of each of the four dorsalmost longitudinal scale rows (Fig. 7).

Snout moderately short and deep; rostral projecting slightly between nasals; frontonasal usually large (due to incorporation of prefrontals), wider than long; prefrontals usually absent, but small and almost invariably separated when present (see below); frontal slightly shorter than midline length of frontoparietals and interparietal; supraoculars four, anterior two in contact with frontal; frontoparietals distinct, each equal to or slightly larger than interparietal in total area; interparietal distinct, with small clear parietal eye spot posteriorly; parietals in broad contact behind interparietal; each parietal bordered posterolaterally by upper secondary temporal, anteriormost nuchal (which is always transversely enlarged) and usually a slightly smaller scale intercalated between the two.

Nasal moderate in size, widely separated from its fellow, with nostril centrally located; loreal single, equal to or slightly larger than nasal; preoculars two; supraciliaries six to eight (mode = seven) first and last
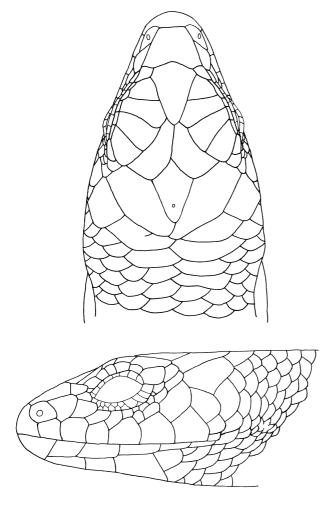
most of length (except for two distalmost scales which are single); subdigital lamellae on fourth toe obtusely keeled, 7-13 ($\overline{X}$ = 9.9, mode = 9).

Snout-vent length 26-59 mm; tail length 1.07-1.58 times SVL; front leg .13-.20 and rear leg .18-.29 times SVL.

Presacral vertebrae 29-30; phalangeal formulae for manus and pes 2-3-4-4-3 and 2-3-4-5-3 respectively.

Colour in preservative. The dorsal colour of *C. scutirostrum* in preservative is very similar to that of *C. lepidorostrum* (p.37).

Chin, throat and lateral area of chest with scattered dark spotting (generally more so in females than males; X^2 = 4.57*, N = 137), rest of ventral part of body immaculate; underside of tail with scattered dark spotting in females but largely unspotted in males (X^2 = 30.78***, N = 137).

Colour in life. Larger individuals of *C. scutirostrum* can be fairly colourful on their ventral surfaces: many have some yellow on the ventral part of the body from about the level of the forelegs back and some show a distinct coral red colour on the underside of the tail and thighs and across the vent. The significance of the variation in both the yellow and coral red colour is discussed below.

The most detailed information on the individual occurrence of yellow ventral colour comes from a series of 14 specimens collected by S.J. Copland at Horton's Creek, N.S.W. from 3-5 January 1948. These specimens range from 33 to 43 mm SVL and comprise eight males and six females. All were noted as having yellow colour on the ventral part of the body, but significantly the six largest males (SVL = 38-43 mm) were described as having yellow venters whereas all the females (SVL = 33-43 mm) and the two smallest males (SVL = 36 mm) were described as having pale yellow venters or white venters with a yellowish wash. These observations indicate that, at this time of year at least, yellow colour occurs on the venter of most (all ?) larger individuals and that it is generally most intense in large males.

This conclusion also seems to be supported by less precise observations which I made on a sample collected on 7 February 1976 5.4 km E of Woodenbong, N.S.W. A subset of this sample that I described in the field as having only the "faintest tinge of yellow" on the ventral part of the body comprised two males 30 and 32 mm SVL and 11 females 32-45 mm SVL, whereas the subset I described as "often (with) definite yellow in the venter anterior to the pelvic area" comprised 16 males 32-43 mm SVL and six females 40-44 mm SVL.

The significance of the polymorphism of the coral red colour on the underside of the tail was investigated in five samples collected without any conscious bias in the following localities in northern New South Wales between 7 February and 14 March 1976: 8.1 km W of Drake (N = 81); 5.4 km E of Woodenbong (N = 38); 7.0 km W of Woodenbong (N = 3); 8.0 km E of Woodenbong (N = 16), and 10.4-12.0 km NW of Bostobrick (N = 6). Tail colour in life, snout-vent

Fig. 8. Dorsal and lateral views of the head of *Calyptotis scutirostrum* (AM R 92088) from 10.4-12.0 km NW of Bostobrick, NSW. In this specimen the postmental and first chin scale are fused on the left side.

largest; postoculars two; subocular series complete, comprising five suboculars, third of which is small and partially incorporated into eyelid; lower eyelid scaly; supralabials six, fourth situated below centre of eye; primary temporal single; secondary temporals two, dorsal much larger than ventral, which is equal in size to primary temporal; external ear opening absent, represented by a scaly, conical depression; infralabials four, first only in contact with postmental; mental followed by postmental and a pair of chin scales in medial contact (Fig. 8).

Transversely enlarged nuchal scales 1-5 ($\overline{X}$ = 2.5, mode = 2) on each side; body scales smooth, in 19-24 ($\overline{X}$ = 20.7, mode = 20) longitudinal rows at midbody; scales in paravertebral rows moderately to appreciably wider than those in more lateral rows, 51-64 ($\overline{X}$ = 55.1) in a single row; medial pair of preanals greatly enlarged; medial row of subcaudals slightly wider than more lateral rows.

Digits short; fourth toe only slightly longer than third, covered above by two longitudinal rows of scales for

length and sex (based on an examination of gonads) were scored for as many of these specimens as possible (N = 133). From these data it was clear that (1) no individual 32 mm SVL or smaller had any red colour in the tail and (2) in individuals 33 mm SVL and larger, males almost invariably had tail colour whereas females almost invariably, but not always, lacked it (X^2 = 82.9***). The two males scored as lacking tail colour were relatively large (42 and 44 mm SVL) and hence cannot have their lack of tail colour ascribed to young age. Four of the seven females scored as having tail colour in life lost this colour after a period of preservation while all other individuals retain tail colour after being treated similarly, thereby indicating that, when present in females, tail colour is perhaps less strongly developed than in males.

Etymology. Although Wilhelm Peters did not specifically state that the name *scutirostrum* derived from the large frontonasal scale of the type, he described the scale and perhaps sought to emphasize it with this name.

Distribution. *Calyptotis scutirostrum* ranges along the coastal plain and highlands from an area just south of Gympie in south-eastern Queensland to an area just northwest of Dorrigo, New South Wales (Figs 9, 14). The most inland extent of the range is in the Bunya Mountains and the highlands SSW of Stanthorpe.

The range of *C. scutirostrum* overlaps the range of its very similar northern relative *C. lepidorostrum* in the highlands separating the Mary and Burnett drainages to the north and the Brisbane drainage to the south (the highlands encircled by the Bruce, Wide Bay, Burnett and D'Aguilar Highways). To the south, *C. scutirostrum* is separated from *C. ruficauda* by the Dorrigo Plateau.

Variation in prefrontal scales. Due to the fact that the general absence of prefrontal scales is the main character by which *C. scutirostrum* can be distinguished from its northern relative *C. lepidorostrum,* it may be useful to discuss briefly the variation in the occurrence of prefrontals in *C. scutirostrum.*

The overall frequency of prefrontals in *scutirostrum* is low; out of 365 specimens surveyed only 16(.04) possessed prefrontals and of these only 9 (.02) possessed prefrontals on both sides. Prefrontals are known to occur in populations from the following localities: Toowoomba, Mt. Mitchell, Upper Brookfield, northern Stradbroke Island, Mt. Ballow and Fletcher in Queensland and 8.1 km W of Drake, 10.4-12.0 km NW of Bostobrick and 11.5 km SW of Nymboida in New South Wales. These localities are widely scattered throughout the range of *C. scutirostrum* and show no significant pattern.

Prefrontals occur in different frequencies in different populations. Of 81 specimens collected 8.1 km W of Drake, N.S.W., for example, 10 possess distinct prefrontals whereas none of 37 specimens collected 5.4 km E of Woodenbong, N.S.W. have distinct prefrontals (P = .02, Fisher Exact Probability Test).

When prefrontals do occur in *C. scutirostrum* they are generally smaller than in *C. lepidorostrum.* This is
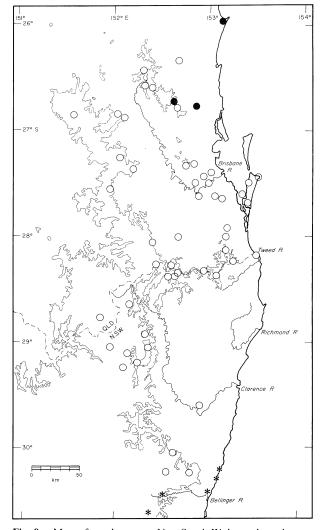

Fig. 9. Map of north-eastern New South Wales and south-eastern Queensland showing the distribution of *Calyptotis scutirostrum* (open circles), the northern part of the distribution of *C. ruficauda* (asterisks) and the southern part of the distribution of *C. lepidorostrum* (black dots). The contour line is 500 m.

especially noticeable when the prefrontals are paired, for then they are generally more widely separated than in *C. lepidorostrum.*

Variation in size. There is evidence that females attain slightly larger size than males in most populations. This is especially evident in the three largest samples mentioned above in conjunction with the analysis of tail colour.

(1) Of the 81 specimens collected 8.1 km W of Drake, N.S.W., 74 could be both accurately sexed and measured. Only two of the 36 males attained a maximum snouth-vent length of 45 mm, whereas four of 38 females attained 45 mm snout-vent length and one reached 48 mm.

(2) Of the 38 specimens collected 5.4 km E of Woodenbong, N.S.W., 35 could be both sexed and measured. One of the 18 males attained a maximum snouth-vent length of 44 mm, while one of the 17

Table 4. Summary of information on the gravid specimens of *Calyptotis scutirostrum*. The superscript "o" indicates enlarged ovarian eggs (in contrast to oviducal eggs) and the letters "R" and "L" indicate right and left ovaries and oviducts, respectively.

Specimen	Locality	Date	SVL (mm)	Clutch Size
QM J 30414	6 km S of Yarraman, Qld		45	1R-1L = 2°
QM J 26720	Mt. Ballow, Qld.	Sept 1975	53	1R-2L = 3°
AM R 76104	5.4 km W of Woodenbong, NSW	19 Sept 1978	41	2R-1L = 3°
AM R 76154	Kingham Rd, Jimna Ra., Qld	24 Sept 1978	43	2R-1L = 3°
AM R 17704	Bunya Mountains, Qld	4-5 Dec 1960	59	4°
AM R 76155	Kingham Rd, Jimna Ra., Qld	24 Sept 1978	50	2R-3L = 5
AM R 43049	11 mi SE Tenterfield, NSW	17 Oct 1972	44	2R-2L = 4
AM R 43050	Crooked Creek, NSW	17 Oct 1972	41	2R-1L = 3
AM R 43055	Rocky River, NSW	17 Oct 1972	42	2R-1L = 3
AM R 43058	1 mi W of Drake, NSW	17 Oct 1972	48	2R-2L = 4
AM R 17702	Bunya Mountains, Qld	4-5 Dec 1960	54	3R-1L = 4
AM R 17705	Bunya Mountains, Qld	4-5 Dec 1960	56	3R-2L = 5
AM R 17706	Bunya Mountains, Qld	4-5 Dec 1960	52	3R-2L = 5
AM R 57533	Wilson's Peak, Qld	10 Dec 1940	52	2R-2L = 4
AM R 57540	Wilson's Peak, Qld	10 Dec 1940	51	2R-2L = 4
AM R 57553	Wilson's Peak, Qld	10 Dec 1940	54	2R-1L = 3
QM J 27365	Stradbroke I., Qld	Jan 1976	37	1R-1L = 2
AM R 57573	Hortons Creek, NSW	3 Jan 1948	42	1R-1L = 2
AM R 57574	Hortons Creek, NSW	3 Jan 1948	43	1R-1L = 2
QM J 2447	Gowrie Scrub, Qld	?	39	Oviducal eggs
QM J 14142	?	?	46	2R-2L = 4
QM J 30415	6 km S of Yarraman, Qld		44	1L = 1

females attained 44 mm SVL and another reached 45 mm.

(3) All 16 specimens collected 8.0 km E of Woodenbong could be sexed and measured. Two of the nine males reached a maximum SVL of 42 mm while two of seven females reached 42 mm SVL and two others reached 43 mm.

In addition to the sexual dimorphism in size, there is also some geographic variation that is interesting. The animals in the Bunya Mountains, for example, seem to reach a larger size than animals from elsewhere. This is evidenced by the fact that out of 261 specimens from throughout the range of *C. scutirostrum* exclusive of the Bunya Mountains, only one (AM R 57553 from Wilson's Peak, SE Queensland) attained a SVL of 54 mm, whereas seven of the 17 specimens from the Bunya Mountains measured 54-59 mm SVL.

Habitat. The available data indicate that *C. scutirostrum* is an inhabitant of both rainforest and moist sclerophyll forest, although personal experience indicates that it is much more common in the latter than in the former.

The habitat associations of *C. scutirostrum* and its close relative *C. lepidorostrum* in their narrow zone of overlap in south-eastern Queensland are discussed in the "Habitat" section of the *C. lepidorostrum* account.

Reproduction. In an effort to learn something about the mode of reproduction, brood size and time of reproduction, the available specimens were examined for gravid females. A total of 22 gravid females was found: five with enlarged, yolky ovarian eggs and 17 with shelled oviducal eggs (Table 4). The texture of the shell in the latter indicated that the species is almost certainly oviparous.

The 21 females in which clutch size could be determined ranged in size from 37-59 mm SVL ($\bar{X}$ = 47.5) and as the smallest individual had oviducal eggs, her size may be taken as approximately the size at the onset of maturity. The number of eggs in these females ranged from 2 to 5 ($\bar{X}$ = 3.6) and there was a positive correlation between female size and clutch size (r = 0.66**). The earliest collection date for a gravid female was for one specimen carrying ovarian eggs: 19 September. The latest dates were for three females carrying oviducal eggs: two collected on 3 January and one collected in "January". In that a very large number of specimens (N = 123) were collected from two nearby areas in northern New South Wales on 7-8 February 1976 and not a single gravid female was included, it would appear that, at least in this area, egg laying had ceased by the first week in February.

Sex ratio. The two largest samples mentioned above in the analyses of tail colour and body size also allow an assessment of sex ratio. The larger of the two samples (collected 8.1 km W of Drake) comprised 81 specimens. It was possible to make unequivocal sex determinations on 76 of these specimens, of which 36 were males and 40 females. The smaller sample (collected 5.4 km E of Woodenbong) comprised 37 specimens. Sex was determined for 35 of these and 18 proved to be males and 17 females. It would appear, therefore, that in neither of these populations is there a significant deviation from a 1:1 sex ratio.

Origin of the type specimen of *Calyptotis scutirostrum*. The type of *C. scutirostrum* was said to

t<t>>tttttttttttttttttt>tt>tt>t>t>t>t>>t>t>t>t8

only *C. lepidorostrum* has been found.

(2) The type specimen of *C. scutirostrum* is a *C. lepidorostrum* that lacks prefrontals. This seems unlikely in that the loss of even a single prefrontal is a very rare event in the known populations of *C. lepidorostrum* (p.37).

(3) The type locality is in error and the type specimen was collected further south, perhaps in what is now the greater Brisbane area where *C. scutirostrum* is common. This last explanation seems the most plausible.

Comparison with other *Calyptotis*. Comparisons between *C. scutirostrum* and *C. ruficauda* and *C. lepidorostrum* have been made on pp.34 and 39 respectively.

Calyptotis scutirostrum differs from *C. temporalis* in having the posteriorly projecting process from the posteromedial corner of the palatal ramus of the pterygoid short instead of long; external ear indicated by a scaly, conical depression instead of a naked tympanum; secondary temporals two instead of one; fourth toe slightly longer than third instead of subequal; phalanges in the fourth toe of pes five instead of four; more subdigital lamellae on the fourth toe (7-13, $\overline{X} = 10.0$, N = 103 vs 8-10, $\overline{X} = 9.0$, N = 8; t = 2.39*); more paravertebrals (51-64, $\overline{X} = 55.1$, N = 37 vs 46-50, $\overline{X} = 47.8$, N = 8) and more presacral vertebrae (29-30 vs 26).

Calyptotis lepidorostrum differs from *C. thorntonensis* in having the external ear indicated by a scaly, conical depression instead of a scaly, discoidal depression (scaly superficial tympanum); postorbital bone present instead of absent; fewer midbody scale rows (19-24, $\overline{X} = 20.7$, N = 107 vs 24, N = 5); fourth toe slightly longer than third instead of subequal, and phalanges of fourth and fifth toes of pes five and three respectively, instead of four and four.

Additional comparisons are provided in Table 5.

Specimens examined. The specimens examined in this study are listed below. The arrangement is roughly from north to south and from west to east.

QUEENSLAND. BMNH 1946.81697 (holotype of *obscurus*); NMV 2050; Port Bowen: ZMB 7823 (holotype of *scutirostrum*); Anamoor: AM R 59249; near "The Breadknife", headwaters of Booloumba Creek, Conondale Range: AM R 59250-59251; Gallangowan: AM R 59257; Gheerulla Creek: AM R 59252; Bunya Mountains: AM R 17702-17707, 21279, 26148, QM J 12188-12189, 23932, QNP 294, 301, 735; Marlaybrook: QM J 27522; Bunya Mountains National Park: QM J 27531-27533, 27535, 27546; approximately 4-5 km SE of Yarraman township, Yarraman State Forest: QM J 26129-26130, 26134; 6 km S of Yarraman: QM J 30414-30416; Blackbutt: AM R 59247-59248; Crows Nest: AM R 26116; Mt Glorious: AM R 26141, QM J 23703; Ravensbourne National Park: QNP 248, 736-737, 740-742; Ravensbourne: QM J 30615-30630; 24.5 km NNW of Mt. Nebo: AM R 92071; Mt. Sampson, Sampsonvale: QM J 3281-3282; Upper Brookfield: AM R 32720; Mt. Cootha: QM J 22969, 23658; Brisbane: QM J 1305, 12190; Aspley: QM J 20221-20222; Auchenflower: QM J 14390-14391; Enoggera: QM J 12185; Indooroopilly: QM J 15803; Stafford Heights: AM R 60997-60999; St. Lucia: MVZ 74779,

QM J 12177, 12184; The Gap: QM J 21371; Virginia: QM J 21426, 21437-21439; Wavell Heights: QM J 21447-21448, 21666; Zillmere: QM J 21941; Slacks Creek: QM J 12178-12179; Point Lookout, Stradbroke Island: QM J 27365; near Point Lookout; QM J 24170; Brown Lake: QM J 24077; pumping station near Dunwich: QM J 24093; 5 mi N of south end of North Stradbroke: QM J 22018; Goodna Scrub: QM J 3147-3148; near Steep Hill, Daisy Hill State Forest via Rochedale: QM J 29925; Gowrie Scrub: QM J 2446-2451; Toowoomba: AM R 54283-54284, QM J 2644-2646, 3031-3036; Cunningham's Gap: QNP 154-155; Boonah: WAM 48131-48139; 1 mi from Eagle Heights: QM J 12182-12183; Mt. Tamborine: QM J 1102-1104, 13913-13916, 13918, 18021, SAM 3365 A-C; Beechmont: QM J 13936; about 29n mi E of Warwick: AM R 54278; Emu Vale: QM J 14316-14317; Upper Emu Creek at foot of Mt. Superbus: QM J 30523-30533; Wilson's Peak: AM R 57533-57553; Mt. Ballow: QM J 26720-26721; Mt. Gipps: AM R 59254-59256; Lamington National Park: QM J 22056, 26896; McPherson Mts: CAS 77097; Springbrook: QM J 21665, QNP 272; Currumbin Creek: QM J 12186-12187; Fletcher: NMV 103, 5690-5693; Wyberba: QM J 13933.

NEW SOUTH WALES. 8.0 km E of Woodenbong: AM R 92072-92087; 5.4 km E of Woodenbong: AM R 92030-92067; 7.0 km W of Woodenbong: AM R 92068-92070; Richmond River: AM R 869; Undercliffe Falls: AM R 59253, 59258; 1 mi W of Drake: AM R 43057-43059; 8.1 km W of Drake: AM R 90387-90453, 92015-92029; 8 mi S of Drake: AM R 43052; Crooked Creek, 25 mi NE of Tenterfield: AM R 43050-43051; 5 mi W of Tenterfield: AM R 35206-35212; 11 mi SE of Tenterfield: AM R 43049; 16 mi SE of Tenterfield: AM R 43056; Rocky River, 23 mi ESE of Tenterfield: AM R 43054; 7 mi E of Sandy Flat: AM 43060-43061; between Clarence River and Grafton: QM J 26145-26146; Horton's Creek at West's Camp near junction with Cloud's Creek, 5 mi from Nymboida on Tyringham road: AM R 57569-57582; 11.5 mi SSW of Nymboida (by road): AM R 57554-57568; 14 mi NW of Dunburrabin: AM R 43046-43048; 10.4-12.0 km NW of Bostobrick Post Office: AM R 92088-92093.

LOCALITY UNKNOWN. AM 6347, QM J 12180.

Calyptotis temporalis n.sp.
Figs 10, 11

Holotype. Queensland Museum J 32594: 9.15 km W of the Cathu State Forestry Office via the road to the native pine plantation in the Clarke Range and then 1.5 km anticlockwise on the plantation loop road, Cathu State Forest, central-east Queensland; or, more approximately, about 9 km SW of Elaroo, Qld. Altitude 685 m. Collected by A. Greer on 17 August 1976. The coordinates of the type locality are 20°49′S, 148°31′E.

Paratypes. All localities are in Queensland.

Australian Museum R 60763-60764: same data as holotype; R 60765: east side of Pistol Gap, approximately 22.6 km N of Yeppoon (from the junction of the Esplanade road and the road to Rockhampton) via the Byfield road, Queensland. Altitude <76 m. Collected by A. Greer on 22 August 1976.

Queensland Museum J 13718: Rockhampton; J 25742-25743: Byfield; J 34089: Finch Hatton National Park; J 35088, 35121: 6 km along Cameron Road, Eungella.
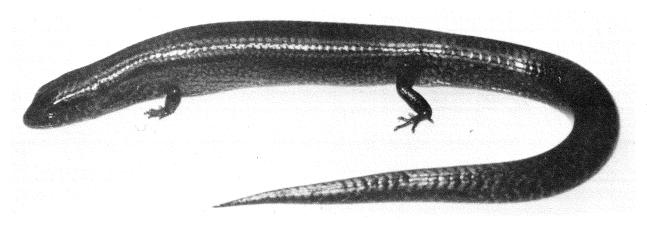
Fig. 10. *Calyptotis temporalis* from the Clark Range, Qld.

Diagnosis. *Calyptotis temporalis* differs from the congeners in each of the following two characters: a single secondary temporal instead of two and a single row of scales covering the fourth toe instead of two or more.

Description. *Calyptotis temporalis* is a small (maximum SVL = 36 mm) dark brown skink with relatively short, nonoverlapping pentadactyl limbs and a dark dorsolateral stripe that extends the length of the neck and body but is most strongly developed on the neck and anterior part of the body (Fig. 10).

Snout moderately short and deep; rostral projecting slightly between nasals; frontonasal large (undoubtedly due to incorporation of prefrontals), wider than long; prefrontals absent; frontal shorter than midline length of frontoparietals and interparietal; supraoculars four, anterior two in contact with frontal; frontoparietals distinct, each slightly larger than interparietal in total area; interparietal distinct, with small clear parietal eye spot posteriorly; parietals in broad contact behind interparietal; each parietal bordered posterolaterally by upper secondary temporal, anteriormost nuchal (which is generally transversely enlarged) and usually one or two smaller scales intercalated between the two.

Nasal moderate, separated from its fellow, with nostril centrally located; loreal single, equal to or slightly larger than nasal; preoculars two; supraciliaries seven, first and last largest; postoculars two; suboculars five, in continuous series below eye; lower eyelid scaly; supralabials six, fourth situated below centre of eye; primary temporal single; secondary temporal single, very large; external ear opening large, circular; tympanum only slightly recessed (more so along its posterior edge), scaleless, moderately to heavily pigmented; infralabials four, first in contact with postmental; mental followed by postmental and a pair of chin scales in medial contact (Fig. 11).

Transversely enlarged nuchals 0-3 ($\overline{X}$ = 2.5, mode = 3) on each side; body scales smooth, in 20-22 (mode = 20) longitudinal rows at midbody; scales in paravertabral rows slightly wider than those in more lateral rows, 46-50 ($\overline{X}$ = 47.8) in a single row; medial
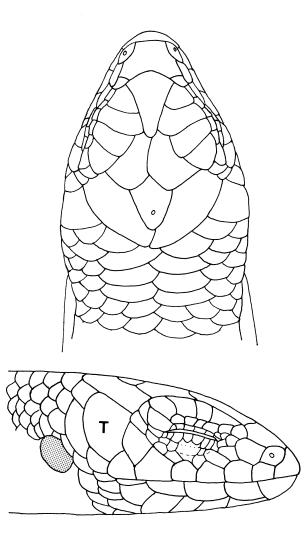

Fig. 11. Dorsal and lateral views of the holotype of *Calyptotis temporalis* (QM J 32594) from Cathu State Forest in the Clark Range, central-eastern Queensland. Note the single large secondary temporal scale (T) which is diagnostic for the species.

pair of preanals greatly enlarged; each preanal overlaps preanal lateral to it and is overlapped by preanal medial to it; medial row of subcaudals slightly wider than more lateral rows.

Digits short; fourth toe equal to or slightly shorter than third and covered above by a single row of scales; subdigital lamellae on fourth toe single with rounded tubercles basally and obtuse keels distally, 8–10 ($\overline{X}$ = 9.0, mode = 9).

Snout–vent length 32–36 mm; tail length 1.47–1.59 times SVL; front leg .16–.19 and rear leg .21–.27 times SVL.

Presacral vertebrae 26; phalangeal formulae for manus and pes 2-3-4-4-3 and 2-3-4-4-3 respectively.

Colour in preservative. Dorsum brown with aggregations of dark brown scattered over the head, generally along the suture lines, and coalesced into broken longitudinal stripes through the centres of the four most dorsal scale rows on the body; a dark brown dorsolateral stripe extends from the posterior corner of the eye to the base of the tail and is confined to the lower part of the third dorsal scale row and the upper part of the fourth at midbody; sides light brown flecked with dark brown; venter immaculate, except for scattered brown spotting on the chin, throat and neck.

Colour in life. Colour notes are available for only four specimens as follows:

AM R 60763 is a 33 mm SVL female which is reproductively inactive, to judge from its small ovaries and oviducts; in life this specimen showed no ventral colour.

AM R 60764 is a 34 mm SVL male with relatively small testes; it showed no ventral colour on the underside of the body in life but did show faint coral pink colour on the underside of the tail.

QM J 32594, the holotype, is a 35 mm SVL male with very large testes; it showed yellow ventral colour from the level of the forelegs posteriorly to the vent and coral pink colour from the level of the vent posteriorly throughout the length of the tail.

AM R 60765 is a 36 mm SVL female with large ovarian eggs; it had yellow on the ventral part of the body and no colour on the underside of the tail.

From these limited data it would appear that mature, and perhaps only reproductively active, individuals have ventral coloration and that this comprises a yellow venter in females and a yellow venter and coral pink underside to the tail in males.

Details of holotype. The holotype (QM J 32594) is a male with a snout–vent length of 35 mm and a tail length of 39 mm, of which 18 mm is regenerated; supraciliaries 7/7; enlarged nuchals 4/4; midbody scale rows 20; paravertebral scales 46, and subdigital lamellae 10/8.

Etymology. The name *temporalis* refers to the single deep secondary temporal that distinguishes this species from all other *Calyptotis*.

Distribution. To date the species is known only from Rockhampton, the Byfield area (NE of Rockhampton), Finch Hatton National Park (W of Mackay), and Cathu State Forest (SSW of Proserpine) in central east Queensland (Figs 6, 14).

Altitudinally the species ranges from the lowlands of the Byfield area up to at least 685 m in the Clarke Range of Cathu State Forest.

Although the general distributions of *C. temporalis* and *C. lepidorostrum* appear to overlap broadly in the area between the Pioneer drainage in the north and the Rockhampton area in the south, the known localities for the two species are very few, and the local distribution patterns remain to be determined. The parapatric distributions of *C. lepidorostrum, C. scutirostrum* and *C. ruficauda* in the south raise the question of whether such a distributional relationship may not also hold for *C. temporalis* and *C. lepidorostrum* in the north.

Habitat. The three specimens from the Clarke Range at Cathu State Forest (AM R 60763–60764 and QM J 32594) were in a small patch of high altitude rainforest which was surrounded on three sides by an immense Hoop Pine plantation and cut off from extensive rainforest on the fourth side by the plantation's service road. A small creek drains this small patch of rainforest and then immediately enters the much larger Plantation Creek, which in turn quickly passes under the service road and into the extensive rainforest. All three specimens were among the loose roots beneath flat stones on a rather steep bank just above the small tributary creek. The bank received partial afternoon sunlight and was moderately moist. *Taudactylus eungellensis* were abundant under the small rocks at the edge of the creek and two *Lampropholis basiliscus* were found in the forest near the creek.

The single specimen from the east side of Pistol Gap on the road to Byfield (AM R 60765) was on very dry soil under a log just above a small dry creekbed. The vegetation along the creek comprised an open depauperate rainforest with sclerophyll elements. The creekbed led into a *Melaleuca* swamp while the surrounding upland vegetation was open sclerophyll forest. The entire area was very dry at the time of collection and the only other reptile collected was a *Carlia pectoralis*.

The two Byfield specimens (QM J 25742–25643) were collected under logs in rainforest, and the single specimen from Finch Hatton National Park (QM J 34089) was collected in leaf litter at site number 9 in the Australian Museum and Queensland Museum's joint faunal survey of eastern Australian rainforests. This site lies at 180 m and is covered with wet complex notophyll vine forest. The specimen was tentatively identified as "*Sphenomorphus scutirostrus*" in the survey's preliminary reports (Anonymous, 1976 and Broadbent and Clark, 1976) and was said to have been "very abundant", although only a single specimen appears to have been collected. Other skinks recorded at the same site were an unidentified species of *Anomalopus, Carlia rhomboidalis,* a member of the
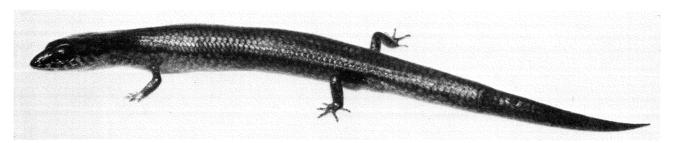
Fig. 12. *Calyptotis thorntonensis* from Thornton Peak, north-eastern Queensland.

Lampropholis challengeri complex, a member of the *Lampropholis delicata* complex, *Sphenomorphus amplus, S. quoyii* and *S. tenuis*.

Reproduction. The only gravid female in the small series is AM R 60765. This animal has a SVL of 36 mm and contains two large yolky ovarian eggs, one in each ovary. The largest male in the series (QM J 32594) has very large testes. Both animals were collected in the third week in August and both appear to have been in reproductive condition.

Comparison with other *Calyptotis*. Comparisons between *C. temporalis* and *C. ruficauda, C. lepidorostrum* and *C. scutirostrum* have been made on pp.34, 39, and 44, respectively.

Calyptotis temporalis differs from *C. thorntonensis* in having the posteriorly projecting process from the posteromedial corner of the palatal ramus of the pterygoid moderately long instead of short; the head and body moderately deep instead of depressed; prefrontals absent instead of present; external ear represented by a naked tympanum instead of a scaly, discoidal depression (scaly superficial tympanum); phalanges in the fourth toe of the manus four instead of three, and phalanges in the fifth toe of the pes three instead of four; fewer midbody scale rows (20–22, $\overline{X}$ = 20.6, N = 8 vs 24, N = 5); and fewer paravertebrals (46–50, $\overline{X}$ = 47.8, N = 8 vs 51–54, $\overline{X}$ = 53.2, N = 5).

Additional comparisons are provided in Table 5.

Calyptotis thorntonensis n.sp.
Figs 12, 13

Holotype. QM J 28354. Southern base of Thornton Peak, NE Queensland. Altitude 640 mm. Collected by W. Boles, E. Cameron, H.G. Cogger and P. Webber on 27 July 1976. The coordinates of the type locality are 16°11′S, 145°24′E.

Paratypes. AM R 56575–56577, 56603. Same data as holotype.

Diagnosis. *Calyptotis thorntonensis* differs from its congeners in each of the following characters: a more depressed head and body; external ear represented by a scaly, discoidal depression (scaly, superficial tympanum) instead of either a scaleless tympanum or a scaly conical depression, and generally more longitudinal scale rows at midbody (24 vs modes of 22 or 20).
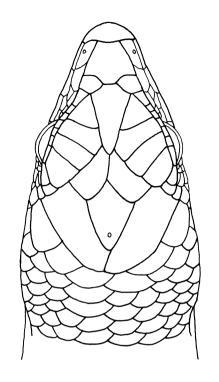
Description. *Calyptotis thorntonensis* is a small (maximum SVL = 35 mm) slightly depressed, dark brown skink with relatively short, nonoverlapping pentadactyl limbs, a finely mottled light and dark brown dorsum and a diffuse dark dorsolateral stripe, which is most pronounced on the neck and shoulder (Fig. 12).

Snout short and depressed; rostral projects moderately onto dorsal surface of snout due to depression of head but projects only slightly between nasals; frontonasal about as wide as long; prefrontals present, moderately well developed and separated medially; frontal much longer than wide, shorter than midline length of frontoparietals and interparietal; supraoculars four, anterior two in contact with frontal; frontoparietals distinct, each equal to or smaller than interparietal in total area; interparietal distinct, with conspicuous light parietal eye spot posteriorly; parietals in broad contact behind interparietal; each parietal bordered posterolaterally by a relatively long, thin upper secondary temporal, anteriormost nuchal (which is generally transversely enlarged) and generally a smaller scale intercalated between the two.

Nasal moderate in size, separated from its fellow, with nostril centrally situated; loreal single, equal to or slightly larger than nasal; preoculars two (larger and lower of two generally reaches the supralabial series but may be 'cut off' by the anterior extension of the first subocular); supraciliaries seven to eight (mode = eight); postoculars one or two; subocular series complete, comprising six scales; lower eyelid scaly; supralabials six, fourth situated below centre of eye; primary temporal single; secondary temporals two, dorsal long and thin, ventral rhomboidal and larger than primary temporal; tympanum superficial, circular, scaly; infralabials four, first only in contact with postmental; mental followed by postmental and a pair of chin scales in medial contact (Fig. 13).

Transversely enlarged nuchals 0–3 ($\overline{X}$ = 1.6, mode = 1) on each side; body scales smooth, in 24 longitudinal rows at midbody; scales in paravertebral rows only slightly wider than those in more lateral rows, 51–54 ($\overline{X}$ = 53.20) in a single row; medial pair of preanals very large, each preanal overlaps the preanal lateral to it and is overlapped by the preanal medial to it; medial row of subcaudals slightly wider than those in more lateral rows.

Digits short; fourth toe equal to or slightly shorter than third, covered by two rows of scales for most of
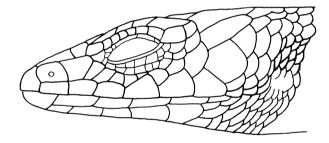
Fig. 13. Dorsal and lateral views of the head of *Calyptotis thorntonensis* (AM R 56574).

length, distalmost scale only single; subdigital lamellae on fourth toe obtusely keeled, 8-10 ($\overline{X}$ = 9.0, mode = 9).

Snout-vent length 29-35 mm; tail length 1.07 times SVL (but N = 1); front leg .16-.19 and rear leg .24-.27 times SVL.

Presacral vertebrae 26; phalangeal formulae for manus and pes 2-3-4-3-3 and 2-3-4-4-4 respectively.

Colour in preservative. Dorsum medium to dark brown with darker mottling very roughly following the scale edges, this pattern more or less conspicuous depending on the intensity of the ground colour. An ill-defined dark dorsolateral stripe extends from the loreal area through the eye and onto the body; this stripe is most distinct on the neck and shoulder. Flanks light brown with dark mottling. Venter off white, immaculate except for dark spotting on the tail and side of chin and throat. First supralabial entirely dark but succeeding supralabials with light central areas.

Colour in life. No specific notes were made on the coloration of the animals in life, but the recollection of those who handled the animals was that there was no colour.

Details of the holotype. The holotype (QM J 28354) is a male with a snout-vent length of 29 mm and a tail length of 35 mm, of which 5 mm is regenerated; supraciliaries 8/8; enlarged nuchals 3/1; midbody scale rows 24; paravertebral scales 53 and subdigital lamellae 8/10.

Etymology. The name *thorntonensis* derives from Thornton Peak, the type and, as yet, only known locality for the species.

Distribution. The species is known only from the type locality on the southern base of Thornton Peak in north-eastern Queensland at an elevation of approximately 640 m (Fig. 14).

This locality lies approximately 600 km north of the nearest population of any other member of *Calyptotis*, i.e. *C. temporalis* at Cathu State Forest.

Habitat. The type locality is site number 39 in the Australian Museum-Queensland Museum joint faunal survey of the fauna in eastern Australian rainforests (Broadbent and Clark, 1976). It is a wet mesophyll vine forest on a rather steep, rock-studded slope. All specimens were found beneath rocks.

The locality was shrouded in low clouds, mist and rain for the two days the collecting party was on the site, and to judge from the accounts of both local residents and members of other expeditions these conditions are not atypical.

The only other reptiles at the site were *Lampropholis basiliscus* and *"Tropidophorus" queenslandiae*. Both these species are endemic to the rainforests of north-eastern Queensland.

Behaviour. One of the most remarkable characteristics of *C. thorntonensis* is its sensitivity to heat. I discovered this when a large specimen I was holding gently in my fingertips in cool shade, gradually went limp and only recovered after being placed free on a piece of cool plastic. Dr H.G. Cogger also discovered the species' sensitivity when specimens began succumbing while being held in plastic bags exposed to shaded ambient midday temperatures at low elevation. The conditions under which these specimens succumbed were both fairly routine, hence the response was especially surprising and noteworthy.

Comparison with other *Calyptotis*. Comparisons between *C. thorntonensis* and *C. ruficauda, C. lepidorostrum, C. scutirostrum* and *C. temporalis* have been made on pp. 34, 39, 44, and 47, respectively and also in Table 5.

The Intrageneric Relationships of *Calyptotis*

There are ten characters which vary interspecifically in *Calyptotis* and whose phylogenetic polarity can be inferred with some confidence (see characters B, D-H and L-O in the Appendix). These characters provide a

basis for inferring the relationships of the species within the genus and for assessing their degree of divergence from each other and from their hypothetical common ancestor. In this analysis, groups are based on shared derived character states and an effort is made to minimize the number of character state changes linking the taxa in their hypothetical phylogeny (without invoking reversals).

The two most parsimonious hypotheses for the interspecific relationships of *Calyptotis* based on these characters are depicted in Figure 18. The two phylogenies differ only with regard to the placement of *C. temporalis,* and this in turn depends on whether one emphasizes the loss of a single phalange in the fourth (indicating relationship with *C. thorntonensis*) or fifth (relationship with the *C. ruficauda-C. lepidorostrum-C. scutirostrum* line) toe of the pes. In either case the consequence is the parallel loss of the phalange in the other digit. Both hypotheses are thus equally plausible and to decide between them objectively requires additional characters.

There are two general points in which the phylogenies agree. First, *C. ruficauda* is the most generally primitive species of *Calyptotis.* This species is primitive in all but one of the ten characters analysed, and thus conforms closely to the hypothetical common ancestor of the genus. The primitive character states shown by *C. ruficauda* are as follows: process of posteromedial corner of palatal ramus of pterygoid short and hence posterior notch of ramus correspondingly shallow (b) (Fig. 21); postorbital bone present (D); presacral vertebrae 26 (E); phalanges in manus 2-3-4-4-3 (f); head and body relatively deep (H); prefrontal scales present (L); external ear with a scaleless tympanum (M); secondary temporals two (N); and scales on dorsal surface of toes in multiple longitudinal rows (O). The single derived character state shown by *C. ruficauda* is the loss of a phalange in the fifth toe of the pes (g).

Second, the separation between the *C. ruficauda-C. lepidorostrum-C. scutirostrum* line and the *C. thorntonensis* line appears to go back to the common ancestor of the genus because each retains a unique primitive character: five phalanges in the fourth toe of the pes in the *C. ruficauda* line and four phalanges in the fifth toe of the pes in the *C. thorntonensis* line.

Third, *C. lepidorostrum* and *C. scutirostrum* are very closely related, the latter probably having evolved morphologically from the former simply through the fusion of the prefrontals and frontonasal.

Finally, it is worth noting that both phylogenies suggest that mosaic, parallel and convergent evolution have all occurred in *Calyptotis.* Mosaic evolution is evident, for example, in the development of the unique secondary temporal scale in *C. temporalis* with its contrastingly primitive postorbital bone, 26 presacral vertebrae, 2-3-4-4-3 phalanges in the manus, deep head and body, and naked tympanum; parallel evolution is evident in the loss of the prefrontal scales in both *C. scutirostrum* and *C. temporalis,* and convergent evolution is evident in the development of the scaly

Fig. 14. Map of Australia showing the distribution of the five species of *Calyptotis: ruficauda* (asterisks), *scutirostrum* (open circles), *lepidorostrum* (black dots), *temporalis* (open squares) and *thorntonensis* (black dot with open star).

tympanum in both the *C. lepidorostrum-C. scutirostrum* line and *C. thorntonensis.*

The Intergeneric Relationships of *Calyptotis*

Within the *Sphenomorphus* group, *Calyptotis* shares the largest number of derived character states with *Saiphos,* a monotypic genus of elongate (maximum SVL = 87 mm) tridactyl skinks which inhabit cool, moist habitats along the coastal lowlands and adjacent mountains from south-eastern Queensland south to the Illawarra area of New South Wales (Figs 15-17). The two genera share five derived character states: palatal rami of pterygoids approximately triangular in shape and separated anteriorly to varying degrees by posteriorly projecting processes from the posteromedial corners of the palatines (a); palatal rami with slight posteriorly projecting processes from their posteromedial corners (b) (Fig. 21); phalanges in fourth toe of the manus four (*Calyptotis*) or fewer (*Saiphos*-3) (f); loreal single (j); and fourth supralabial subocular (k). The two genera also share a relatively low number of longitudinal scale rows at midbody ($\leqslant$24) and a bright
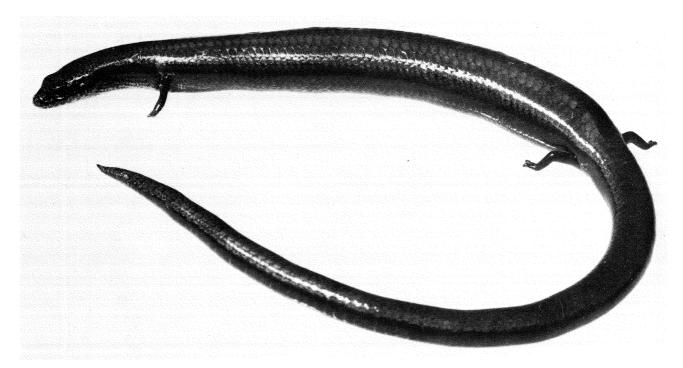
Fig. 15. *Saiphos equalis* (gravid female) from "Tallawong", Mt. Irvine, NSW.

ventral colour which involves some shade of yellow and/or red and extends from the level of the forelegs back, but the phylogenetic significance of these characters is uncertain. The morphological and ecological similarity between the two taxa plus their geographical proximity suggest that they are each other's closest living relatives.

There appear to be two equally plausible hypotheses with regard to the relationship between *Saiphos* and *Calyptotis* (Fig. 18). The first is based on a primitive character state possessed by *Saiphos* but not seen in *Calyptotis*—the postmental in contact with two infralabials (I) instead of (i)—and suggests that the two taxa shared a common ancestor with this primitive feature. The second takes note of the three derived character states shared by *Saiphos* and *Calyptotis scutirostrum*—increased number of presacral vertebrae (e), loss of prefrontals (l) and presence of a scaly auricular depression (m)—and suggests that *Saiphos* was derived from a form like *Calyptotis scutirostrum*. Under the first hypothesis the three derived character states shown between *Saiphos* and *Calyptotis scutirostrum* are interpreted as convergent, and under the second having the two infralabials in contact with the postmental is interpreted as the reacquisition of a primitive character state. Both hypotheses are supported by geography because the relevant taxa for each hypothesis—for the first *C. ruficauda* as the most generally primitive *Calyptotis* and for the second *C. scutirostrum*—are both parapatric with *Saiphos*. Additional characters will be needed to test further these two hypotheses.

It is important to note that even if *Saiphos* is closely related to *Calyptotis scutirostrum* it is still distinguished

from this and other species of *Calyptotis* by a number of unusual or unique derived character states. This makes it useful to continue treating the taxon as a distinct genus. These character states are: posteromedial processes from the palatal rami of the pterygoids extended posteriorly (b') (a similar but less well developed extension occurs in *C. temporalis*); maxilla and frontal bones in superficial contact (c); postorbital bone absent (d) (also in *C. thorntonensis*); presacral vertebrae increased to 38–40 (e'); phalanges reduced to 0-2-3-3-0 in manus (f") and to 0-2-3-3-0 in pes (g'"); and retention of the eggs either to term as in the cooler northern highlands part of its range (Bustard, 1964 and pers. obs.) or to within a few days of term in the southern part of its range (p) (pers. obs.).

If one makes the further assumption that for those characters in which the polarity of states is uncertain the primitive condition is shown by the more generally primitive species in the *C. ruficauda–C. scutirostrum* line, then the following character states can also be interpreted as derived in *Saiphos:* body length increased by approximately half (to a maximum of 87 mm from approximately 55 mm); tail length relative to SVL slightly decreased (to a maximum of 1.3 from approximately 1.5); limbs reduced in absolute size; ventral colour uniform with loss or masking of yellow on body; loss of sexual dichromatism in intensity of ventral colour, and relatively small brood size through failure of brood size to increase with body size (Table 6).

It is tempting and perhaps even reasonable to interpret most of the morphological and osteological specializations of *Saiphos vis-à-vis Calyptotis* as adaptations to its more burrowing existence. Certainly
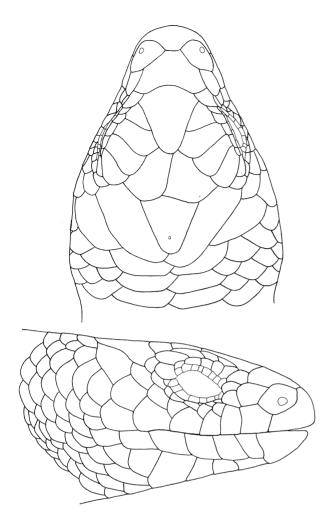
Fig. 16. Dorsal and lateral views of the head of *Saiphos equalis* (AM R 87316).

Fig. 17. Map of Australia showing the distribution of *Saiphos equalis*.

features such as body elongation, tail shortening (relative to SVL), limb and digit reduction, loss of external ear opening and perhaps loss of the postorbital are plausible burrowing adaptations, as they appear to have evolved in a number of burrowing lineages. The reproductive specializations of *Saiphos,* however, are probably best interpreted as another example of the evolution of egg retention and live bearing in a cool climate, albeit an especially interesting one in that it involves intraspecific variation. The significance of the loss of the body-tail difference in ventral colour and the loss of sexual dimorphism in the intensity of ventral colour in *Saiphos* is obscure, but may be related to its more cryptozoic habits and presumed attendant loss or reduction of the visual component in intraspecific communication.

Table 6. Summary of information on the size of gravid females and their brood size in four species of *Calyptotis* and *Saiphos equalis*.

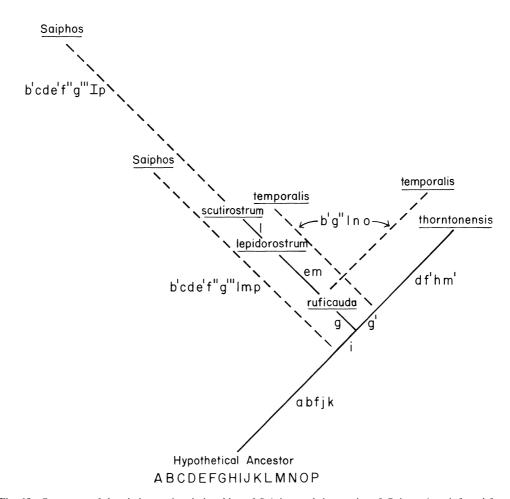|	C. ruficauda (N = 10)	C.lepidorostrum (N = 8)	C. scutirostrum (N = 21)	C. temporalis (N = 1)	S. equalis (N = 44)
Size of gravid females (mm)					
Range	42–52	39–55	42–59	36	58–87
Mean	48.5	49.3	48.5		74.7
S.D.	2.99	4.95	5.32		6.58
Brood sizes					
Range	2–6	2–4	1–5	2	1–7
Mean	3.3	3.4	3.2		2.9
S.D.	1.25	.92	.92		1.04

Fig. 18 Summary of the phylogenetic relationships of *Saiphos* and the species of *Calyptotis* as inferred from an analysis of 12 characters (C–E, G–I, L–P, see Appendix). The distance between any two species along the branches of the phylogeny is roughly proportional to the number of character state changes that separate them. The lower case letters beside each section of the phylogeny indicate the character state changes that are hypothesized to have occurred in that part of the phylogeny. Taxa whose relationships are subject to alternative interpretations have those alternatives shown by broken lines.

The Relationships of the *Calyptotis–Saiphos* Lineage

It would be interesting to know the closest living relative of the *Calyptotis–Saiphos* lineage, if for no other reason than it would allow a more detailed assessment of primitive and derived character states, and hence relationships, within the lineage itself. On the basis of present knowledge this relative would only be recognizable if it shared one or more of the five derived character states that distinguish *Calyptotis* and *Saiphos* as a lineage within the *Sphenomorphus* group (see pp.49 above).

Unfortunately, any search for this relative using these characters is hindered by two problems. First and most serious is an incomplete understanding of the distribution of the character states within the *Sphenomorphus* group. This is especially true of the osteological characters in many of the smaller and rarer species of south-east Asia and the Indo-Australian Archipelago. The second problem is convergence. This

is especially true of the two scale characters—the single loreal and fourth supralabial subocular—both of which appear to be associated with small size. Both problems would be diminished by a more thorough knowledge of the five characters within the *Sphenomorphus,* but the size of the group plus its many rare and undescribed species make it certain that this knowledge will develop only slowly.

Key to the Species of *Calyptotis*

1. External ear indicated by a shallow auditory meatus and a scaleless tympanum .. 2

——— External ear indicated by a depression that is completely scaled 3

2. Secondary temporals two; prefrontals present; upper surface of digits
    covered by two or more rows of scales .... *C. ruficauda*

——— Secondary temporal single, large; prefrontals absent; upper surface of
    digits covered by a single row of scales .... *C. temporalis*

3. Head and body relatively deep; ear a scaly, conical depression; postorbital
    bone present 4

——— Head and body depressed; ear a scaly, superficial disc (tympanum);
    postorbital absent .... *C. thorntonensis*

4. Prefrontals present .... *C. lepidorostrum*

——— Prefrontals usually absent .... *C. scutirostrum*

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Appendix

Phyletic Analysis of Character States

The method for inferring the polarity of character states used in diagnosing taxa and analysing their relationships has been discussed in enough detail elsewhere not to warrant lengthy consideration here (for recent discussions involving reptile examples see Moffat, 1973, Kluge, 1976, and Hecht, 1976). Briefly, the method is based on the assumption that the primitive state of a character that varies within a group is that state that occurs exclusively in the group's nearest relative, or if the character varies within those relatives, in the group's next most closely related relatives.

For the purposes of this analysis the group under consideration is, of course, the *Calyptotis-Saiphos* lineage, and this group's successively more distant relatives are (1) all other members of the *Sphenomorphus* group (p.30)[1]; (2) all other lygosomines with special reference to *Mabuya,* the most generally primitive living genus of this subfamily of skinks; (3) all other skinks with special reference to *Eumeces,* the most generally primitive living genus of the family, and (4) all other lepidosaurs with special reference to the Gerrhosauridae, probably the closest living relatives of skinks.

A and B. *Configuration of bones in the posterior part of the secondary palate.* In all lygosomines the palatine bones are roughly rectangular in shape and meet along the midline to form a secondary palate. In the most primitive lygosomines—*Mabuya* and the seemingly most primitive members of the *Sphenomorphus* group—the palatal rami of the pterygoids (which follow the palatines) diverge smoothly from the midline posteriorly and do not contribute substantially to the secondary palate. In several diverse lygosomine lineages, however, the palatal rami meet or approach along the midline in various configurations and thereby extend the secondary palate posteriorly.

In the *Sphenomorphus* group the most common configuration is for the palatal rami to be roughly rectangular or square in shape and to meet broadly along the midline (A). The most plausible explanation for the evolution of this configuration is through the progressive posterior apposition of the medial edges of the rami. Indeed, there is a group of closely related species in *Sphenomorphus* (members of the *variegatus* species group) that can be arranged in just such a morphocline, e.g. *S. indicus* and *S. tersus→S. nitidus* and *S. sanctus→S. striolatus* and *S. anomalopus→S. variegatus.*

In the *Calyptotis-Saiphos* lineage the palatal rami differ somewhat from the derived condition described above, i.e. palatal rami squared off and meeting medially. The rami are basically triangular in shape (i.e. narrow anteriorly and broad posteriorly) and are separated to varying degrees by posteriorly extending processes from the posteromedial corners of the palatines (Fig. 21). Unfortunately the evolution of this configuration is unclear. It could have evolved from the primitive lygosomine condition by the simultaneous medial expansion of the posterior parts of the palatal rami and the posterior extension of the posteromedial processes of the palatines, or it could have evolved from the common *Sphenomorphus* group pattern (A) by the anterior separation of the palatal rami and the posterior extension of the palatine processes (a). I suspect that the latter sequence is correct and assume it to be true for the analysis here. Be that as it may, it is clear that the basic configuration of bones in the posterior part of the secondary palate in the *Calyptotis-Saiphos* lineage is derived within the *Sphenomorphus* group and hence is of importance in diagnosing the lineage within the group.

A second important feature of the *Calyptotis-Saiphos* secondary palate is the process from the posteromedial corner of the palatal ramus (Fig. 21). This process can be viewed as yet a further extension of the secondary palate—probably from a condition in which the rami meet or are apposed at smooth rounded corners (B)— and hence appears to be yet another derived character state (b) that distinguishes *Calyptotis* and *Saiphos* as a lineage within the *Sphenomorphus* group.

The process varies in its degree of development within the lineage. In *Calyptotis ruficauda, C. lepidorostrum, C. scutirostrum* and *C. thorntonensis* the process is relatively short (b) and probably represents the primitive condition. In *Saiphos* and to a lesser extent *Calyptotis temporalis,* however, the process is somewhat longer (b') and probably represents the derived condition. The similarity between these last two forms has probably resulted from parallel evolution rather than inheritance from a common ancestor because, as the total phylogenetic analysis shows (Fig. 18), it is supported by only one other character (absence of prefrontals) and is not corroborated by geography.

C. *Superficial contact between prefrontal, nasal, frontal and maxilla bones.* These four bones may form one of two basic configurations on the dorsolateral surface of the snout of adults[1]: (1) the sutural contact between the prefrontal and nasal may be exposed due to the separation of the frontal and maxilla or (2) the frontal may contact the maxilla and thereby cover the contact between the prefrontal and nasal. In certain cases all four bones may meet at a point, but this configuration is rarely modal and with a series of adult specimens most species can be assigned unequivocally to one of the two basic configurations.

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[1]The more closely related phyletically the relatives are to the group under study, the more weight they carry in assessing the polarity of character states within the group. For reasons explained in a preceding section, however, it is not yet possible to identify the closest living relatives of the *Calyptotis-Saiphos* lineage. For this reason I have adopted the conservative approach of taking all other members of the *Sphenomorphus* group as the closest relatives of this lineage.

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[1]Ontogenetic variation makes it mandatory that mature animals be used in evaluating this character.
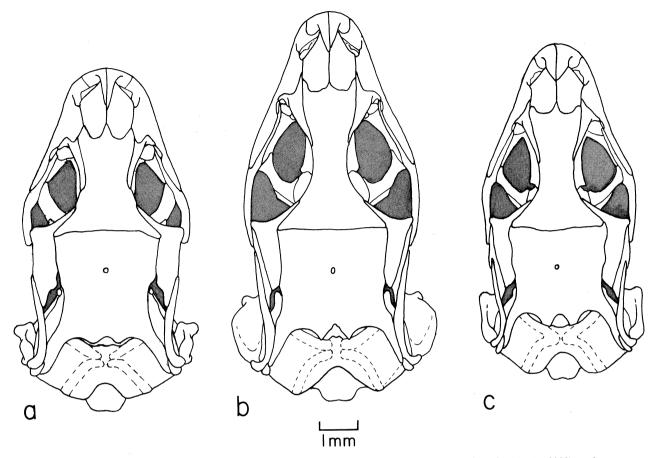
Fig. 19. Dorsal view of the skull of (a) *Saiphos equalis* (AM R 7242); (b) *Calyptotis ruficauda* (AM R 52339), and (c) *Calyptotis scutirostrum* (AM R 43061).

It is difficult to infer the phylogenetic polarity of the two configurations in the *Calyptotis-Saiphos* lineage because there are no clear trends in the taxonomic distribution of the character states in the relatives of the group. Most of the taxonomically stable genera in the *Sphenomorphus* group are characterized by one state or the other, but the genera are about evenly divided on this basis. The species within the large and taxonomically 'unstable' genus *Sphenomorphus* are also about evenly divided, and the same is true of the species of *Mabuya* (Table 7). Most species of *Eumeces* have the frontal in contact with the maxilla, but many other scincine genera have the prefrontal in contact with the nasal. The closest relatives of skinks—the gerrhosaurids—have the contact between the prefrontal and nasal exposed. This suggests that this condition is primitive for skinks as a group and that unless there is evidence to the contrary it is the condition most logically taken as primitive for any group within skinks. In this analysis, therefore, the superficial exposure of the contact between the prefrontal and nasal is taken as primitive (C) and the covering of this contact by the contact of the frontal and maxilla is taken as derived (c).

Calyptotis has the contact of the prefrontal and nasal exposed whereas *Saiphos* has this contact covered by the contact of the frontal and maxilla (Figs 19, 20).

D. Postorbital bone. The postorbital bone occurs in a wide variety of reptiles (Romer, 1956) including gerrhosaurids, and hence its presence in skinks is almost certainly the primitive condition (D) and its absence either through loss or fusion is derived (d).

The postorbital is present in *Calyptotis ruficauda, C. lepidorostrum, C. scutirostrum* and *C. temporalis* and absent in *C. thorntonensis* and *Saiphos* (Figs 19, 20). When present in *Calyptotis* the bone is long and thin and extends posteriorly to the supratemporal fenestra.

E. Presacral vertebrae. The modal number of presacral vertebrae in those skinks that have not undergone any marked limb reduction is 26 (Hoffstetter & Gasc, 1969); hence this number can be taken as primitive (E) and any deviations from it can be taken as progressive derivations (e).

Calyptotis ruficauda, C. temporalis and *C. thorntonensis* have 26 presacral vertebrae (E); *C. lepidorostrum* has 29 (e), *C. scutirostrum* 29–30 (e) and *Saiphos equalis* 38–39 (e') (Table 7).

F-G. Phalanges. The 'basic' phalangeal formulae for lepidosaurs are 2-3-4-5-3 (F) for the manus and 2-3-4-5-4 (G) for the pes (Romer, 1956). These formulae also characterize most robust-limbed,
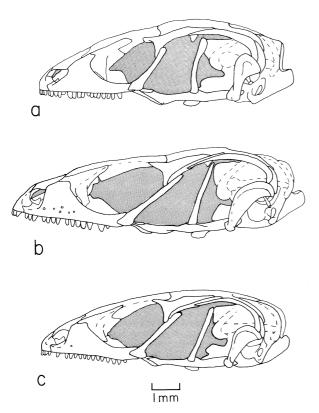
Fig. 20. Lateral view of the skull of (a) *Saiphos equalis;* (b) *Calyptotis ruficauda,* and (c) *Calyptotis scutirostrum.* Same specimens as in Fig. 19.

pentadactyl skinks, including *Eumeces* and *Mabuya.* This suggests that these formulae are primitive for skinks.

For the manus, *Calyptotis ruficauda, C. lepidorostrum, C. scutirostrum* and *C. temporalis* have a phalangeal formula of 2-3-4-4-3 (f); *C. thorntonensis* has 2-3-4-3-3 (f′) and *Saiphos equalis* 0-2-3-3-0 (f″) (Table 7). The formula 2-3-4-4-3 is taken as primitive for the *Calyptotis-Saiphos* group because it is closest to the primitive lepidosaur formula (F). The fourth phalange of the fourth toe is assumed to have been lost independently in both *Saiphos* (f→f″) and *Calyptotis thorntonensis* (f→f′). The contrary assumption, namely that the phalange was lost in an exclusive common ancestor of the two forms, seems unlikely in that it is supported by only one other character state (the absence of the postorbital bone) and is not supported by distribution.

For the pes, *Calyptotis ruficauda, C. lepidorostrum* and *C. scutirostrum* have a phalangeal formula of 2-3-4-5-3 (g); *C. thorntonensis* has 2-3-4-4-4 (g′), *C. temporalis* 2-3-4-4-3 (g″) and *Saiphos equalis* 0-2-3-3-0 (g‴) (Table 7). The formula 2-3-4-5-4 is taken as primitive (G) for the group because this is the most conservative combination that can account for the evolution of the observed formulae without hypothesizing the reacquisition of a phalange. The reason for excluding this latter possibility is that the acquisition of phalanges, at least as evidenced by hyperphalangy above the primitive number of
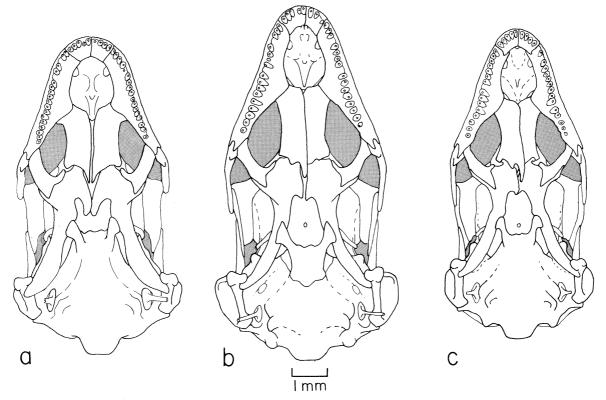

Fig. 21. Ventral view of the skull of (a) *Saiphos equalis;* (b) *Calyptotis ruficauda,* and (c) *Calyptotis scutirostrum.* Same specimens as in Fig. 19.

Table 7. Number of species in *Mabuya* and the genera of the *Sphenomorphus* group showing the prefrontal in contact with the nasal, the frontal in contact with the maxilla, or all four bones in point contact. Species reported here as having a point contact are invariably represented by single specimens. Species with equal numbers of specimens showing the prefrontal in contact with the nasal and the frontal in contact with the maxilla are scored as 0.5 in each of these columns. The total number of species in each genus is given in parentheses.

Taxon	Prefrontal contacts nasal	Frontal contacts maxilla	All four bones in point contact
Mabuya (c.75)	12	12	1
Ablepharus (5)	4	0	0
Anomalopus (12)	2	6	1
Ateuchosaurus (2)	1	0	0
Calyptotis (5)	3	0	0
Ctenotus (c.55)	1	20	0
Eremiascincus (2)	0	2	0
Hemiergis (5)	5	0	0
Isopachys (3)	1	1	1
Lerista (36)	0	9	1
Lipinia (21)	8	0	0
Lobulia (5)	0	2	0
Notoscincus (2)	1	0	0
Prasinohaema (5)	0	3	0
Saiphos (1)	0	1	0
Scincella (c.32)	6	1	0
Tropidophorus (20)	1	4	0
Sphenomorphus (c.180)	21.5	26.5	1

2-3-4-5-4, is extremely rare in skinks (known only in *Scincus* where there is an extra phalange in the fifth digit of both the manus and pes—El Toubi, 1938, and E.N. Arnold, pers. comm.). The loss of phalanges, however, is extremely common in skinks, and especially so in the *Sphenomorphus* group among lygosomines.

H. *Depth of head and body.* The head and body are relatively deep in the vast majority of skinks and hence this can be taken as the primitive condition (H) in any particular skink lineage. Conversely, a depressed head and body is rare and can be taken as derived (h).

Saiphos and all species of *Calyptotis* except *C. thorntonensis* have a relatively deep head and body. *C. thorntonensis* is noticeably depressed (Fig. 12).

I. *Number of infralabial scales contacted by post-mental scale.* The postmental contacts the first two infralabials in most lygosomines, including the generally primitive genus *Mabuya,* and hence this character state may be taken as primitive (I) in any particular lineage. Conversely, the postmental contacts the first infralabial only in relatively few taxa, for which there is no other evidence of common ancestry, and hence this character state may be taken as derived (i).

Saiphos has the postmental in contact with two infralabials (Fig. 16) but *Calyptotis* with only one (Figs 2, 5, 8, 11 and 13). A comparison of the number of infralabials and the sutural relationships of the labials make it clear that the first two infralabials have fused in *Calyptotis.*

J. *Loreal scales.* Two loreals, one anterior and one posterior, characterize the vast majority of lygosomine skinks, including the most generally primitive taxa such

as *Mabuya.* This condition, therefore, appears to be primitive (J). A single loreal, in contrast, occurs in relatively few taxa that share little else in common other than perhaps a tendency toward small size. This condition, therefore, appears to be derived (j).

Saiphos and *Calyptotis* both have only a single loreal (Figs 2, 5, 8, 11, 13 and 16).

K. *Subocular supralabial scale.* The fifth or sixth supralabial is situated below the centre of the eye in most skinks, including *Eumeces* and *Mabuya.* This suggests that one of these scales is primitive for lygosomines (K) and that higher and lower (k) numbers are derived.

Calyptotis and *Saiphos* both have the fourth supralbial subocular (Figs 2, 5, 8, 11, 13 and 16).

L. *Prefrontal scales.* A single pair of prefrontals occurs in most lygosomine skinks, including all primitive taxa of all major lineages. It would appear, therefore, that the presence of prefrontals is primitive (L) and their absence derived (l).

Prefrontals are present in *Calyptotis ruficauda, C. lepidorostrum* and *C. thorntonensis* (Figs 2, 5 and 13) but absent in *C. scutirostrum, C. temporalis* and *Saiphos* (Figs 8, 11 and 16).

M. *External ear.* An external ear comprising a naked tympanum is typical of the more generally primitive skinks such as *Eumeces* and *Mabuya.* This type of external ear, therefore, may be taken as primitive within any skink lineage in which it occurs (M). In contrast, a scaled-over tympanum may be taken as derived (m).

A naked tympanum occurs in *Calyptotis ruficauda* and *C. temporalis* (Figs 2 and 11) and a scaled-over

Fig. 22. Dorsal view of the right hind foot of (a) *Calyptotis ruficauda* (AM R 90608) and (b) *C. temporalis* (AM R 60764).

tympanum occurs in *C. lepidorostrum, C. scutirostrum, C. thorntonensis* and *Saiphos* (Figs 5, 8, 13 and 16). It seems likely, however, that the tympanum may have scaled-over in two different ways in the *Calyptotis-Saiphos* group, because in *Calyptotis lepidorostrum, C. scutirostrum* and *Saiphos* the scales are relatively small and the underlying dermis thick (m) whereas in *Calyptotis thorntonensis* the scales are larger and the dermis thinner (m').

It may be of interest to note here how little the morphology of the middle ear and its associated structures has changed in the 'earless' forms of the *Calyptotis-Saiphos* lineage. The middle ear has been examined in *Calyptotis ruficauda,* which has a distinct external auditory meatus and a scaleless tympanum, and in *C. lepidorostrum, C. scutirostrum* and *Saiphos,* which have a scaly conical depression or crease. In all four forms the similarities outweigh the differences. For example, there is always a distinct eustachian tube, middle ear cavity and round window and in all the

columella attaches to the skin at the base of the auricular depression, be it the scaleless tympanum of *Calyptotis ruficauda,* or the scaly depression of the others. The most noticeable difference is in the size of the quadratal conch. In *C. ruficauda,* the conch is fairly well developed and extends along the outer edge of the quadrate for most of its depth; in *C. lepidorostrum* and *C. scutirostrum* the conch is reduced to a small cup-like flange on the dorsal end of the quadrate, and in *Saiphos* it is completely lost and the quadrate is simply a stout vertical shaft.

It would appear therefore that despite the scaling over of the tympanum and the reduction and loss of the quadratal conch, the middle ear in the 'earless' members of the *Calyptotis-Saiphos* lineage is still attuned to receiving air-borne vibrations.

N. *Secondary temporal scales.* Two secondary temporals, one dorsal and one ventral, characterize most skinks. This condition, therefore, may be taken as primitive (N). In contrast, a single temporal is very rare in skinks; therefore, this condition may be taken as derived (n).

Saiphos and all *Calyptotis* except *C. temporalis* have two secondary temporals (Figs 2, 5, 8, 13 and 16). *C. temporalis* has only one (Fig. 11).

O. *Scales covering the dorsal surface of the digits.* Two or more rows of scales covering the dorsal surface of the digits, especially the fourth toe, appears to be primitive for the *Sphenomorphus* group (O) and a single row derived (o). The basis for this inference has been discussed elsewhere (Greer, 1979).
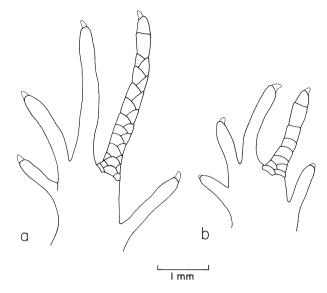
Saiphos and all *Calyptotis* except *C. temporalis* have two or more rows of scales covering the digits; *C. temporalis* has only a single row (Fig. 22).

P. *Mode of reproduction.* Oviparity—the laying of shelled eggs which develop to term outside the body of the mother—is almost unquestionably the primitive mode of reproduction for amniotes (P), and ovoviviparity—the deposition of full term young in translucent sacs—is derived (p).

The species of *Calyptotis* for which the mode of reproduction is known (*C. ruficauda, C. lepidorostrum* and *C. scutirostrum*) are oviparous. *Saiphos* is nearly

Table 8. Number of presacral vertebrae and phalanges in the species of *Calyptotis* and *Saiphos* as determined by X-ray analysis.

Taxon	Presacral Vertebrae				Phalanges	
	Range	Mean	Mode	N	Manus	Pes
Calyptotis						
ruficauda	26	26	26	10	2-3-4-4-3	2-3-4-5-3
lepidorostrum	29	29	29	9	2-3-4-4-3	2-3-4-5-3
scutirostrum	29-30	29.5	29/30	10	2-3-4-4-3	2-3-4-5-3
temporalis	26	26	26	4	2-3-4-4-3	2-3-4-4-3
thorntonensis	26	26	26	5	2-3-4-3-3	2-3-4-4-4
Saiphos						
equalis	38-40	38.5	38	17	0-2-3-3-0	0-2-3-3-0

or completely ovoviviparous: southern, lowland populations lay a calcium streaked egg which takes 7-8 days to hatch whereas northern highland populations deposit full term young which break free of their clear embryonic membranes in 1-2 days (Bustard, 1964, and Greer, in prep.).