

A NEW SPECIES OF *SALTUARIUS* (LACERTILIA: GEKKONIDAE) FROM  
GRANITE-BASED, OPEN FORESTS OF EASTERN AUSTRALIA

P.J. COUPER, C.J. SCHNEIDER AND J.A. COVACEVICH

Couper, P.J., Schneider, C.J. & Covacevich, J.A. 1997 06 30: A new species of *Saltuarius* (Lacertilia: Gekkonidae) from granite-based, open forests of eastern Australia. *Memoirs of the Queensland Museum* 42(1): 91-96. Brisbane. ISSN 0079-8835.

*Saltuarius wyberba* sp. nov., from the 'granite-belt' of southern Queensland and northern New South Wales, is separated from three of the four previously-known members of the genus in lacking male preanal pores. From the fourth, *S. swaini* (an obligate rainforest species), it is distinguished by smaller size, greater dorsoventral compression, shape and spinosity of the attenuated tail tip, colour and pattern. Analysis of mitochondrial cytochrome-b sequence data shows that *S. wyberba* sp. nov. represents an evolutionary lineage independent of the *S. swaini* populations of southeastern Queensland. □ *Saltuarius Sqamata*, Gekkonidae, granite-based forests, Queensland.

P.J. Couper & J.A. Covacevich, Queensland Museum, PO Box 3300, South Brisbane, Queensland 4101; C. J. Schneider, Zoology Department, University of Queensland, Queensland 4072, Australia 6 January, 1997.

In their recent revision of *Saltuarius*, Couper et al. (1993) recognised four species: *S. cornutus*, *S. salebrosus*, *S. occultus* and *S. swaini*. That *Saltuarius* specimens from southeastern Queensland's 'granite belt' differ morphologically (size, proportion) and in colour and pattern from those from rainforests of southeastern Queensland is well documented (Covacevich, 1975; Couper et al., 1993). Couper et al. (1993) assigned them to one of three 'forms' of *S. swaini*. The 'heavily-blotched' form was recognised from 'dry eucalypt/granite habitats centred on the Stanthorpe area, SEQ, and the New England Tableland, NSW'. The rainforest populations of *Saltuarius* in southeastern Queensland belong to *S. swaini*. Those from the open forests of the Stanthorpe area, SEQ are not simply a 'form' of *S. swaini*. Previously-recognised morphological differences, supported by biochemical data, indicate that they belong to a distinct new species. The status of *Saltuarius* specimens from the New England Tableland, NSW remains enigmatic because of scant biochemical data from these populations. *Saltuarius* specimens from the granite habitats of SEQ are easily-separated from *S. swaini*. Recognition of this new species necessitates modification to the description of *S. swaini*, and to the previously published list of specimens referred to that species by Couper et al. (1993).

Morphological characters follow Covacevich (1975) and Couper et al. (1993). Skeletal definitions follow Bauer, (1990). The following abbreviations apply: snout to vent length (SVL); tail length (T), from posterior margin of cloaca to tip of tail; attenuated tip of original tail (TT); head

length (HL); head width (HW); head depth (HD) lower jaw to top of head, between eyes; snout length (S). Additional measurements include - length of front leg (L1) axilla to tip of longest digit; length of hind leg (L2) groin to tip of longest digit; neck length (NL) axilla to posterior margin of ear. Specimen designators: Australian Museum (AMR), Queensland Museum (QMJ) and South Australian Museum (SAM). Comparative material is listed in Appendices 1 and 2.

#### SYSTEMATICS

##### *Saltuarius wyberba* sp. nov. (Figs 1-3)

MATERIAL EXAMINED. HOLOTYPE: QMJ61541 (Fig. 1), Girraween NP, Granite Arch Trail, 1-5km from Bald Rock campground, granite boulders in open forest (28°50', 151°56.04') SEQ; C. Schneider, P. Couper, M. Lara & J. Girling; 11 Nov 1995. Tissues from this specimen have been lodged with the SAM. PARATYPES: AMR92121, R92123, 6km W of Amiens (28°34'S, 151°46'E) SEQ; AMR98332, Approx 1.5km NW of Amiens (28°34'S, 151°46'E) SEQ; QMJ35401, Boonoo Falls, via Tenterfield (28°48'S, 152°10'E) NSW; QMJ25374, Girraween NP, via Stanthorpe (28°50'S, 151°55'E) SEQ; QMJ28648-49, Girraween area, nr Wyberba (28°50'S, 151°55'E) SEQ; QMJ29115-J29117, Stanthorpe area, ?Girraween (28°50'S, 151°55'E) SEQ; QMJ30677, Stanthorpe, Aztec Temples, nr Underground R (28°50'S, 152°05'E) SEQ; QMJ-27349, Girraween NP, nr (28°50'S, 151°55'E) SEQ; QMJ51633-J51636, Girraween NP, Natural Arch track (28°50'S, 151°55'E) SEQ; QMJ51093, Girraween NP, edge, outside park (28°50'S, 151°56'E)

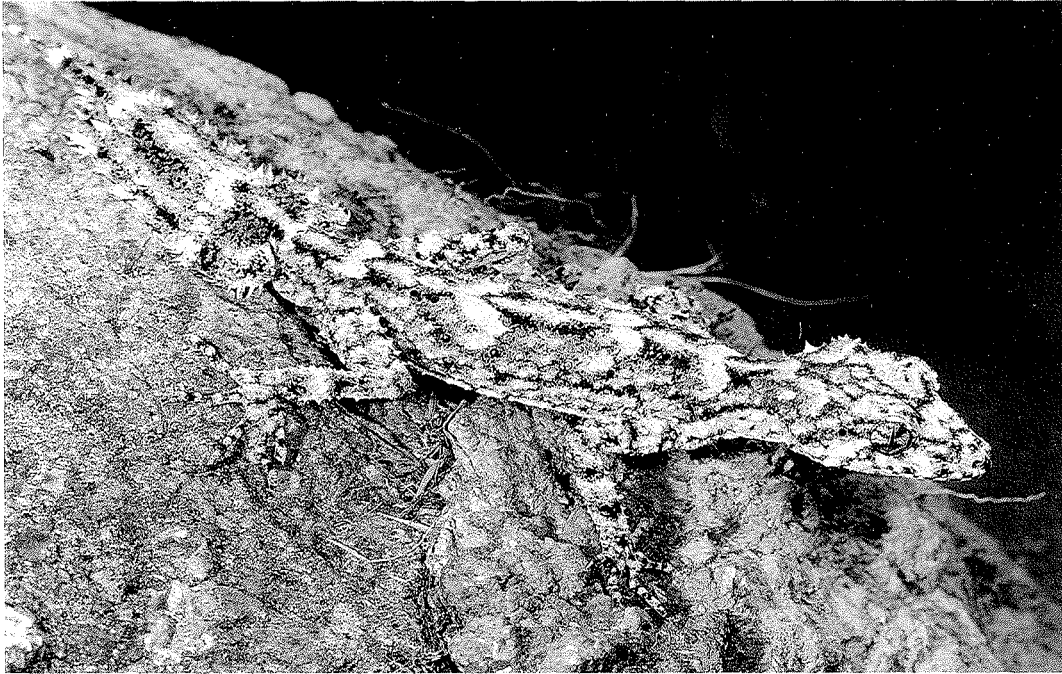


FIG. 1. The holotype of *Saltuarius wyberba* sp. nov. (QMJ61541).

SEQ; QMJ61539-40, J61542-45, Girraween NP, Granite Arch Trail, 1-5km from Bald Rock campground (28°50', 151°56.04') SEQ; QMJ50345, Girraween NP (28°51'S, 151°55'E) SEQ; QMJ54847, Bookookoora, Boonoo SF (28°51'S, 152°11'S) NSW; QMJ30420, Wyberba, nr (28°52'S, 151°52'E) SEQ.

**ETYMOLOGY.** Wyberba is a rail-siding on the western boundary of Girraween National Park, in the Stanthorpe area, SEQ. The name is reported to be of Aboriginal origin, and said to mean 'at the end of the mountain' (Harslett & Royle, 1980). The epithet is to be treated as a noun in apposition.

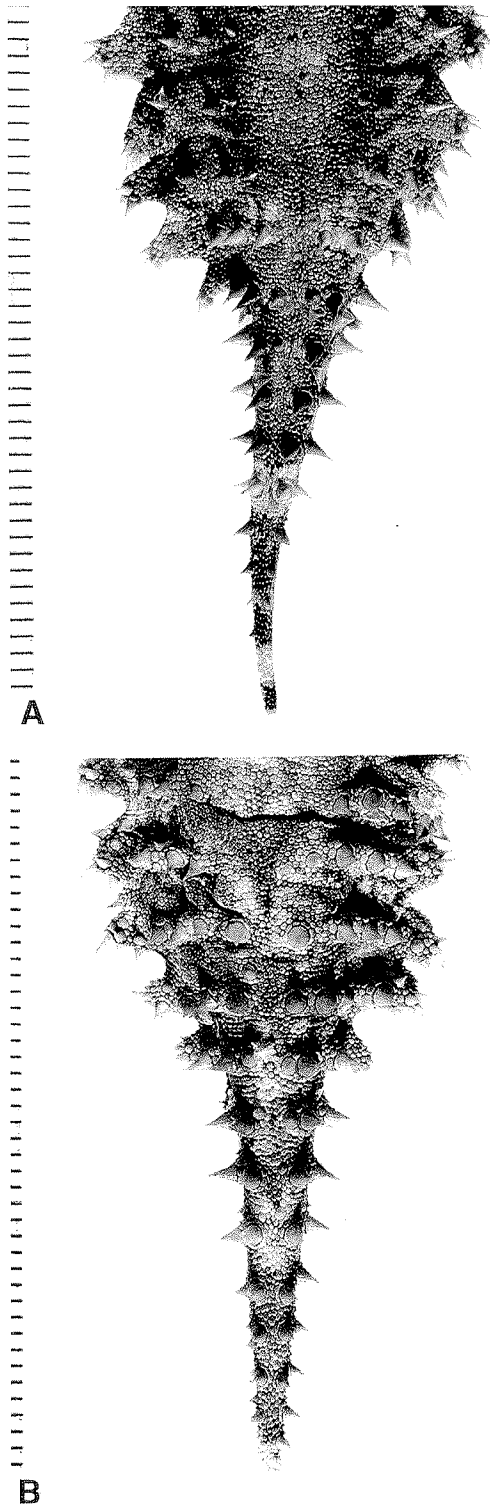
**DIAGNOSIS.** *Saltuarius wyberba* sp. nov. is distinguished from *Saltuarius* spp. except *S. swaini*, in lacking male preanal pores. *S. wyberba* is separated from *S. swaini* by size (max SVL 109.2mm vs 131mm); in being more dorsoventrally compressed (mean HD 38% HW n=26 vs 45% n=35), and by the shape and spinosity of the attenuated tail tip (finely tipped with only minute tubercles, Fig. 2a vs bluntly tipped with large tubercles, Fig. 2b). Colour pattern also distinguishes these two species. *S. wyberba* is grey to tan, with a pale vertebral stripe and heavy brown to black blotching. *S. swaini* is grey or mid-dark brown with lichen-like, dark-edged,

dorsal blotches or grey/brown with a pale vertebral streak. *S. wyberba* has a wide, open V-shaped marking between the eyes (Fig. 3a). In *S. swaini* this is a narrow deep V (Fig. 3b).

**DESCRIPTION.** SVL(mm): 75.4-109.2 (n = 27, mean = 95.2). Proportions as % SVL: T = 68.4-80.9 (n = 11, mean = 72.4); TT = 26.8-32.4 (n = 11, mean = 29.4); L1 = 40.1-51.6 (n = 25, mean = 44.9); L2 = 51.0-59.7 (n = 24, mean = 55.3); HL = 26.4-29.5 (n = 27, mean = 27.8); HW = 20.5-23.7 (n = 27, mean = 22.3); HD = 7.2- 9.7 (n = 26, mean = 8.5); S = 11.0-12.9 (n = 27, mean = 12.1); NL = 15.6-21.9 (n = 25, mean = 19.4).

**Head.** Large, depressed, triangular, distinct from neck; covered in small granules which are intermixed with large rounded to conical tubercles; skin of head coossified with skull; rostral completely divided by a single deep groove (n = 26), or almost completely divided (n = 1); rostral contacting nostril; ear opening elliptical, vertical, much less than half as large as eye; supralabials 13-18 (n = 54, mean = 14.6); infralabials 10-14 (n = 54, mean = 12.2); Tongue colour in life, grey/purple.

**Neck.** Moderate to broad, 31-48% HW.



Body. Moderate, depressed, covered in small granules; dorsal granules intermixed with larger conical tubercles; tubercles moderate to large on back, flanks and neck; lower flank tubercles small to large, sometimes associated with a lateral flange running from axilla to groin; basal scales surrounding flank tubercles slightly enlarged; granules on throat noticeably smaller than those on chest and belly.

Preanal pores. Absent.

Limbs. Long, covered in pointed tubercles dorsally; digits strong, compressed distally; subdigital lamellae (fourth toe) 18-24 (n = 54, mean = 20.4).

Original tail. (n = 11) Depressed, broad and contracted at base and attenuated at tip; anterior flared portion surrounded by an undulating flange which bears slender, sharply pointed tubercles around its margin; dorsal surface of tail (except along midline of flared portion) covered in large conical tubercles which are particularly pronounced on the attenuated tip: tail tip slender and free of tubercles, or with only minute tubercles; number of rows of enlarged spinose tubercles anteriorly across the attenuated tip 4-6 (n = 11, mean = 5.5); attenuated tip accounts for 38-45% of total tail length; ventral surface smooth with a shallow groove along the midline of attenuated tip.

Regenerated tail. (n = 11) Depressed, broad and leaf-like contracted at base and only just attenuated at tip; tail margin is a broad, thin flange which bears minute spinose tubercles around the edges; tail free from spinose tubercles on both dorsal and ventral surfaces; ventral surface without any indication of a shallow groove along the midline.

*Skeletal Features.* Supraocular portion of frontal grooved; anterior process of interclavicle not present; epipubic cartilage expanded; presacral vertebrae 25; sacral vertebrae 2; lumbar vertebrae 2; 1st autotomy septum 6; abdominal vertebrae bearing reduced ribs 4; rib free cervicals 3; cervical vertebrae not elongate; sternal ribs 3; mesosternal ribs 2; based on QMJ29115 (alizarin stained).

*Pattern (in spirit).* Dorsum tan or grey; heavily marked with dark brown/black or grey blotches on head, body and limbs; a narrow vertebral

FIG. 2. Attenuated, original tail tips of the *Saltuarius* species. A, *S. wyberba* (QMJ61541), with a finely tipped tail, and only minute tubercles; B, *S. swaini* (QMJ5649), with a bluntly tipped tail, and large tubercles.

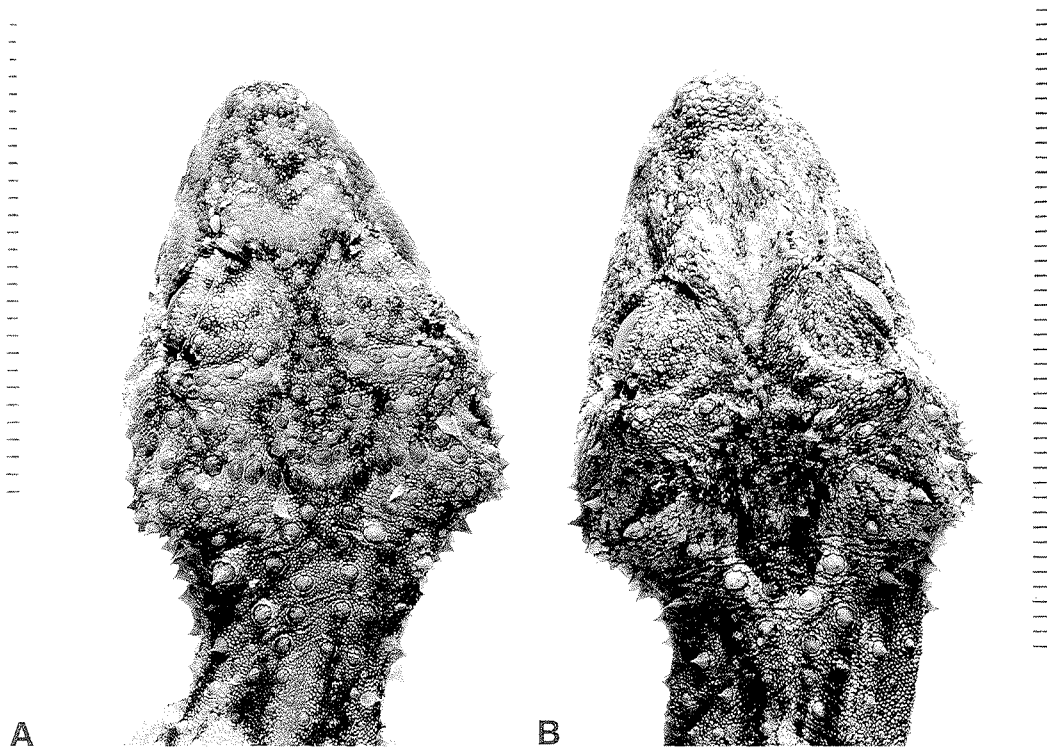


FIG. 3. Markings between the eyes in the *Saltuarius* species. A, *S. wyberba* (QMJ61541), with a wide, open 'V'; B, *S. swaini* (QMJ51638), with a narrow, deep 'V'.

stripe, broken by four irregular tan or grey blotches, extends from neck to base of tail; a wide, open V-shaped marking between the eyes (Fig. 3a); labials light grey, mottled with dark brown; toes prominently marked by alternating pale and dark crossbands. Venter cream with clusters of dark brown granules which often form irregular bars below the infralabials, and on the anterior margin of the thigh. Original tail grey to tan above, marked with four to six irregular pale crossbands which extend to the ventral surface on the attenuated tail tip; cream to pale grey below, mottled with brown, and with a series of pale blotches along the midline of the anterior flared portion. Regenerated tail pale grey, or tan with darker marbling.

*Measurements and Scale Counts.* Holotype (QMJ61541): SVL(mm): 97.56, T = 69.55, TT = 26.19, L1 = 43.0, L2 = 53.6, HL = 26.0, HW = 21.0, HD = 8.2, S = 11.6, NL = 17.2, supralabials 13/13, infralabials 13/12, subdigital lamellae (4th toe) 22/22.

#### GENETICS

Analysis of mitochondrial cytochrome-b sequence data supports the recognition of *Saltuarius* populations from granite habitats in the Stanthorpe area (28°40'S, 151°56'E) SEQ, as distinct from *S. swaini* sensu stricto. 372 base pairs of the 5' end of the light strand (and corresponding heavy strand) of the cytochrome-b gene were sequenced from 7 individuals from Girraween National Park (28°50'S, 151°55'E), near Stanthorpe, and compared with homologous sequences from all species of leaf-tailed geckos including 2 individuals representing *S. swaini* from Lamington National Park (28°14'S, 153°08'E) and Mt Tamborine (27°58'S, 153°11'E). Amplification of target DNA was achieved from CsCl gradient purified mtDNA and/or total genomic DNA extracts with primers Ph-1 and MVZ04 (primer sequences available from CJS). PCR was performed in 25 l reactions with 1.5mM MgCl<sub>2</sub>, 0.5U Taq polymerase (Promega), 1X Promega Thermobuffer, 60M each dNTP, 0.2M each primer, and 30 cycles with 45

seconds at 94°C, 45 seconds at 45°C, and 45 seconds at 72°C. Automated sequencing of double-stranded products followed manufacturer's (ABI) suggested protocols. Analyses are those of one of us (CJS), unpub. data. Phylogenetic analysis reveals that Girraween sequences form a strongly supported sister group to a monophyletic group — composed of the Lamington-Mt Tambourine sequences (100% of bootstrap replicates in parsimony analysis with all characters unordered and equally weighted). Sequences from the Girraween group differ from the Lamington-Mt Tambourine group at 13.8% of sites, a level of difference similar to that among species of the closely related genus *Phyllurus* (*P. isis*, *P. nephtys*, and *P. ossa* differ at 10.0-13.9% of homologous sites). These data, in combination with morphological differences indicate that the Girraween NP *Saltuarius* populations represent an evolutionary lineage independent of the Lamington-Mt Tambourine populations.

Tissue samples from *Saltuarius* specimens from localities in New South Wales are scant. However, tissues (AMR141964-5, tissue sample numbers NR878-9) were obtained from specimens in two populations of *Saltuarius* at Chelundi State Forest (30°01'07"S, 152°30'02"E & 30°03'04" S, 152°21'36"E), NSW. Chelundi SF is near Guy Fawkes NP, approximately 145kms SW of Girraween NP. Cytochrome-b sequences from these individuals differ slightly from each other (0.5%) and form a sister group to the *Saltuarius* populations of Girraween NP, SEQ. Importantly, these sequences differ from the Girraween samples at approximately 11% of sites and from Lamington-Mt Tambourine, SEQ sequences at 12.6-13.1% of sites. Given the level of sequence differences and the discontinuity of suitable habitat, it seems unlikely that the Chelundi and Girraween populations are conspecific. However, in the absence of comprehensive data, their status remains uncertain.

#### REMARKS

Populations of *S. wyberba* from the granite-based forests of the Stanthorpe area, SEQ are morphologically and genetically distinct from populations of *S. swaini* occurring in the rainforests of southeastern Queensland. Specimens QMJ53984, AMR141964-65, AMR43870, AMR123490 and AMR149768, listed in Appendix 2, are of uncertain status. Morphology and colour-pattern of these specimens readily separate them from *S. swaini*. Although they are sim-

ilar in some respects to *S. wyberba* (colour/pattern) they have been excluded from the type series because morphological variations set them apart from *S. wyberba* from SE Queensland. (Specimen QMJ53984, Mann R. Nature Reserve, NSW, has large, scattered granules intermixed among the small granules of the chin. There is no evidence of this character in any of the specimens from the Stanthorpe area). *Saltuarius* specimens similar in colour and pattern to *S. wyberba* have been recorded from dry, open forests associated with granite as far south as Armidale, 30°31'S, 151°40'E (H. Hines pers. comm.). The possibility that isolates of granite-based forest in N NSW may support several species of *Saltuarius* is not without precedent. In a recent review, Couper et al. (1993) described three new species of *Phyllurus* from rainforests in coastal, mid-eastern Queensland. All occur in extremely close proximity on rainforest-covered mountains, their populations being separated by narrow corridors (9-30km) of open forest. Two of these species (*P. nephtys* and *P. ossa*) may be sympatric in the Clarke Ra. A parallel situation may occur in the granite-based, open forest habitats of SE Queensland and N NSW (28°40'-30°31'S). Here, exposed granite occurs as isolated outcrops and distinct gorge systems in a 'sea' of dry, open forest (New England hardwoods). It seems possible that each separate 'island' may also support a distinct *Saltuarius* sp. Assessment of the status of these *Saltuarius* populations hinges on extensive collecting and genetic sampling throughout the 'granite belt' of SE Queensland and N NSW.

Although *S. swaini* sensu stricto appears to be a rainforest species, it may occur in sympatry with *S. wyberba* in granite-based open forests in the Amiens region (28°34'S, 151°46'E), SEQ. A single specimen (AMR92122) morphologically indistinguishable from *S. swaini*, has been collected from '6km NW Amiens' (Couper et al., 1994). Available data suggest *S. swaini* is an obligatory rainforest species, with the exception of this enigmatic specimen. There is no reason to question data associated with AMR92122. Ross Sadlier of the Australian Museum (in litt., 23 April, 1996) regards the collector of this specimen as supplying data that was 'usually better than average'. Specimen AMR92122 has been formalin-fixed. Attempts to extract useable DNA for a genetic assessment of this specimen were unsuccessful.

## S. SWAINI SENSU STRICTO

With the recognition of *S. wyberba*, the following changes apply to the description of *S. swaini* Wells & Wellington (Couper et al, 1993). Material examined: specimens QMJ35401, QMJ-24250, QMJ27349, QMJ25374, QMJ28648-9, QMJ29115-7, QMJ30677, QMJ51093, QMJ-51633-6, QMJ54847, QMJ50345, QMJ30420, AMR92121, AMR92123, AMR98332, AMR-110510 are *S. wyberba*, not *S. swaini*. Specimens QMJ53984, AMR141964-65, AMR43870, AMR123490 and AMR149768 (Appendix 1) are *Saltuarius* sp. incerta cedis. Morphology: *S. swaini* has a deep head (mean head depth 45% HW) and the attenuated tail tip has large spines, and terminates bluntly (Fig. 2b). Meristics: the range for each measurement provided by Couper et al. (1993) remains unchanged (all measurements for *S. wyberba*, except HD, fall within the range previously given for *S. swaini*). Colour/pattern: two principle colour forms exist: 1) grey-medium brown with both paler and darker blotches in the base colour; these blotches are edged with brown or black lines to give a 'lichen-like' effect; often with a pale vertebral streak. 2) grey or mid-dark brown with a pale vertebral streak.

## ACKNOWLEDGEMENTS

The authors thank the Co-operative Research Centre for Tropical Rainforest Ecology and Man-

agement and the Centre for Conservation Biology, University of Queensland; the Queensland Museum; Ross Sadlier (Australian Museum), Harry Hines, Guy Hodgson (NSW National Parks and Wildlife Service), Noel Cortinas, Kate Couper, Amy Couper, Jenny Faulkner, Janie Girling, Marcia Lara, Mary Mulcahy, Simon and Jenny Ormsby Jeff Wright, Steve Wilson and Lauren Keim, who assisted us in the preparation of this work.

## LITERATURE CITED

- BAUER, A.M. 1990. Phylogenetic systematics and biogeography of the Carphodactylini (Reptilia: Gekkonidae). Bonner Zoologische Monographien 30: 1-217.
- COUPER, P.J., COVACEVICH, J.A. & MORITZ, C. 1993. A review of the leaf-tailed geckos endemic to eastern Australia: a new genus, four new species, and other new data. *Memoirs of the Queensland Museum* 34(1): 95-124.
- COUPER P.J., COVACEVICH, J.A. & MORITZ, C. 1994. Designation of the type species of *Saltuarius*, and other data on the genus. *Memoirs of the Queensland Museum* 35(1): 26.
- COVACEVICH, J. 1975. A review of the genus *Phyllurus* (Lacertilia: Gekkonidae). *Memoirs of the Queensland Museum*. 17(2): 293-303.
- HARSLETT, J. & ROYLE, M. 1980. They came to the plateau (International Colour Productions: Stanthorpe, Qld) 213pp.

## APPENDIX 1.

Specimens of *Saltuarius swaini* examined in the current study. All localities are for Queensland unless otherwise indicated.

QMJ398, J2409, J2933-34, J3254, J4439, J8183, J8359, J8861, J10440, J12257, J51095 Mt Tamborine, (27°55'S, 153°10'E); J4819, Mt Tamborine, Eagle Heights (27°55'S, 153°12'E); J148 Canungra Ck (27°58'S, 153°09'E); J3215 Canungra (28°01'S, 153°11'E); J4198, J5690 Mudgeeraba (28°05'S, 153°22'E); J5649 Flying Fox Valley, Beechmont (28°08'S, 153°12'E); J3313 Tallebudgera (28°08'S, 153°26'E); J5382 Lamington NP (28°12'S, 153°05'E); J8646 Lamington NP Binna Burra (28°12'S, 153°11'E); J51094 Mt Superbus SF, via Warwick, (28°13'S, 152°28'E); J51637-40 O'Reilly's, Lamington NP (28°14'S, 153°08'E); J23937 near Mt Ballou, (28°16'S, 152°37'E); J8074, J8075 (alizarin stained), J8099 Mt Clunie, via Boonah (28°18'S,

152°32'E); J1143 Tweed R. (28°18'S, 153°27'E) NSW; J5757 Chillingham, Murwillumbah (28°19'S, 153°17'E) NSW; J10565 Mt Lindesay (28°23'S, 152°43'E) SEQ; J54846 Bray's Ck, Border Ranges NP (28°24'S, 153°03'E) NSW; J9054 Bulahdelah, 96km NE Newcastle (32°25'S, 152°12'E) NSW.

## APPENDIX 2.

Specimens of uncertain status from granite habitats in NSW. QMJ53984, Teapot Ck, Narrow Pass Fire Trail, Mann River Nature Reserve (29°45'S, 152°02'E) NSW; AMR141964, Chaelundi SF, (30°01'07"S, 152°30'02"E) NSW; AMR141965, Chaelundi SF, Sundew Lookout (30°03'04"S, 152°21'36"E) NSW; AMR43870, 35km E. of Guyra (30°15'S, 152°00'E) NSW; AMR123490, Tullawudjah CK, NSW; AMR149768, Black Ck, 6.1km SE along Black Hole Trail, Curramore SF (29°30'30"S, 152°11'24"E) NSW.