



<http://dx.doi.org/10.11646/zootaxa.3694.6.1>

<http://zoobank.org/urn:lsid:zoobank.org:pub:78CB5CDB-354D-4814-B7F7-ABA7AE9D8585>

A new species of lizard in the genus *Caledoniscincus* (Reptilia: Scincidae) from southern New Caledonia and a review of *Caledoniscincus atropunctatus* (Roux)

ROSS A. SADLIER¹, AARON M. BAUER², PERRY L. WOOD, Jr.^{2,3}, SARAH A. SMITH^{2,4}
& TODD R. JACKMAN²

¹Section of Herpetology, Australian Museum, 6 College Street, Sydney 2000, NSW, Australia

²Department of Biology, Villanova University, 800 Lancaster Avenue, Villanova, Pennsylvania 19085, USA

³Department of Biology and Bean Life Science Museum, Brigham Young University, Provo, UT, 84602, USA

⁴Eco Logical Australia Pty Ltd., 16/56 Marina Boulevard, Cullen Bay 0820, NT, Australia

Abstract

A new species of skink, *Caledoniscincus notialis* **sp. nov.**, is described from the ultramafic ranges in southern New Caledonia. It is most similar to, and has previously been referred to *Caledoniscincus atropunctatus* (Roux), a species with a widespread distribution throughout the Grand Terre and Loyalty Islands. The new species is distinct genetically from all other *Caledoniscincus* and can be distinguished by a unique pattern of dorsal coloration in males. Its range extends over much of the extensive ultramafic block in the south of the island, including the Goro Plateau and the mountain ranges at the southern edge of the Chaîne Centrale north to Mt. Humboldt. It occurs mainly in humid forest habitat, much of which is now present only as isolated fragments in southern New Caledonia. Its preference for a habitat that has undergone a significant reduction in area of extent in a region under pressure from a range of anthropogenic threats suggests this new species is of conservation concern, and could be ranked as Vulnerable under IUCN listing. The genetic relationships of a redefined *Caledoniscincus atropunctatus* identifies two major subgroups, one located mainly in the northern and central-east regions of Grand Terre and the other in the southern and central-west regions and also including the population on the Loyalty Islands.

Key words: Reptilia, Scincidae, southern New Caledonia

Résumé

Une nouvelle espèce de scincidé *Caledoniscincus notialis* **sp. nov.** est décrite des massifs ultra-mafiques du sud de la Nouvelle-Calédonie. Elle est le plus semblable à *C. atropunctatus*, une espèce à large répartition sur l'ensemble de la Grand Terre et les Îles Loyauté à laquelle elle était autrefois rattachée. La nouvelle espèce est génétiquement différente de tous les autres membres du genre *Caledoniscincus* et s'en distingue par un patron unique de coloration dorsale chez les mâles. Sa répartition s'étend sur la majorité des blocs ultra-mafiques du sud de l'île, y compris le Plateau Goro, les massifs de la bordure méridionale de la Chaîne centrale et au nord jusqu'au Mt. Humboldt. On la rencontre principalement dans les forêts humides, la plupart d'entre elles n'existant plus que sous la forme de lambeaux au sud de la Nouvelle-Calédonie. Sa préférence pour un habitat soumis à une ré

duction significative de son étendue dans une zone sujette à de fortes menaces d'origine anthropogénique suggère que cette nouvelle espèce présente un statut particulier pour sa conservation. Elle doit être classée dans la catégorie Vulnérable selon les critères des listes de l'UICN. Les relations génétiques de *C. atropunctatus* tel que nous le redéfinissons ici permettent de distinguer deux sous-groupes principaux, l'un localisé surtout dans les régions nord et centre-est de la Grand Terre et l'autre dans les régions sud et centre-ouest, ce dernier incluant également la population des Îles Loyauté.

Introduction

The island of New Caledonia has a rich and diverse scincid lizard fauna with 52 described species in 15 genera, all belonging essentially to the Australasian *Eugongylus* group (sensu Greer 1979). All, except three species in two widespread genera (*Emoia* Gray and *Cryptoblepharus* Wiegmann), are part of an endemic New Caledonian radiation (Smith *et al.* 2007). The diversity of the endemic New Caledonian scincid lizard fauna (49 species in 13 regionally endemic genera) can be fully appreciated when compared with the regional skink faunas of significantly larger land masses in the Pacific region (e.g., New Zealand's 33 species in 1 genus; Chapple *et al.* 2009). Additionally, this diversity includes at least double the number of putative genera for the *Eugongylus* group of skinks found in New Guinea, and approaches the generic diversity for the *Eugongylus* group found Australia.

Extensive investigation of the relationships and diversity of the New Caledonian skinks (all taxa except three) using mitochondrial and nuclear DNA sequence data has identified the New Caledonian and New Zealand skinks as sister taxa in a monophyletic 'Tasmantis' group (Smith *et al.* 2007; Chapple *et al.* 2009) and the existence of several putatively cryptic taxa in different genera. Sequence data from all species of *Caledoniscincus* identified two highly divergent lineages in the samples previously assigned to *Caledoniscincus atropunctatus* (Roux).

Caledoniscincus is the most diverse genus of New Caledonian skinks with 13 species recognized based on morphological and genetic criteria (Sadlier, Bauer & Wood, unpublished). Species in the genus can be distinguished primarily by combinations of male dorsal color pattern and ventral coloration, and for a few taxa attributes of size, scalation and osteology. Superficially, individuals belonging to the two genetic lineages and previously regarded as *C. atropunctatus* are very similar in appearance. Adult males of both lineages have dark colored bodies with pale markings present on the dorsal scales that yield a highly spotted appearance, whereas females of both lineages are two-toned with light-mid brown dorsal surfaces contrasting with a darker upper lateral surface. Individuals of both sexes lack a dark mid-rostral streak, a character state long considered diagnostic for the species (Sadlier 1986; Bauer & Sadlier 2000), given that all its congeners possess a dark marking on the middle of the rostral scale. However, examination of live and preserved museum specimens has revealed diagnostic differences in the adult male coloration consistent with the allocation of individuals to the two genetic lineages. In one the pale markings on each scale consist of a single large spot on the posterior margin and a smaller spot on the lateral margins, while in the other lineage the pale markings on each scale (when present) consist of several pale flecks often located on the raised keels of each individual scale. The lectotype of *Lygosoma austro-caledonicum atropunctatum* Roux (see photographs and notes in Sadlier 1986) designated by Kramer (1979) is an adult male from the far north-east of Grand Terre with the dorsal color pattern featuring a large spot on the posterior margin and a smaller spot on the lateral margin of each body scale. Individuals sampled in this study with a dorsal color pattern matching the lectotype were recovered as a strongly supported lineage in the phylogenetic analyses presented here, and as such we recommend that *Caledoniscincus atropunctatus sensu stricto* be regarded as comprising populations characterized by this trait. Populations in this lineage extend across all major regions of the Grand Terre, the Loyalty Islands and into Vanuatu. The results of the phylogenetic analyses also indicate significant regional sub-structuring exists within this redefined *Caledoniscincus atropunctatus*.

In southern New Caledonia the distribution of pale markings on the dorsal scales of adult males included in the genetic study conforms with their assignment to the lineages characterized by that trait, indicating consistent morphological differentiation between these taxa in an area of broad regional sympatry. Populations belonging to the genetic lineage characterized by a pattern of pale flecks (*versus* spots) on the body scales were recorded from near coastal and interior forest habitats on ultramafic surfaces in the south of the island, whereas *Caledoniscincus atropunctatus sensu stricto*, the genetic lineage characterized by a pattern of pale spots on the body scales, was more frequently recorded from coastal habitats, although both species have been recorded in local sympatry from humid forest habitat of the interior at Rivière Bleue.

The new species described here occurs only in habitats on the nickel bearing ultramafic substrates that cover most of southern Grand Terre. Much of the region is under mining concessions and large-scale mining occurs in the far south on the Goro Plateau and is projected to further develop in throughout the region. As a consequence, the remaining small isolated fragments of forest on an already highly fragmented landscape could be threatened by these activities. The invasive Little Red Fire Ant, *Wasmannia auropunctata* (Roger), has been identified as a major threat to small lizards (Jourdan *et al.* 2001), and is widespread in coastal and inland regions of the south and has also invaded low–mid elevation humid forests.

Materials and methods

Acronyms: Specimen abbreviations are prefixed as follows: AMS Australian Museum, Sydney; MNHN Museum National d'Histoire Naturelle, Paris; CAS California Academy of Sciences, San Francisco; USNM United States National Museum of Natural History, Washington; NHMB Naturhistorisches Museum, Basel.

Measurements: The following characters were scored for each specimen (to the nearest 0.5mm) where possible: snout–vent length (SVL)—measured from tip of snout to caudal edge of anal scales; axilla–groin distance—measured from middle of base of the forelimb to middle of base of hind limb; forelimb–snout length—measured from tip of snout to middle of base of forelimb; hind limb length—measured from middle of base of hind limb to tip of fourth toe including nail; tail length—measured from caudal edge of anal scales to tip of tail, on complete original tails only. Body measurements are expressed as percentages of snout to vent length (SVL) in the taxon accounts. Examination of X-rays for a subset of specimens showed a very high number had incomplete tails, as such only the length of the longest tail is given from the few individuals that could confidently be determined as having complete tails, and is intended as guide comparative to other species in the genus.

Scalation: Head scalation generally follows Sadlier (1986). For characters used in Table 1 the abbreviation is given in parentheses: midbody scale rows (MBR)—number of longitudinal scale rows around body counted midway between axilla and groin; dorsal scale rows (DSR)—number of scales in a row from first scale posterior to parietal scale to last scale at the level of vent opening; fourth finger (FFS) and toe (FTS) scales—number of dorsal scales on fourth digit of hand and foot, distal scale contains claw and basal scale broadly contacts adjacent basal scale of third finger or toe; fourth finger (FFL) and toe (FTL) lamellae—number of ventral scales on fourth digit of manus or pes, distal scale borders the claw and basal scale is last largely undivided scale at a point level with intersection of third and fourth digits. Bilaterally scoreable scalation characters were scored on both sides and the mean value used; in the holotype description these values are presented as left/right values. Variation between species and populations was assessed using independent two-sample *t*-tests for size and scalation characters.

Osteology: Specimens were X-rayed for determining the number of presacral and postsacral vertebrae. For the new species recognized here a series of four individuals from the Ni River, four from the Pourina River and eight from Mt. Humboldt were X-rayed, and for *Caledoniscincus atropunctatus sensu stricto* a series of six individuals from Houaïlou and two from Plum. The number of postsacral vertebrae data was only taken from individuals that could confidently be determined as having complete tails.

Genetic studies: We obtained sequence data from a 514 bp fragment of the mitochondrial NADH dehydrogenase 2 (ND2) gene from 47 samples representing 27 locations determined as *Caledoniscincus atropunctatus sensu stricto* on the basis of the distribution of pale markings as spots on the dorsal scales of adult males in the populations sampled, and 24 samples representing nine locations determined as *Caledoniscincus* sp. on the basis of the distribution of pale markings as streaks on the dorsal scales of adult males in the populations sampled. Sixteen samples representing all other described species of *Caledoniscincus* were also included in the ingroup. Outgroups were selected on the basis of a broader phylogenetic analysis of New Caledonian skinks by Smith *et al.* (2007) and sequences for these were obtained from GenBank.

Total Genomic DNA was isolated from liver or skeletal muscle specimens stored in 95% ethanol using the Qiagen DNeasy™ tissue kit (Valencia, CA, USA). The target gene was amplified using a double-stranded Polymerase Chain Reaction (PCR). Included in the reaction were 2.5 µl genomic DNA, 2.5 µl light strand primer MET F6 L4437 5'-AAGCTTTCGGGCCCATACC-3' (Macey *et al.* 1997), 2.5 µl heavy strand primer TRP R3 H5540 5'-TTTAGGGCTTTGAAGGC-3' (Macey *et al.* 1997), 2.5 µl dinucleotide pairs, 2.5 µl 5x buffer, MgCl 10x buffer, 0.18 µl Taq polymerase, and 9.82 µl H₂O. All reactions were executed on an Eppendorf Mastercycler gradient thermocycler under the following conditions: initial denaturation at 95°C for 2 min, followed by a second denaturation at 95°C for 35 s, annealing at 50–54°C for 35 s, followed by a cycle extension at 72°C for 35 s, for 31 cycles. PCR products were visualized on 1.5% agarose gel electrophoresis.

PCR products were purified using AMPure magnetic bead solution (Agentcourt Bioscience, Beverly, MA, USA) to remove any impurities in the PCR products. Purified PCR products were then sequenced using DYEnamic™ ET Dye Terminator kit (GE Healthcare, Piscataway, NJ, USA). Products were purified using a Cleanseq magnetic bead solution (Agentcourt Bioscience, Beverly, MA, USA). Purified sequence reactions were analyzed using an ABI 3730XL automated sequencer. Sequences were analyzed from both the 3' and the 5' ends independently. Both the contiguous and the complimentary strands were uploaded and edited in Genious™ version

5.4 (Drummond *et al.* 2011), ambiguous bases were corrected. After editing the sequences they were initially aligned by eye. MacClade v4.08 (Maddison & Maddison 2005) was used to check for premature stop codons and to ensure that the alignment was in the correct amino acid reading frame.

For our phylogenetic analyses we applied a pluralistic approach using both model-based (Maximum Likelihood—ML and Bayesian Inference—BI) and character-based methods (Maximum Parsimony—MP). Maximum Parsimony (MP) was implemented in PAUP^M v4.0 (Swofford 2002). The heuristic search algorithm was used with a starting tree obtained by stepwise addition. One thousand random addition replicates were carried out with a TBR branch swapping algorithm. Branch lengths of zero were collapsed to yield polytomies and gaps were treated as missing data. Bootstrap support values (Felsenstein 1985) for nodes in MP trees were calculated using 1000 pseudo-replicates each including 50 random addition-sequence replicates.

The Akaike Information Criterion (AIC) as implemented in ModelTest v3.7 (Posada & Crandall 1998) was used to calculate the best-fit model of evolution for both ML and BI. For both model-based approaches we partitioned our data set by codon position. The General Time Reversal (GTR) plus (I) for proportional sites plus (Γ) for gamma distribution among site variation was applied for all codon positions

Maximum Likelihood analysis was performed using RAxML HPC v7.2.3 (Stamatakis *et al.* 2008). The analysis was performed using the above model of evolution. Gaps were treated as missing data and clade support was assessed with 1000 bootstrap pseudoreplicates using the rapid hill-climbing algorithm (Stamatakis *et al.* 2008).

The Bayesian analysis was carried out in MrBayes v3.1 (Huelsenbeck & Ronquist 2001; Ronquist & Huelsenbeck 2003) using default priors. The GTR+I+ Γ model was applied to each codon position. Two simultaneous runs were performed with 4 chains per run, 3 hot and 1 cold following default settings. The analysis was run for 10,000,000 generations and sampled every 1000 generations from the Markov Chain Monte Carlo (MCMC). The analysis was halted after 10,000,000 generations if the average standard deviation split frequency was below 0.01. The program Are We There Yet? (AWTY) (Nylander *et al.* 2008) was used to plot the log likelihood scores against the number of generations to assess convergence and to determine the appropriate burn-in. A consensus tree from the two runs was built using TreeAnnotator v1.6.1 (Drummond & Rambaut 2006). Nodes that had posterior probabilities above 0.95 were considered significantly supported.

The content and order of authors for the description of each species reflects the individual contributions of those individuals to the discovery and recognition of that species, and as such does not necessarily reflect the content and arrangement of authors for this article as a whole.

Results

The results of the extensive sampling of *Caledoniscincus* species (Fig. 1) for the mitochondrial DNA study identified two widely divergent genetic groups (minimum sequence divergence 12.8–13.8% Table 1) within the samples previously assignable to *Caledoniscincus atropunctatus sensu lato*. There is complete concordance between these genetic groups and the configuration and distribution of pale markings on the dorsal scales of adult males in the populations sampled. The consistency between the diagnostic morphological markers and the genetic groups retrieved in the molecular phylogeny identifies these groups as each representing a distinct evolutionary lineage. Voucher specimens of adult males in the genetic study with a dorsal color pattern of pale markings on the scales similar to that in the lectotype of *C. atropunctatus* belonged to the lineage that is widespread over New Caledonia, the Loyalty Islands and extending into Vanuatu (hereafter *Caledoniscincus atropunctatus sensu stricto*). Voucher specimens of adult males with a dorsal color pattern of pale flecks belonged to the lineage restricted to ultramafic surfaces in the south of the island (hereafter *Caledoniscincus sp. nov.*).

Significant intraspecific genetic structure exists within the widespread *Caledoniscincus atropunctatus sensu stricto*. Four well supported regionally parapatric groups characterized by relatively high levels of inter-group divergence (Table 2) were identified: a localized group centered around central-east coastal ultramafic surfaces (group 1 of Table 2); a group on the central-east metamorphic ranges and central-east near-coastal ultramafic surfaces (group 2 of Table 2); a widespread group on the northwest region including the Belep Islands (group 3 of Table 2); and a ‘southern’ subgroup represented by samples from the southern and central-west regions of the Grand Terre plus the Loyalty Islands and Vanuatu (group 4 of Table 2). Each of the four groups was recovered as well supported monophyletic clades, and the first three groups received a moderate level of support (PP .81) in forming a broader ‘northern’ supergroup.

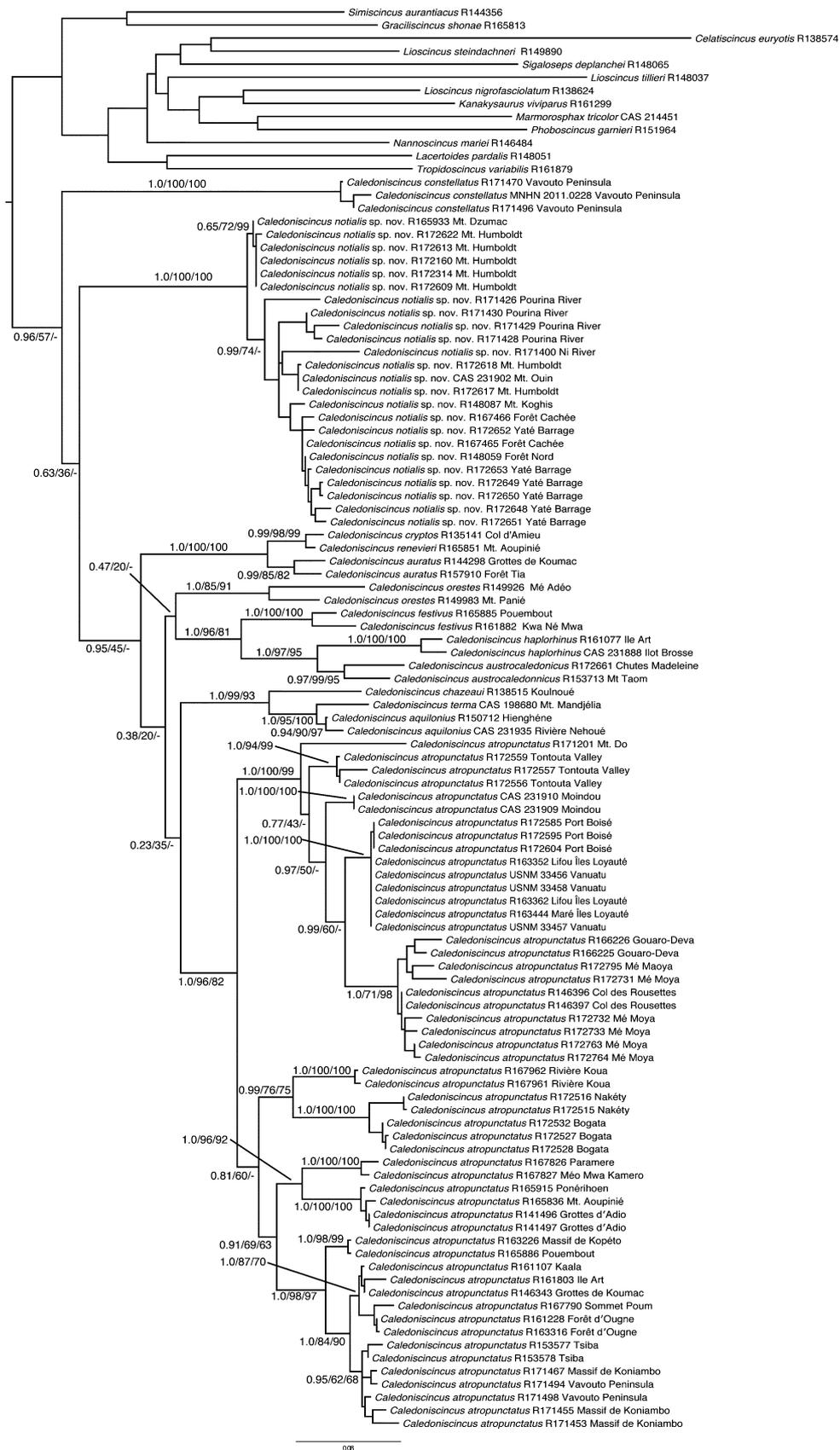


FIGURE 1. Phylogenetic relationships among the populations of *Caledoniscincus notialis* sp. nov. and *Caledoniscincus atropunctatus* with the relative position of each species within the genus. Bayesian topology is shown with posterior probabilities and MP bootstrap support shown.

TABLE 1. Pairwise sequence divergences (range %) between all species of *Caledoniscincus* and *Caledoniscincus notialis* **sp. nov.** (below the diagonal) and intraspecific genetic diversity all species (on diagonal – bolded).

	<i>notialis</i>	<i>cryptos</i>	<i>chazeaui</i>	<i>renevieri</i>	<i>auratus</i>	<i>orestes</i>	<i>festivus</i>	<i>aplorhinus</i>	<i>austro.</i>	<i>terna</i>	<i>aquilonius</i>	<i>atropunct.</i>
<i>notialis</i> sp. nov.	0.0–7.3%											
<i>cryptos</i> Sadlier, Bauer & Colgan	15.3–17.9%	-										
<i>chazeaui</i> Sadlier, Bauer & Colgan	12.6–17.9%	12.80%	-									
<i>renevieri</i> Sadlier, Bauer & Colgan	14.3–16.8%	1.75%	12.40%	-								
<i>auratus</i> Sadlier, Bauer & Colgan	12.8–16.3%	5.2–6.2%	11.4–12.2%	5.60%	3.50%							
<i>orestes</i> Sadlier	13.0–17.6%	12.6–13.4%	11.4–12.2%	13.4–13.6%	12.2–13.0%	7.30%						
<i>festivus</i> (Roux)	11.0–16.3%	13.2–14.2%	11.4–12.4%	12.2–12.8%	11.2–13.0%	12.2–14.7%	3.60%					
<i>aplorhinus</i> (Günther)	14.2–16.8%	14.2–14.6%	12.0–12.2%	14.0–14.2%	13.2–15.0%	13.8–14.9%	11.0–12.4%	2.80%				
<i>austrocaledonicus</i> (Bavay)	13.4–16.8%	14.9–15.7%	13.0–13.6%	14.3–15.3%	13.4–14.2%	14.5–15.5%	9.0–11.8%	9.5–9.8%	6.00%			
<i>terna</i> Sadlier, Bauer & Colgan	14.4–16.9%	13.80%	8.50%	13.80%	13.0–14.9%	12.8–14.4%	12.2–13.4%	14.2–14.9%	14.9–15.1%	-		
<i>aquilonius</i> Sadlier, Bauer & Colgan	14.2–16.6%	12.2–11.2%	7.5–7.7%	12.6–13.6%	12.0–13.8%	12.6–13.4%	11.4–13.0%	14.4–14.6%	15.1–15.5%	3.8–4.8%	1.30%	
<i>atropunctatus</i> (Roux)	12.8–18.1%	12.0–17.2%	10.7–15.1%	11.2–16.3%	12.2–16.9%	10.5–15.4%	11.0–16.7%	12.5–16.7%	13.4–17.7%	12.0–15.7%	11.2–15.5%	0.1–13.0%

TABLE 2. Pairwise sequence divergences (range %) between the groups of *Caledoniscincus atropunctatus sensu stricto* (below the diagonal) and within the sub-groups (on diagonal—bolded).

	<i>atropunctatus</i> Group 1 central-east	<i>atropunctatus</i> Group 2 central-east	<i>atropunctatus</i> Group 3 north-east & north-west	<i>atropunctatus</i> Group 4 southern & central-west
<i>atropunctatus</i> (1)	0.1–7.9%			
<i>atropunctatus</i> (2)	7.9–10.5%	0.0–7.3%		
<i>atropunctatus</i> (3)	7.9–10.5%	7.1–10.3%	0.1–5.2%	
<i>atropunctatus</i> (4)	8.3–13.8%	9.5–13.4%	8.3–13.8%	0.0–9.2%

TABLE 3. Variation in body length (SVL—adults only) and number of midbody scale rows (MBR), dorsal scale rows (DSR), fourth finger (FFS) and toe (FTS) scales, and fourth finger (FFL) and toe (FTL) lamellae between samples of *Caledoniscincus notialis sp. nov.*, *Caledoniscincus atropunctatus* (all populations combined), *C. atropunctatus* populations putatively assignable to the northern genetic group, *C. atropunctatus* populations putatively assignable to the southern genetic group (excluding the Loyalty Island population) and the population of *C. atropunctatus* from the Loyalty Islands—note not all *C. atropunctatus* populations combined could be assigned to either the northern or southern genetic groups with confidence. The *t* values relate to independent *t*-tests for characters for comparisons between samples of: *C. notialis sp. nov.* and *C. atropunctatus* all populations (under *C. notialis sp. nov.*); between *C. atropunctatus* northern group and *C. atropunctatus* southern group (under *C. atropunctatus* northern); and between *C. atropunctatus* southern group and *C. atropunctatus* Loyalties population (under *C. atropunctatus* Loyalties)—highly significant P values <0.01 have been highlighted.

	<i>notialis sp. nov.</i>	<i>atropunctatus</i> all populations	<i>atropunctatus</i> northern group	<i>atropunctatus</i> southern group	<i>atropunctatus</i> Loyalties
SVL	n = 60	n = 80	n = 35	n = 32	n = 9
range	40–57	32–54	35–54	40–53	31–41
mean	46.8	46.8	43.7	47.4	37.3
	$T_{144} = 3.250$ P = 0.001		$T_{66} = 3.960$ P = 0.000		$T_{39} = 8.791$ P = 0.000
MBR	n = 60	n = 86	n = 38	n = 33	n = 9
range	26–32	26–32	26–30	28–32	28–30
mean ± sd	29.9 ± 1.18	29.3 ± 1.20	28.7 ± 1.08	29.8 ± 1.10	29.6 ± 0.88
	$T_{144} = 2.631$ P = 0.009		$T_{69} = 3.820$ P = 0.000		$T_{40} = 0.432$ P = 0.668
DSR	n = 59	n = 85	n = 37	n = 33	n = 9
range	49–61	49–63	52–63	50–60	49–56
mean ± sd	54.3 ± 2.94	55.6 ± 2.42	55.95 ± 2.32	55.8 ± 2.40	53.2 ± 1.92
	$T_{142} = -2.772$ P = 0.006		$t_{68} = -0.227$ P < 0.821		$T_{40} = 2.995$ P < 0.005
FFS	n = 60	n = 85	n = 38	n = 32	n = 9
range	9–13	8–11	8–11	8–11	8–9
mean ± sd	11.1 ± 0.63	9.1 ± 0.48	9.15 ± 0.52	9.1 ± 0.47	8.7 ± 0.36
	$T_{143} = 21.974$ P = 0.000		$t_{68} = -0.296$ P = 0.768		$T_{39} = 2.277$ P = 0.028
FFL	n = 59	n = 85	n = 38	n = 32	n = 9
range	14–20	12–17	13–17	12–16	14–16
mean ± sd	17.2 ± 1.08	14.8 ± 0.84	14.8 ± 0.89	14.9 ± 0.89	14.8 ± 0.75
	$T_{142} = 14.8111$ P = 0.000		$t_{68} = 0.339$ P = 0.736		$T_{39} = 0.128$ P = 0.899
FTS	n = 60	n = 85	n = 38	n = 32	n = 9
range	11–18	11–15	11–14	11–15	11–14
mean ± sd	15.6 ± 1.11	12.5 ± 0.88	12.6 ± 0.91	12.7 ± 0.86	12.0 ± 0.93
	$T_{143} = 18.326$ P = 0.000		$t_{68} = 0.301$ P = 0.764		$T_{39} = 1.976$ P = 0.055
FTL	n = 59	n = 85	n = 38	n = 32	n = 9
range	26–36	24–31	24–31	25–31	24–28
mean ± sd	31.3 ± 1.65	26.7 ± 1.56	26.5 ± 1.38	27.3 ± 1.53	25.4 ± 1.55
	$T_{142} = 15.385$ P = 0.000		$t_{68} = 2.186$ P = 0.032		$T_{39} = 3.231$ P = 0.003

We could find no clear cut morphological differentiation concordant with the genetic groups within *Caledoniscincus atropunctatus sensu stricto* (Table 3), but did detect intriguing morphological novelties peculiar to certain regions. Samples from the Loyalty Islands (and Vanuatu) were much smaller at maturity than ‘southern group’ samples from the Grand Terre which they grouped with genetically, and samples from some ultramafic massifs in the north-west region have a pattern of pale spots on the body as subadults and adults of both sexes (a feature usually typical only of adult males) (see ‘Variation’ in account for *Caledoniscincus atropunctatus*).

At the broadest level of comparison (all *Caledoniscincus atropunctatus sensu stricto* versus *Caledoniscincus sp. nov.*), tests for differences in scalation showed highly significant differences in number of dorsal scales and in the mean number of scales above and below the longest (fourth) digit of the manus and pes (Table 3), however all characters show some degree of overlap in the range of values for the two species. Samples from both species from the area of broad regional sympatry in southern New Caledonia showed a similar pattern of differentiation in scalation of the digits, but with a narrower overlap in the range of values for some characters, most significantly for the number of dorsal scales and lamellae of the fourth digit of the pes.

Tests for sexual dimorphism in scalation on a large sample ($n = 34$) of *Caledoniscincus sp. nov.* from the Goro Plateau found no significant differences ($P < 0.001$) between the sexes for the scalation characters surveyed except for the number of fourth toe lamellae in which significant difference was detected ($t_{33} = 3.160$, $P = 0.003$), and tests for sexual dimorphism in scalation on a large sample of *Caledoniscincus atropunctatus sensu stricto* from Plum in southern Grand Terre ($n = 19$) showed a significant difference between the sexes for dorsal scale rows of the body.

Systematics

The species of *Caledoniscincus* Sadlier range from moderately small (*Caledoniscincus chazeaui* Sadlier, Bauer & Colgan, maximum SVL 43mm) to moderately large in size (*C. festivus* (Roux), maximum SVL 72mm) with moderately well developed limbs and digits, and a moderately long tail (~ 150% of SVL across most species in the genus). In scalation and osteology they share the following suite of characters (apomorphic character states for genus denoted by asterisk *; polarities follow Sadlier [2010]): *body scales with three strong keels dorsally; supranasal absent; *nasal scale with a postnasal crease; frontonasal broader than long; *prefrontals reduced in size and widely separated; frontal nearly as broad as long; supraoculars four; *frontoparietals fused; interparietal distinct; parietals in broad contact behind interparietal, and each bordered by a single nuchal and upper secondary temporal scale; primary temporal single; lower secondary temporal single; tertiary temporals two; postlabials two; nasals moderately to widely separated; anterior loreal higher than wide; supraciliaries seven; upper labials 7 with the fifth subocular and contacting the lower eyelid; postmental contacting first and second lower labial; transversely enlarged chinshields three, first pair in broad contact, second pair separated by one scale, third pair separated by three scales; premaxillary teeth 11; altantal arches of first cervical vertebrae fused to the *intercentrum; presacral vertebrae 29; phalangeal formula for the manus 2.3.4.5.3 and for the pes 2.3.4.5.4.; two pairs of mesosternal ribs contacting the mesosternum; *hemipenes distinctly bifurcated.

The species of *Caledoniscincus* are all conservative in morphology with minimal diagnostic differentiation between species in body proportions or scalation (see Sadlier *et al.* 1999). The most notable difference between the species is in adult male coloration. In each species of *Caledoniscincus* the adult females typically retain a color pattern similar to that of juveniles, whereas the adult males change in pattern and often also develop a different ventral coloration to that of adult females.

The genetic data in combination with diagnostic morphological differences in adult male coloration indicate two species exist within what has previously been regarded as *Caledoniscincus atropunctatus*. Here we describe the new species and redefine *C. atropunctatus*.

***Caledoniscincus notialis* sp. nov. Sadlier, Smith, Bauer & Wood**

Figs.2–5

Holotype. MNHN 2011.0277 (formerly AMS R.166147^M) New Caledonia, Province Sud, Plaine des Lacs, Route de La Wajana 22°16'35"S 166°58'38"E (22 December 2003, R. Sadlier & G. Shea).

Paratypes. All from sites within the Province Sud of New Caledonia: AMS R.148029–30 Mt. Ouin (south face) 22°01'33"S 166°28'32"E (26 September 1995, R. Sadlier & G. Shea); AMS R.148087 Mt. Koghis 22°10'S 166°30'E (30 September 1995, R. Sadlier & G. Shea); AMS R.148059 Plain des Lacs, Kwa Neie 22°18'55"S 166°54'47"E (28 September 1995, R. Sadlier & G. Shea); R152631–32 Rivière Bleue, track to Vue Panoramique vicinity Pont Germain 22°5'44"S 166°40'7"E (21 May 1998, R. Sadlier & A. Bauer); AMS R.161897 Monts Kwa Né Mwa, 7km W crossing of Rivière des Pirogues (Rte.1) 22°12'22"S 166°40'43"E (23 February 2002, R. Sadlier); AMS R.161915, AMS R.161924 Le Bois de Sud 22°10'22"S 166°45'53"E (23 February 2002, R. Sadlier); AMS R.164219–20 Pic du Pin 22°14'20"S 166°50'7"E (13 December 2004, R. Sadlier & G. Shea); AMS R.164266 Pic du Pin 22°14'53"S 166°49'45"E (14 December 2004, R. Sadlier & G. Shea); AMS R.164273 Pic du Pin 22°14'20"S 166°50'7"E (14 December 2004, R. Sadlier & G. Shea); AMS R.164328 Pic du Grand Kaori 22°17'5"S 166°53'42"E (16 December 2004, R. Sadlier & G. Shea); AMS R.164343 Forêt Nord 22°19'5"S 166°55'18"E (17 December 2004, R. Sadlier & G. Shea); AMS R.165766–67 Plaine des Lacs, Route de la Mine 22°16'52"S 166°57'13"E (24 December 2003, R. Sadlier & G. Shea); AMS R.165771 Plaine des Lacs, Route de la Mine 22°17'47"S 166°57'33"E (23 December 2003, R. Sadlier & G. Shea); AMS R.165776–77, AMS R.165796 Mt. Ouin 22°01'33"S 166°28'32"E (26 December 2003, R. Sadlier & G. Shea); AMS R.165809 Mt. Ouin 22°01'S 166°28'E (26 December 2003, R. Sadlier & G. Shea); AMS R.165933 Mt. Dzumac 22°01'56"S 166°28'21"E (20 September 2002, R. Sadlier & A. Bauer); AMS R.166028–29, AMS R.166031–33, AMS R.166036 Plaine des Lacs, Route de la Goro/Route de la Mine Intersection 22°18'17"S 166°57'39"E (12 December 2003, R. Sadlier & G. Shea); AMS R.166059–64 Pic du Grand Kaori 22°17'05"S, 166°53'42"E (13 December 2003, R. Sadlier & G. Shea); AMS R.166157 Plaine des Lacs, Route de la Wajana 22°17'4"S 166°58'57"E (22 December 2003, R. Sadlier & G. Shea); AMS R.166189–90, AMS R.166192 Plaine des Lacs, Route de la Wajana 22°17'35"S 166°59'33"E (24 December 2003, R. Sadlier & G. Shea); AMS R.167417–18 2.7km SE Ka Yé Wagwé, Plaine des Lacs 22°13'17"S 166°54'25"E (7 February 2007, R. Sadlier & A. Whitaker); AMS R.167425 3.5km SSE Ka Yé Wagwé, Plaine des Lacs 22°14'22"S 166°53'48"E (8 February 2007, R. Sadlier & A. Whitaker); AMS R.167465–66 Forêt Cachée, Creek Pernod, Plaine des Lacs 22°11'50"S 166°47'13"E (16 February 2007, R. Sadlier & A. Whitaker); AMS R.171400, AMS R.171401–03 Ni River Valley 21°53'01"S 166°32'14"E (11 November 2008, R. Sadlier); AMS R.171427, AMS R.171428–30 Pourina River Valley 22°1'39"S 166°43'37"E (13 November 2008, R. Sadlier); AMS R.172609–10, AMS R.172613–14, AMS R.172617–18, AMS R.172622 Mt. Humboldt (1349–1415m) 22°52'S 166°24'E (13–17 October 2009, R. Sadlier & C. Beatson).

Etymology. The species epithet *notialis* is taken from the Greek *notos* for southern and is in reference to the distribution of the species in the south of the Grand Terre.

Diagnosis. *Caledoniscincus notialis* **sp. nov.** differs from all other species of *Caledoniscincus* (except *Caledoniscincus atropunctatus*) in several features of coloration: both sexes lack an obvious dark mid-rostral marking (*versus* a dark marking forming a medial streak extending from the base of the rostral scale in all other *Caledoniscincus*). Both sexes lack obvious orange or yellow ventral coloration (*versus* prominent ventral coloration in males and to a lesser degree females in most other *Caledoniscincus*—see Sadlier *et al.* 1999). Adult males have a dorsal pattern that primarily features only individual pale markings on a dark background to the body scales (for descriptions and illustrations of patterns in other *Caledoniscincus* species (see Sadlier *et al.* 1999; Bauer & Sadlier 2000).

Adult male *Caledoniscincus notialis* **sp. nov.** can be distinguished from adult male *C. atropunctatus* in having a dorsal pattern in which the pale markings when present on the individual scales in adult males (usually one in every three scales, occasionally all) consist of several fine white flecks positioned along the long axis of the keels *versus* a pattern in which the pale markings are present on each individual scale and consist of a single large pale spot on the poster-medial edge of each scale and pale border to the antero-lateral edge either side of each scale (Fig. 2). Juvenile and adult female *C. notialis* **sp. nov.** are not readily distinguished from juvenile and adult female *C. atropunctatus* in coloration and pattern.

The two species showed a highly significant level of difference ($t < 0.005$) in mean scalation of the digits, but in nearly all cases there is extensive overlap in ranges of values, limiting the use of these characters as unequivocal markers for diagnosing individuals to either species. In southern Grand Terre, where the two species are present, differences in the number of scales on the upper and lower surfaces of the fourth toe may assist with determination of some juvenile and adult female specimens, with *Caledoniscincus atropunctatus* from the region having a tendency toward a lower range of dorsal toe scales (11–15 *versus* 13–17) and lamellae (24–31 *versus* 28–36) for the fourth toe than *C. notialis* **sp. nov.**

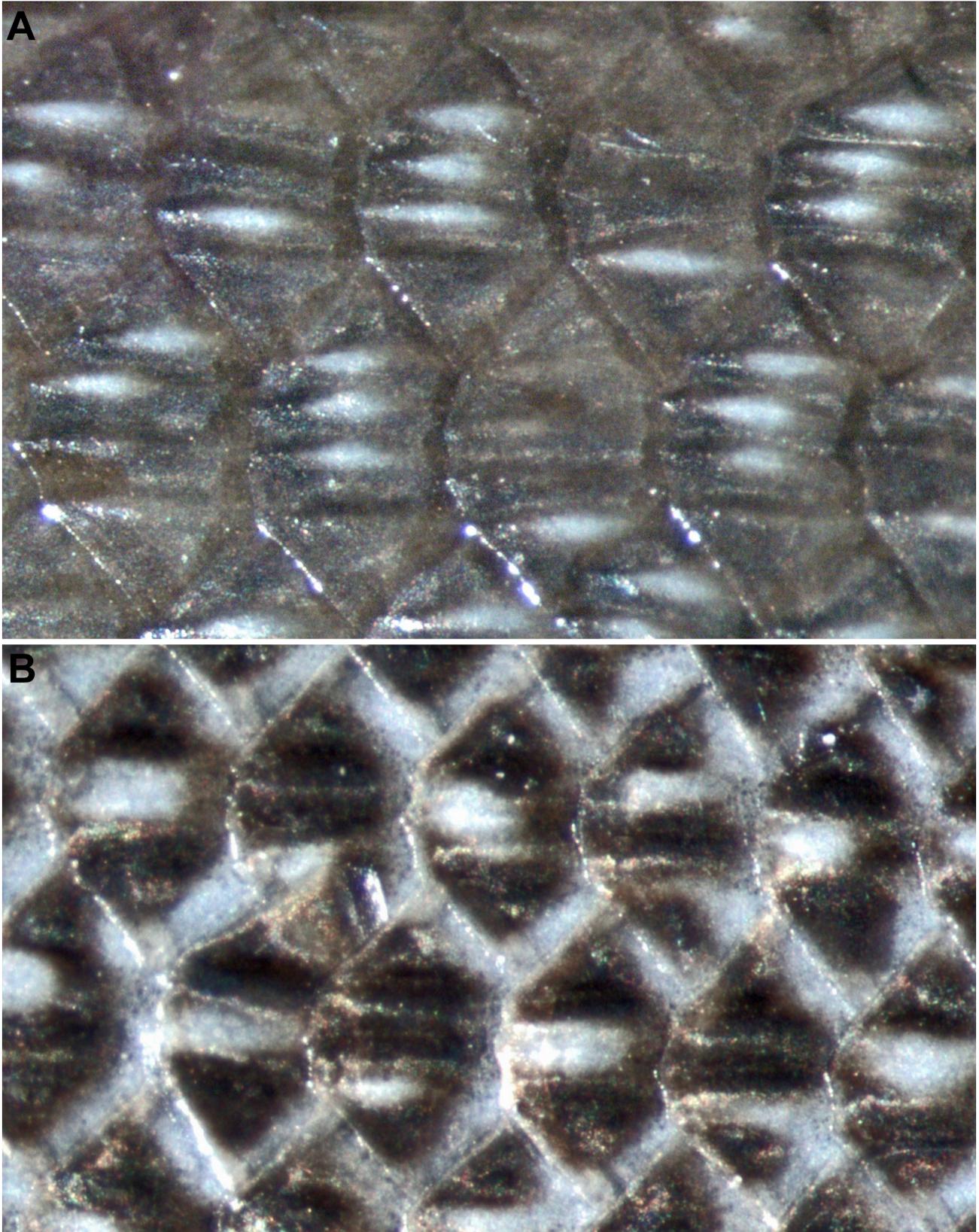


FIGURE 2. Diagrammatic representation of the dorsal pattern of *Caledoniscincus notialis* sp. nov. (a) and *Caledoniscincus atropunctatus* (b).



FIGURE 3. Adult male AMS R172150 (a) and adult female (b) *Caledoniscincus notialis* sp. nov. from the Goro Plateau, and adult male AMS R172613 (c) Massif du Humboldt.

Differences in the number of postsacral vertebrae between *Caledoniscincus notialis* **sp. nov.** and *C. atropunctatus* (49 versus 51–52) indicate *C. notialis* **sp. nov.** could have fewer vertebrae in the tail. However, earlier studies (Sadlier *et al.* 1999) showed a range of between 2 to 5 postsacral vertebrae within a species, and the utility of this character in diagnosing *C. notialis* **sp. nov.** from *C. atropunctatus* is at this time limited until further sampling is undertaken.

Description. The species is described from 41 adult males, 18 adult females and 1 subadult.

Measurements (adults only): size 40–54mm SVL; axilla–groin distance 51.7–59.6% SVL (\bar{x} = 55.7); forelimb–snout distance 34–40.9% SVL (\bar{x} = 38.1); hindlimb length 33.0–41.5% SVL (\bar{x} = 37.2); tail length of individual with most complete tail 166.7% SVL.

Scalation (all specimens): midbody scale rows 26–32 (\bar{x} = 29.8, sd = 1.19); dorsal scale rows 49–61 (\bar{x} = 54.3, sd = 2.94); scales on top of fourth finger 9–13 (\bar{x} = 11.1, sd = 0.63); lamellae beneath fourth finger 14–20 (\bar{x} = 17.2, sd = 1.08); scales on top of fourth toe 11–18 (\bar{x} = 15.6, sd = 1.11); lamellae beneath fourth toe 26–36 (\bar{x} = 31.3, sd = 1.65).

Osteology: presacral vertebrae 29 (n = 14), 28 (n = 1) or 30 (n = 1); postsacral vertebrae 49 (n = 1).

Colour and Pattern: adult males (Fig. 3a & c) with the dorsal surface of body and tail mid to dark brown, with some scales (~1 in 2 scales to 1 in 3, but rarely all) having several fine white flecks, usually positioned on and running along the individual keels of each scale, unmarked scales uniformly colored. Side of body mid to dark brown uppermost with pale markings similar to those on dorsal scales, these tending to be tinted with the brown base color, progressively grading to light brown approaching the venter and with pale markings poorly differentiated from light brown base color. Dorsal surface of the head and neck light copper-brown in life with scattered dark markings to the dorsal and lateral headshields, including the lower margin of the rostral scale. Ventral surface lacking obvious color in life, but with an underlying dark anterior edge outlining each scale.

Adult females (Fig. 3b) two-toned, with the dorsal surface of body and tail mid brown, each scale usually with dark fleck down the centre and giving the impression of a series of fine, dark, parallel lines down the back, tending to break up anteriorly where the individual dark markings are either only partially present or absent. Sides of body uniformly dark brown uppermost and well defined from lighter dorsal color and lighter lower lateral color. Dorsal surface of the head and nape light brown with scattered markings similar to males. Ventral surface lacking obvious color in life but with an underlying dark anterior edge outlining each scale as in males.

Subadults and juveniles with a contrasting light dorsal and dark upper lateral surface as for adult females, but largely without dark flecks on the dorsal scales, and with the lateral surface of the body uniformly dark grey overall, and ventral surface grey overall.

Details of Holotype: adult male; 45mm SVL; tail length 66mm. Midbody scale rows 30; dorsal scale rows 50; dorsal scales of fourth finger 11/10; lamellae of fourth finger 17/17; dorsal scales of fourth toe 17/-; lamellae of fourth toe 30/-

Variation: a comparison between samples from low elevation on the Goro Plateau, low elevation on the south-east coast and those from high elevation on Massif du Humboldt, Mt. Ouin and Mt. Dzumac on the Chaîne Centrale showed that the population on the Goro Plateau was significantly smaller in adult size (range 40–49; \bar{x} = 44.5, n = 35) than the low elevation sample from the south-east coast in the Ni and Pourina River valleys (44.5–50; \bar{x} = 48.1, n = 8, t_{41} = -3.728 P = 0.001), and the high elevation samples from the Massif du Humboldt, Mt. Ouin and Mt. Dzumac combined (45–57; \bar{x} = 51.1, n = 14, t_{47} = -7.397, P = 0.000). The high elevation samples had significantly more dorsal scales (55–61; \bar{x} = 58.1, n = 14) than the low elevation samples from the Goro Plateau (range 49–57; \bar{x} = 52.8, n = 35, t_{47} = -8.367 P = 0.000) and the Ni and Pourina River valleys (range 53–57; \bar{x} = 54.9, n = 8, t_{19} = 4.113 P = 0.001), although the significance of the latter should be viewed with caution given the lack of samples from intervening elevations. A single adult male from mid elevation on Mt. Koghis (500m) is large in size (SVL 54mm) and in this respect similar to the high elevation population from the Ouin/Dzumac ranges, but it has a fewer dorsal scales (54) and for this trait is more similar to the low elevation population on the Goro Plateau.

Additional material. Specimens also included in the genetic study (Appendix 2) or in the map of distribution (Fig. 4) but not included in the type series: CAS 231902 Mt. Ouin (south face) 22°01'33"S 166°28'32"E (26 September 1995); AMS R.171426 Pourina River Valley 22°1'39"S 166°43'37"E (13 November 2008); AMS R.172150 Kwe Nord 22°16'47"S 166°56'46"E (15 May 2009); AMS R.172648–53 La Réserve Naturelle du Barrage de Yaté 22°09'09"S 166°53'30"E (22 October 2009); AMS R.174598–99 Réserve Naturelle Intégrale de la Montagne des Sources 22°07'51"S 166°36'17"E (23 October 2010)

Distribution and biology. *Caledoniscincus notialis* **sp. nov.** is known from a number of localities on the Goro Plateau in far southern New Caledonia, and from scattered sites in the ranges of southern Grand Terre north to the Ni River and the Humbolt Massif (Fig. 4).

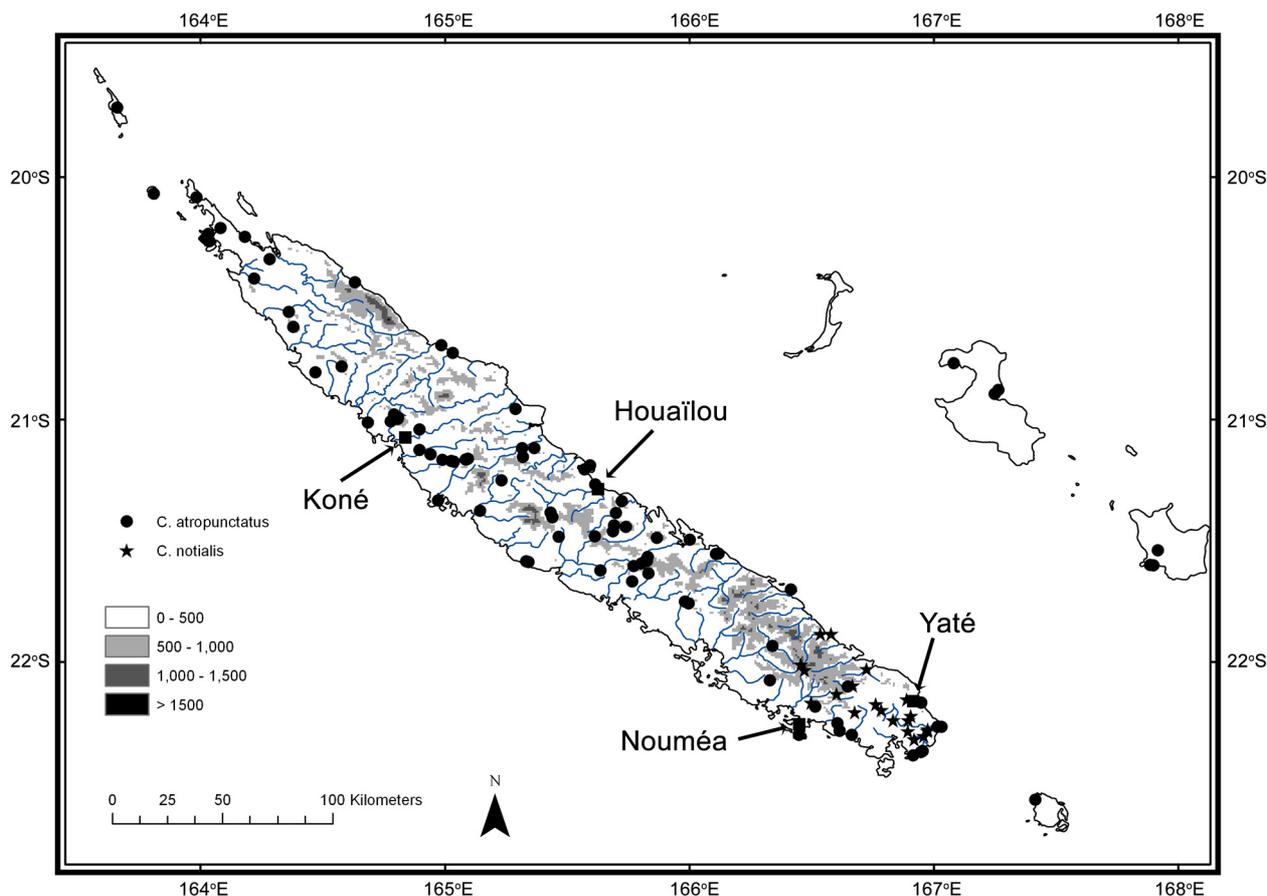


FIGURE 4. Distribution of *Caledoniscincus notialis* **sp. nov.** (stars) and *Caledoniscincus atropunctatus* (circles) in southern New Caledonia.

It has been recorded primarily from humid forest and tall-canopied maquis habitat across a broad altitudinal range on ultramafic substrates. On the Goro Plateau the species occurs in the patches of humid forest (Fig. 5a) and tall-canopied maquis paraforestier and maquis preforestier habitat (Fig. 5a) scattered across the landscape, and also from adjacent low-canopied maquis arbustif, but only rarely in open habitats (maquis arbustif or lingo-herbaceous maquis). It is relatively abundant in forest and canopied maquis habitats. Forest in this region is present as isolated patches of varying size usually at the base and slopes of the low ranges, whereas canopied maquis is a more extensive but still highly fragmented formation that is present on the hard laterite cuirasse cap that extends over much of the plateau. Elsewhere on the ranges of the central mountain chain the species has been recorded from humid forest patches at low and mid elevation, and forest and adjacent maquis shrubland at high elevation. Systematic sampling between 1000–1340 m on Mt. Humboldt recorded it only from the edge of high elevation humid forest and adjacent maquis shrubland, not from the interior of the humid forest or the extensive moss forest.

Conservation status. The area of occupancy for *Caledoniscincus notialis* **sp. nov.** is likely to be >2,000km². It is known from at least nine separate locations in the southern ranges of the Chaîne Centrale (Mt. Humbolt, Ni River, Mt. Ouin/Mt. Dzumac, Mt. Koghis, Pourina River, Montagne des Sources, Rivière Bleue, Yaté Barrage, Monts Kwa Né Mwa) and from numerous isolated areas of humid forest and tall canopied maquis habitat scattered across the Plaine des Lacs and Goro Plateau (Le Bois de Sud, Forêt Cachee, Pic du Pin, Ka Yê Wagwé, Pic du Grand Kaori, Forêt Nord and numerous sites on the plateau of the Kwé and Wadjana River drainages). There is extensive potential habitat along the main ranges of the southern ultramafic block and the species is likely to be recorded elsewhere within its extent of occurrence. The extent of occurrence and potential area of occupancy for *C. notialis* **sp. nov.** both are well within the thresholds for higher Red List categories. Populations in the south of the



FIGURE 5. Humid forest (a) and maquis preforest (b) on ultramafic surfaces of the Goro Plateau, typical habitat for *Caledoniscincus notialis* **sp. nov.** in the Grand Sud.

species range are highly fragmented. The forest and tall-canopied maquis patches have high edge to area ratios and as such are likely to be particularly susceptible to degradation from wildfires. Many also sit within mining concessions and loss of habitat associated with an expanding mining industry is a threat, particularly to areas of tall-canopied maquis. For these reasons the species meets the criteria for placement in the IUCN threatened category 'Vulnerable'.

Caledoniscincus atropunctatus (Roux)

(Figs. 2, 4, 6)

Lygosoma austro-caledonicum atropunctatum Roux 1913: 117.

The name '*atropunctatum*' was proposed by Roux (1913) for one of several subspecies of *Lygosoma austro-caledonicum* Bavay in the first comprehensive monograph of the New Caledonian lizard fauna based on 18 months of fieldwork in the territory. Roux did not examine the types of *Lygosoma austro-caledonicum* from which Bavay (1869) described that species, nor did he designate a holotype in describing *Lygosoma austro-caledonicum atropunctatum*, but did list the location of specimens (syntypes) used in describing the subspecies. Subsequently a lectotype designation for *Lygosoma austro-caledonicum atropunctatum* Roux was made by Kramer (1979) when compiling a catalogue of types in the Naturhistorisches Museum Basel, Switzerland. The specimen chosen by Kramer as lectotype for the species (NHMB 7308) is an adult male with a single large spot on the posterior margin of each body scale from Oubatche on northeast coast of New Caledonia.

The species was first reviewed by Sadlier (1986) who listed 91 specimens in the Australian Museum and NHMB from across the Grand Terre and Loyalty Islands and re-described the species from the two largest samples available from Houailou (19) and Mt Dore (20). Both samples are referable to *Caledoniscincus atropunctatus sensu stricto*. Specimens of *C. notialis* **sp. nov.** were not among the remaining specimens of '*atropunctatus*' examined at that time. Since then a considerable amount of reference material assignable to *C. atropunctatus sensu stricto* has been acquired and includes material from areas not, or only poorly, represented in the earlier studies, most notably the central-west and north-west ultramafic massifs and the Loyalty Islands.

Diagnosis. See diagnosis for *Caledoniscincus notialis* **sp. nov.** (above) for features that distinguish *Caledoniscincus atropunctatus* from other members of the genus.

Description. The re-description of the species is a composite of all specimens assigned to the lineage defined by the presence of the diagnostic dorsal coloration of adult males. Measurements are given only for the adults (n = 77) and scalation on all specimens (n = 86) except where indicated.

Measurements: size 32–54 mm SVL; axilla–groin distance 50.5–60.4% SVL (\bar{x} = 56.1); forelimb–snout distance 33.3–43.3% SVL (\bar{x} = 37.6); hindlimb length 29.3–41.1% SVL (\bar{x} = 35.3, n = 76); tail length of individual with most complete tail 169.6% SVL.

Scalation: midbody scale rows 26–32 (\bar{x} = 29.3, sd = 1.2); dorsal scale rows 49–63 (\bar{x} = 55.6, sd = 2.42, n = 85); scales on top of fourth finger 8–11 (\bar{x} = 9.1, sd = 0.48, n = 85); lamellae beneath fourth finger 12–17 (\bar{x} = 14.8, sd = 0.84, n = 85); scales on top of fourth toe 11–15 (\bar{x} = 12.5, sd = 0.88, n = 85); lamellae beneath fourth toe 16–31 (\bar{x} = 26.6, sd = 1.92, n = 85)

Osteology: presacral vertebrae 29 (n = 7) or 28 (n = 1); postsacral vertebrae 51–52 (n = 2)

Color and Pattern: adult males (Figs. 6a & 6c) with the dorsal surface of body and tail dark brown with numerous pale spots, each dorsal scale having a single pale spot medially on the posterior edge of each scale and a pale marking to each latero-dorsal edge. Pale markings forming a near continuous stripe (1/2 scale width) along the dorsolateral edge anteriorly from just behind the forelimbs to, and above the eye. Side of body mid to dark brown uppermost with scattered pale markings, progressively grading to light brown approaching the venter and with the pale markings poorly differentiated. Dorsal surface of the head and neck light copper-brown in life with scattered dark markings to the dorsal and lateral headshields, including the lower margin of the rostral scale. Ventral surface generally lacking obvious color in life, but with an underlying dark anterior edge outlining each scale. Individuals from the central ranges have a faint orange wash to the underside of the body and a grayish-blue color to the underside of the tail.



FIGURE 6. Adult male AMS R174539 (a) and female (b) *Caledoniscincus atropunctatus* from Parc des Grand Fougères, Farino, and adult male AMS R171493 (c) from Massif de Koniambo in the northwest region.

Adult females (Fig. 6b) two-toned, with the dorsal surface of body and tail mid brown, each scale usually with dark fleck down the centre and giving the impression of a series of fine parallel lines down the back, tending to break up anteriorly where the individual dark markings are either only partially present or absent. Sides of body uniformly dark brown uppermost and well defined from lighter dorsal color and lighter lower lateral color. Dorsal surface of the head and nape light brown with scattered markings similar to males. Ventral surface lacking obvious color in life in having an overall grayish-blue color to the underside of the body and tail, and with an underlying dark anterior edge outlining each scale as in males.

Subadults and juveniles as for adult females but dorsal surface of the body largely without dark flecks, and lateral surface of the body uniformly dark grey overall. Ventral surface grey.

Details of Lectotype of Lygosoma austro-caledonicum atropunctatum (NHMB 7308): adult male size 49mm SVL; axilla–groin distance 28.5mm; forelimb–snout distance 17.5mm; hindlimb length 16.5mm; tail length 49mm, regenerated. Midbody scale rows 30; dorsal scale rows 56; lamellae of fourth toe 23/26.

Variation: specimens from the Loyalty Islands are nested within the ‘southern’ genetic group of *Caledoniscincus atropunctatus* but are significantly smaller and show minimal overlap in adult size with the other samples assigned to the ‘southern’ group from the Grand Terre (31–42, $\bar{x} = 37.3$ versus 40.5–54, $\bar{x} = 47.8$; $t_{50} = 7.606$ $P = 0.000$). The size of adult male (35–40mm SVL, $n = 4$) and adult female (36.5–41mm SVL, $n = 5$) specimens from Maré and Lifou Island are at or below the minimum size limit for reproductively mature adult males (43mm SVL) and females (40.5mm SVL) from samples assigned to the ‘southern’ genetic group of *Caledoniscincus atropunctatus* on the Grand Terre. In this respect the Loyalty Island population is more similar in size at maturity to populations in north-west region ultramafic ranges. Excluding the Loyalty Islands sample from the ‘southern’ genetic group, the remaining ‘southern’ group samples are clearly significantly larger (40.5–54, $\bar{x} = 47.8$ versus 38–49, $\bar{x} = 43.45$; $t_{69} = 4.751$ $P = 0.000$) than samples assigned to the ‘northern’ genetic group.

Within the ‘northern’ genetic group samples from the north-west region ultramafic ranges had reproductively active females with shelled eggs at a very small size (40–41.5mm SVL for three individuals carrying 1–2 developing eggs from high elevation on Massif de Koniambo and 38.5–42mm SVL for three individuals carrying 1–2 developing eggs from low elevation on Massif de Koniambo; 42mm SVL and carrying 2 shelled eggs from high elevation on the Massif de Kopéto; 39.5mm SVL carrying 2 shelled eggs from near the summit of the Ouazangou-Toam massif; 42.5 and 46.0mm SVL and both carrying 2 shelled eggs from low elevation ultramafic ranges at Tsiba). Reproductively mature males from high elevation on the north-west region ultramafic ranges are also small in size (44–47mm SVL on Massif de Koniambo; 40.5–43mm SVL, $n = 3$ on Massif de Kopéto and Paéoua), as were individuals from low elevation sites (41mm SVL at Tsiba; 41–47mm at base of Koniambo massif). Populations further north on the west coast and in the extreme far north are represented by very small samples and the trend with regard to adult size is difficult to interpret other than the few reproductively active females recorded from low elevation at Koumac (43.5mm SVL, $n = 1$) and Ile Baaba (46mm SVL, $n = 1$) were relatively small.

Populations from mid-high elevation on north-west region ultramafic ranges are also unusual in having a spotted dorsal pattern (a trait normally only associated with mature males) in small but reproductively mature females on some massifs (summit of the Ouazangou-Toam; high elevation on Koniambo) and in some reproductively immature males (31.5–37mm SVL, $n = 2$ summit of Massif de Kopéto).

Samples assigned to the ‘southern’ genetic group (including the Loyalty Islands) had significantly more midbody scale rows than samples assigned to the ‘northern’ genetic group (28–32, $\bar{x} = 29.7$ versus 26–32, $\bar{x} = 28.7$; $t_{84} = 4.321$ $P = 0.000$) but for this character the level of overlap in range of each genetic group negates its utility in diagnosing populations to either regional group. Within the ‘southern’ genetic group specimens from the Loyalty Islands had significantly fewer dorsal scale rows smaller than the other samples assigned to the ‘southern’ group (49–56, $\bar{x} = 53.2$ versus 50–60, $\bar{x} = 55.8$; $t_{50} = 3.161$ $P = 0.003$), but again the level of overlap in range negates the usefulness of this character in diagnosing either regional group.

Distribution and biology. *Caledoniscincus atropunctatus* is wide-ranging across the Grand Terre and major island groups (Loyalty Island, Iles Belep, Ile Baaba, and Ile de Pins) as well as some of the small offshore islands in the lagoon (Fig. 4).

In the south of Grand Terre it is recorded from mainly coastal and near coastal sites, generally coastal humid forest (Plum; Forêt Thi; Cap N’Doua, Port Boisè; Yatè) and moist secondary growth (Nouméa), but has also been recorded from low elevation maquis preforestier (Cap N’Doua), forest seche (dry forest Gouaro-Déva), and high elevation humid forest (Mt. Do), and humid forest in the interior of the region at Rivière Bleue. It has also been recorded from small ilots in the lagoon and from the Ile de Pins.

In the central-east and central-west regions it has been recorded from a range of coastal and near coastal sites characterized by secondary growth (Houailou; Moindou), and from low and mid elevation humid forest on metamorphic (Sarraméa; Col d' Amieu; Col de Roussettes; Mt. Aoupinié) and ultramafic (Presque Ile Bogata, Nakéty, Mt. Menazi, Poro, Cap Bocage) substrates.

In the north of Grand Terre *Caledoniscincus atropunctatus* has a scattered distribution across a range of natural habitat types in the north-west region that includes high elevation humid forest on ultramafic massifs (Ouazangou-Taom; Koniambo, Kopéto & Paéoua), low forest patches on low elevation ultramafic ranges (Tsiba), humid forest on kaarst (Koumac) and vallicole forest (Rivière Néhoué; Forêt D'Ougne). In the far north it has been recorded only from disturbed coastal habitats (Poum; Arama; Ile Art) and from low canopied humid forest patches on ultramafic soils (Sommet Poum). In the north-east it has been recorded from secondary growth at coastal sites (Kolnoué) in the region of Hienghène, and from further north on the coast (Oubatche), but surprisingly not from humid forest habitat of the extensive Panié Range despite investigations undertaken at a number of sites.

Conservation status. An assessment of potential threats to the species has been identified (IUCN 2011) that includes the following array of low to moderate level human-mediated impacts to preferred habitat: 'loss and fragmentation humid forest' primarily from clearing for ranching or agriculture or from local agriculture (east coast); a decline in area, extent and quality of forest habitats on ultramafic soils through activities associated with mining; and a decline in area, extent and quality of mid elevation humid forest in the long term from the impact of repeated firing of adjacent savannah habitat on the forest edge. Preliminary studies of the interaction between the invasive Little Red Fire Ant and lizards in sclerophyll forest habitat indicate the presence of the ant has a severe negative impact on *Caledoniscincus austrocaledonicus* (Jourdan *et al.* 2001), and it is considered *C. atropunctatus* would be similarly affected in invaded areas of humid forest habitat.

Caledoniscincus atropunctatus has a relatively widespread distribution over large areas of potentially suitable habitat away from disturbance and under some circumstances is tolerant of low levels of disturbance, for this reason it is not at this time considered to be under any immediate threat and satisfies the criteria to be categorized as Lower Risk—least concern based on IUCN Criteria (IUCN 2001).

Discussion

The distinctiveness of the extensive southern ultramafic region as an area of endemism for lizards has been highlighted in earlier reviews (Bauer & Sadlier 1993, 2000), and elsewhere in publications on the systematics of the territories skink fauna (*Sigaloseps* Sadlier, Sadlier *et al.* 2013 in press and a new genus, Sadlier, Bauer, Smith, Shea & Whitaker, unpublished). The description of *Caledoniscincus notialis* **sp. nov.** adds yet another to the list of species endemic to the region.

What is emerging from recent studies and not previously reported are the internal biogeographic patterns for skinks and geckos within the southern ultramafic region which include regionally endemic species with widespread distributions that cover the entire region (the skinks *Tropidoscincus variabilis* (Bavay) and '*Lioscincus*' *tillieri* (Ineich and Sadlier), and the geckos *Bavayia geitaina* Wright, Bauer & Sadlier and *Eurydactylodes symmetricus* (Andersson)); regional species with distributions restricted to the southernmost massifs of the region and the adjoining Goro Plateau (the skinks *Caledoniscincus notialis* **sp. nov.**, *Graciliscincus shonae* Sadlier, *Simiscincus aurantiacus* Sadlier & Bauer, *Lacertoides pardalis* Sadlier, Shea & Bauer, and the geckos *Bavayia septuiclavis* Sadlier and *Rhacodactylus sarasinorum* Roux); high elevation endemism in skinks for the complex of ranges of the Mts. Humboldt/Ouin/Kouakoué (*Sigaloseps*, three species; *Marmorosphax montana* Sadlier & Bauer; undescribed genus and species, Mt Ouin); and broad scale localized endemism within the region independent of altitude (the gecko *Bavayia nubila* Bauer, Sadlier, Jackman & Shea; *Sigaloseps*, two species; *Nannoscincus* Günther two species currently under *N. mariei* (Bavay)).

As such, the internal evolutionary scenario for lizards in the extensive southern ultramafic is more complex than previously expected and likely to be driven by a range of factors that include isolation on mountain summits in response to historical climatic change and sub-regional vicariance in response aspects of topography. A comprehensive knowledge of these evolutionary patterns is however hampered by a lack of overall field investigation in the north of the region, and of high elevation habitats on massifs of the central mountain chain.

Acknowledgments

The specimens used in this research project have been collected over a long period time under a number of permits and we thank the authorities of Province Nord, Province Sud and the Province des Îles for permission to conduct our herpetological research, and in particular the following individuals for their assistance with our research: Jean-Jérôme Cassan, Direction du Développement Économique et de l'Environnement (DDE-E), Province Nord; Anne-Claire Goarant (former Chef du service des milieux terrestres) Direction de l'environnement de la province Sud and Joseph Manaute (Directeur Parc Provincial de la Rivière Bleue) Direction de l'environnement de la province Sud. The holotype was collected under permit 6034-5080 to Australian Museum Business Services during fieldwork carried out under contract AMBS-200313 between the Australian Museum and Goro Nickel (GNi – now Vale Nouvelle-Calédonie). Some of the samples used in this research were collected during the course of field surveys of mining leases and we gratefully acknowledge the assistance of staff of Société Le Nickel (SLN), Vale-Nouvelle Calédonie, and (then) Falconbridge and (now) Xstrata Nickel for access to sites under their control and in certain instances commissioning the fieldwork. Hervé Jourdan of IRD Nouméa provided important logistical backing for our research in New Caledonia, and Tony and Vivienne Whitaker collaborated in field work and provided samples from their field surveys. Michael Elliot of the Collection Informatics Unit, Australian Museum produced the map of distribution (Fig. 4). Ivan Ineich of the Muséum national d'Histoire naturelle provided the French Résumé. This research was supported by grant DEB 0108108 from the National Science Foundation (U.S.A.) to A. M. Bauer and T. Jackman and by the project BIONEOCAL funded by the Agence Nationale de la Recherche (France).

References

- Bauer, A.M. & Sadler, R.A. (1993) Systematics, biogeography and conservation of the lizards of New Caledonia. *Biodiversity Letters*, 1, 107–122.
- Bauer, A.M. & Sadler, R.A. (2000) *The Herpetofauna of New Caledonia*. Society for the Study of Amphibians and Reptiles, Ithaca, NY. 310 pp, 24 pls.
- Bavay, A. (1869) Catalogue des reptiles de la Nouvelle-Calédonie et description d'espèces nouvelles. *Mémoires de la Société Linnéenne de Normandie*, 15, 1–37.
- Chapple, D.G., Ritchie, P.A. & Daugherty, C.H. (2009) Origin, Diversification and Systematics of the New Zealand Skink Fauna (Reptilia: Scincidae). *Molecular Phylogenetics and Evolution*, 52, 470–487.
<http://dx.doi.org/10.1016/j.ympev.2009.03.021>
- Drummond, A.J. & Rambaut, A. (2006) BEAST v1.4. Available from: http://beast.bio.ed.ac.uk/Main_Page (Accessed 1 Aug 2013)
- Drummond, A.J., Ashton, B., Buxton, S., Cheung, M., Cooper, A., Duran, C., Field, M., Heled, J., Kearse, M., Markowitz, S., Moir, R., Stones-Havas, S., Sturrock, S., Thierer, T. & Wilson, A. (2011) Geneious v5.4. Available from: <http://www.geneious.com/> (Accessed 1 Aug 2013)
- Felsenstein, J. (1985) Confidence limits on phylogenies: An approach using the bootstrap. *Evolution*, 39, 783–791.
<http://dx.doi.org/10.2307/2408678>
- Greer, A.E. (1979) A phylogenetic subdivision of Australian skinks. *Records of the Australian Museum*, 32, 339–371.
<http://dx.doi.org/10.3853/j.0067-1975.32.1979.459>
- Huelsenbeck, J. & Ronquist, F. (2001) MRBAYES: Bayesian inference of phylogeny. *Bioinformatics*, 17, 754–755.
<http://dx.doi.org/10.1093/bioinformatics/17.8.754>
- IUCN (2001) *IUCN Red List Categories and Criteria: version 3.1*. IUCN Species Survival Commission, IUCN, Gland, Switzerland and Cambridge, UK. ii + 30 pp.
- Jourdan, H., Sadler, R.A. & Bauer, A.M. (2001) Little fire ant invasion (*Wasmannia auropunctata*) as a threat to New Caledonian lizards: Evidence from a sclerophyll forest (Hymenoptera: Formicidae). *Sociobiology*, 38 (3A), 283–301.
- Kramer, E. (1979) Typenkatalog der Echsen im Naturhistorischen Museum Basel (BM), Stand 1978. *Revue Suisse de Zoologie*, 86, 159–166.
- Macey, J.J., Larson, A., Ananjeva, N.B., Fang, Z. & Papenfuss, T.J. (1997) Two novel gene orders and the role of light-strand replication in rearrangement of the vertebrate mitochondrial genome. *Molecular Biology and Evolution*, 14, 91–104.
<http://dx.doi.org/10.1093/oxfordjournals.molbev.a025706>
- Maddison, D.R. & Maddison, W.P. (2005) *MacClade: Analysis of Phylogeny and Character Evolution*. v4.08. Sinauer Associates, Sunderland, Massachusetts.
- Nylander, J.A.A., Wilgenbusch, J.C., Warren, D.L. & Swofford, D.L. (2008) AWTY (are we there yet?): a system for graphical exploration of MCMC convergence in Bayesian phylogenetics. *Bioinformatics*, 24, 581–583.
<http://dx.doi.org/10.1093/bioinformatics/btm388>

- Posada, D. & Crandall, K.A. (1998) Modeltest: testing the model of DNA substitution. *Bioinformatics*, 14, 817–818.
<http://dx.doi.org/10.1093/bioinformatics/14.9.817>
- Ronquist, F. & Huelsenbeck, J.P. (2003) MRBAYES 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics*, 19, 1572–1574.
<http://dx.doi.org/10.1093/bioinformatics/btg180>
- Roux, J. (1913) Les reptiles de la Nouvelle-Calédonie et des Îles Loyalty: In: Sarasin, F. and Roux, J. (eds.), *Nova Caledonia, Zoologie*, Vol. 1(2). C.W. Kreidels Verlag, Wiesbaden, pp. 79–160, 2 pls.
- Sadlier, R.A. (1986) A review of the scincid lizards of New Caledonia. *Records of the Australian Museum*, 39, 1–66.
<http://dx.doi.org/10.3853/j.0067-1975.39.1987.164>
- Sadlier, R.A. (2010) *Systematic Studies of the Scincid Lizards of New Caledonia*. PhD. Dissertation, Griffith University, Queensland, Australia. 199 pp.
- Sadlier, R.A., Bauer, A.M. & Colgan, D.J. (1999) The scincid lizard genus *Caledoniscincus* (Reptilia: Scincidae) from New Caledonia in the southwest Pacific: a review of *Caledoniscincus austrocaledonicus* (Bavay) and description of six new species from Province Nord. *Records of the Australian Museum*, 51 (1), 57–82.
<http://dx.doi.org/10.3853/j.0067-1975.51.1999.1295>
- Sadlier, R.A., Bauer, A.M., Wood, P.L. Jr., Smith, S.A., Whitaker, A.H., Jourdan, H. & Jackman, T. (2013) Localized endemism in the southern ultramafic bio-region of New Caledonia as evidenced by the scincid lizards in the genus *Sigaloseps* (Reptilia: Scincidae), with a description of four new species. *Zoologia Neocaledonica 8. Mémoires du Muséum national d'Histoire naturelle*, in press.
- Smith, S.A., Sadlier R.A., Bauer A.M., Austin C.C. & Jackman, T. (2007) Molecular phylogeny of the scincid lizards of New Caledonia and adjacent areas: Evidence for a single origin of the endemic skinks of Tasmantis. *Molecular Phylogenetics and Evolution*, 43, 1151–1166.
<http://dx.doi.org/10.1016/j.ympev.2007.02.007>
- Stamatakis, A., Hoover, P. & Rougemont, J. (2008) A rapid bootstrap algorithm for the RAxML web servers. *Systematic Biology*, 57, 758–771.
<http://dx.doi.org/10.1080/10635150802429642>
- Swofford, D.L. (2002) Paup* Phylogenetic Analysis Using Parsimony (and Other Methods) Version 4.0. Sinauer Associates, Sunderland, Massachusetts.

APPENDIX 1. Material of *Caledoniscincus atropunctatus* examined for this study - a superscript ^M after the registration number denotes specimens used in the morphological analysis, and a superscript ^G in genetic studies, remaining specimens were examined and are listed for the purposes of plotting the species distribution. Unless otherwise marked all ‘R.’ prefixed registration numbers are AMS specimens.

Grand Terre: R77400, Nouméa, Mt. Coffyn 22°18'S 166°27'E; R.77524–28 4km N of junction of Poya road on Bourail–Houaïlou road 21°29'S 165°28'E; R.77573–94 Houaïlou airstrip 21°16'S 165°37'E; R.77732 Mt. Aoupinié, 3km NE of Mt. Aoupinié forestry camp by road 21°07'S 165°22'E; R.77923 Poum 20°14'S 164°02'E; R.78148, R.97969–70 Mt. Gouémba, 3km S La Fausse Yaté bridge, Yaté 22°10'S 166°57'E; R.78229 Waho, 3km S La Fausse Yaté bridge 22°10'S 166°57'E; R.78261–70^M, R.78272–73^M, 78275–81^M Mt. Dore, 2km W Plum turnoff on Mt. Dore road 22°17'S 166°37'E; R.125902–03^M Rivière Bleue, Giant Kauri 22°06'S 166°39'E; R.135015–17 Sarraméa 21°38'S 165°50'E; R.135027 Perlou (vic.), 8km West of Coula on Bourail road 21°23'S 165°26'E; R.135143 8.3km from Kouaoua/Canala road intersection on La Foa road 21°34'57"S 165°49'42" E; R.135824–25^M 4.6km N of Col de Roussettes on Houaïlou–Bourail road 21°24'11"S 165°26'30"E; R.138519–22 Koulnoué, Hienghène region 20°41'32"S 164°59'10"E; R.138555^M Ile des Pins, Gite Kodjeu on Waa Mé Bay 22°34'S 167°25'E; R.144175^M, R.144282, R.147899^M 5.4km from Kouaoua/Canala Road intersection on La Foa road 21°33'56"S 165°49'51"E; R.144283 9.8km from Kouaoua/Canala Road intersection on La Foa road 21°35'03"S 165°49'12"E; R.144295, R.146343^G Koumac Caves, approx. 9km E Koumac 20°33'18"S 164°21'49"E; Mt. Aoupinié (1.5–2.5km below logging camp) 21°07'S 165°19'E; R.146396–97^G, R.146431^M 4.6km N of Col de Roussettes on Houaïlou–Bourail road 21°24'11"S 165°26'30"E; R.146410 Mt. Do (below summit) 21°45'S 165°59'E; R.146496–98^{MG} Adio Caves, NE of Poya 21°15'S 165°14'E; R.147851 Forêt Thy 22°11'S 166°31'E; R.147981 Rivière Bleue, vic. Pont Germain 22°06'S 166°39'E; R.149979 Néoua area, Me Adéo 21°28'52"S 165°36'51"E; R.152654–56^M 8.3 Km From Koauoua/Canala Road intersection on La Foa road 21°34'57"S 165°49'42"E; R.153502^M, R.153577^G, R.153578^{MG} Tsiba (transmission tower), ~3km N Ouaco 20°48'14"S 164°28'19"E; R.153640 ~2km N Arama (far NW coast) 20°14'43"S 164°10'59"E; R.153641 Poum–Boat Pass road, 5km N turnoff from Poum–Koumac road 20°12'36"S 164°05'01"E; R.157873 Tia (5km SE Pouembout) 21°08'36"S 164°56'35"E; R.161083^G Îles Belep, Ile Art, northern plateau 19°42'47"S 163°39'38"E; R.161107^G Mt Kaala, 6km N Kaala–Gomen, headwaters of Oue Injob 20°37'3"S 164°22' 49"E; R.161137 Massif de Koniambo, 8km NE Koné, headwaters of Rivière Pandanus 20°59'42"S 164°48'56"E; R.161228^{MG} Vallée Poupoule, Forêt d'Ougne, 24km N Koumac 20°20'15"S 164°17'02"E; R.162841 Farino

21°40'S 165°46'E; R.162877^M Baie de Goro, Ilot Nuu 22°16'S 167°02'E; R.162885^M Baie de Goro, Îlot Nie 22°16'S 167°01'E; R.162890–91^M, R.162892 Plum 22°18'S 166°40'E; R.162895^M Rivière des Pirogues; R.162911 Baie de Port-Bouquet, Îlot Tupeti 21°42'S 166°25'E; R.163226^G Mt. Vert, Massif de Kopéto 21°10'22"S 165°2'15"E; R.163316^G Vallée Punu, Forêt d'Ougne, 24 km N Koumac 20°20'25"S 164°17'34"E; R.163317 Maa Bwén, Île Baaba, 18 km N Poum 20°04'58"S 163°59'05"E; R.164194^M Massif d'Ouzangou-Taom, Mt. Taom 20°46'52"S 164°34'46"E; R.164228^M, R.164484 Cap N'Doua 22°23'08"S 166°55'44"E; R.164387 Pic d'Amoa (north slopes) 20°57'22"S 165°17'27"E; R.164403–04 Col d'Amieu 21°35'33"S 165°48'19"E; R.164484 Cap N'Doua 22°23'15"S 166°55'46"E; R.165829–30^M Col des Rousettes, 4.2km E of crest of range 21°24'02"S 165°26'27"E; R.165836^{MG} Mt. Aoupinié 21°09'12"S 165°19'14"E; R.165886^G Pouembout, Hotel Bougainvillia 21°07'27"S 164°53'52"E; R.165889^M Massif de Kopéto 21°10'12"S 165°01'39"E; R.165894 Rivière Néhoué 20°25'03"S 164°13'15"E; R.165915^G 31km N of Ponérihouen 21°12'15"S 165°34'19"E; R.165954–55, CAS 231909–10 R.153578^G 7.6km NW Moindou on Col du Boghen road 21°38'58"S 165°38'04"E; R.166225–26^G Marais Fournier, Mouéara, Gouaro-Déva, 4 km NW Plage de Poé 21°35'14.87"S 165°20'34.60"E; R.167179–80 Mt. Mou 22°04'28"S 166°19'52"E; R.167209^M 'Eglantine', Papainda, Massif de Kopéto 21°10'10"S 165°00'33"E; R.167218–19^M Paidi, Mt. Tiaoue, Massif de Kopéto 21°09'54"S; R.167293–94 Fwaxo, Île Yandé 20°04'02"S 163°48'34"E; R.167498^M Nakuta, 0.6km N Bwa Méyu 21°29'13"S 165°52'08"E; R.167784^M Paevala, Sommet Poum 20°15'04"S 164°01'23"E; R.167790^G Paevala, Sommet Poum 20°15'06"S 164°01'22"E; R.167792^M Paevala, Sommet Poum 20°15'20"S 164°01'32"E; R.167799 Sommet Poum 20°15'50"S 164°02'17"E; R.167825^M 0.6km SW Mé Mwa 21°26'31"S 165°44'31"E; R.167826^{MG} Paraméré, 2km SW Gwâ Rùvianö 21°27'38"S 165°41'21"E; R.167827^{MG} Méö Mwâ I Kamérö, 1km NW Gwâ Rùvianö 21°26'08"S 165°41'37"E; R.167954 Néjéré Dumwa, Poro 21°20'11"S 165°43'31"E; R.167961^{MG}, R.167962^G Rivière Koua 21°23'06"S 165°42'05"E; R.168086 Col de Plum 22°15'03"S 166°36'27"E; R.168171–72^M Carrière des Sapins, Paéoua 21°09'48"S 165°05'10"E; R.168203^M Ponatapoué, Paéoua 21°09'40"S 165°05'41"E; R.171453^G Massif du Koniambo, headwaters of Rivière Pandanus 20°59'45.95"S 164°48'31.1"E; R.171454, R.171455^G, R.171456–57 Massif du Koniambo, headwaters of Rivière Pandanus 20°59'48.51"S 164°48'30"E; R.171467^G Massif du Koniambo, headwaters of Creek Coco 20°58'42"S 164°47'38"E; R.171472–77 Poavétalapa, Pointe de Vavouto 21°0'34.52"S 164°41'2.01"E, R.171493, R.171494^G Poavétalapa, Pointe de Vavouto 21°0'34.52"S 164°41'2.01"E; R.171495, R.171498^G Poavétalapa, Pointe de Vavouto 20°0'39.86S 164°41'6.30E; R.171200, R.171201^G, R.171202–05, R.171211, R.171214 Mt. Do 21°45'17"S 166°00'01"E; R.172511 Uwêciã, Haut Nakéty, 8km E Nakéty 21°33'07"S 166°07'15"E; R.172515–16^G, R.172517 Chetoré Kwèdè, Haut Nakéty, 8km E Nakéty 21°33'11"S 166°06'39"E; R.172527 Bwa Uja, Presqu'île Bogota 21°29'43"S 166°00'11"E; R.172527–28^G Bwaako, Presqu'île Bogota 21°29'02"S 166°00'41"E; R.172532^G Bwaako, Presqu'île Bogota 21°29'01"S 166°00'39"E; R.172542 Mwâxâ Nébi, Cap Bocage 21°11'16"S 165°35'44"E; R.172553 Mine Galliéni, Mt. Vulcain, Tontouta valley 21°54'20"S 166°20'57"E; R.172554, R.172556–57^G, R.172559^G Kalouéhola River, Tontouta valley 21°55'59"S 166°20'37"E; R.172557–60 Kalouéhola River, Tontouta valley 21°55'56"S 166°20'31"E; R.172583–84, R.172585^G, R.172586 Koé Vané, Ko Mwa Nürri, Port Boisé 22°21'56"S 166°57'19"E; R.172595^G Koé Vané, Ko Mwa Nürri, Port Boisé 22°21'46"S 166°56'28"E; R.172603, R.172604^G Ko Mwa Nürri, Port Boisé 22°22'14"S 166°56'57"E; R.172731–33^G, R.172763–64^G, R.172795^G Me Maoya 21°26'19.8"S 165°21'15.4"E; R.174532, R.174553, R.174571, R.174573 Parc des Grand Fougères, Pic Vincent 21°36'10"S 165°46'27"E; R.154521, R.174538–39, R.174555 Parc des Grand Fougères, Aire des Carpolepis 21°36'43"S 165°46'22"E.

Loyalty Islands: R.163351^M, R.163352^{MG}, R.163553^M, R.163356^M Lifou, Luceilla, forest track at Lycée Polyvalent 20°53'36"S 167°15'00"E; R.163362^{MG}, R.163363, R.163364^M Lifou, Point Chateaubriand 20°52'38"S 167°15'56"E; R.163426^M Maré, Ciengete, Hotel Nengone Village 21°35'59"S 167°53'10"E; R.163444^{MG}, R.163445^M, R.163449 Maré, Tadine district 21°32'18"S 167°55'05"E.

Vanuatu: R.112037–38 Bethel, Tanna Island 19°34'S 169°18'E; USNM 33456–58^G.

APPENDIX 2. List of specimens used in the genetic study. For museum acronyms see materials and methods.

Genus & Species		Voucher	Locality	GenBank Accession
Outgroup				ND2
<i>Celaticincus euryotis</i> (Werner)		AMS R.138574	Île des Pins	DQ675204
<i>Graciliscincus shonae</i> Sadlier		AMS R. 165813	Mt. Ouin	DQ675207
<i>Kanakysaurus viviparus</i> Sadlier, Smith, Bauer & Whitaker		AMS R.161299	Île Pott, Îles Belep	DQ675209
<i>Lacertoides pardalis</i> Sadlier, Shea & Bauer		AMS R.148051	Kwa Néie	DQ675211
<i>Lioscincus nigrofasciolatus</i> (Peters)		AMS R.138624	Île des Pins	DQ675216
<i>Lioscincus steindachneri</i> Bocage		AMS R.149890	Mé Adéo	DQ675218
<i>Lioscincus tillieri</i> (Ineich & Sadlier)		AMS R.148037	Mt. Vulcain	DQ675220
<i>Marmorosphax tricolor</i> (Bavay)		CAS 214451	Mt. Koghis	DQ675227
<i>Phoboscincus garnieri</i> (Bavay)		AMS R.151964	Mt. Dore	DQ675237
<i>Sigaloseps deplanchei</i> (Bavay)		AMS R.148065	Plaine des Lacs	DQ675238
<i>Simiscincus aurantiacus</i> Sadlier & Bauer		AMS R.144356	Mt. Koghis	DQ675250
<i>Tropidoscincus variabilis</i> (Bavay)		AMS R.161879	Kwa Nê Mwa	DQ675242
Ingroup				
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172515	Nakéty	JQ914664
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172516	Nakéty	JQ914665
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172527	Bogata	JQ914666
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172528	Bogata	JQ914667
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172532	Bogata	JQ914668
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172556	Tontouta valley	JQ914669
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172557	Tontouta valley	JQ914670
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172559	Tontouta valley	JQ914671
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172585	Port Boisé	JQ914672
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172604	Port Boisé	JQ743853
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172731	Mé Maoya	JQ914673
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172732	Mé Maoya	JQ914674
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172733	Mé Maoya	JQ914675
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172763	Mé Maoya	JQ914676
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172764	Mé Maoya	JQ914677
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172795	Mé Maoya	JQ914678
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.166225	Gouaro-Déva	JQ914679
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.166226	Gouaro-Déva	JQ914680
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.165886	Pouembout	JQ914681
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.153578	Tsiba	JQ914682
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.153577	Tsiba	JQ914683
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.167790	Sommet Poum	JQ914684
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.167826	Paramere	JQ914685
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.167827	Méo Mwa Kamero	JQ914686
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.167961	Rivière Koua	JQ914687
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.167962	Rivière Koua	JQ914688
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.171201	Mt. Do	JQ914689

.....continued on the next page

APPENDIX 2. (Continued)

Genus & Species		Voucher	Locality	GenBank Accession
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.171453	M. de Koniambo	JQ914690
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.171455	M. de Koniambo	JQ914691
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.171467	M. de Koniambo	JQ914692
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.171494	Vavouto Peninsula	JQ914693
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.171498	Vavouto Peninsula	JQ914694
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.172595	Port Boisé	JQ914695
<i>Caledoniscincus</i>	<i>atropunctatus</i>	CAS 231910	Moindou	JQ914696
<i>Caledoniscincus</i>	<i>atropunctatus</i>	CAS 231909	Moindou	JQ914697
<i>Caledoniscincus</i>	<i>atropunctatus</i>	USNM 33456	Vanuatu	JQ914698
<i>Caledoniscincus</i>	<i>atropunctatus</i>	USNM 33457	Vanuatu	JQ914699
<i>Caledoniscincus</i>	<i>atropunctatus</i>	USNM 33458	Vanuatu	JQ914700
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.163352	Lifou - Îles Loyauté	JQ914701
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.163362	Lifou - Îles Loyauté	JQ914702
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.163444	Maré - Îles Loyauté	JQ914703
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.146396	Col des Rousettes	JQ914704
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.146397	Col des Rousettes	JQ914705
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.165915	Ponérihoen	JQ914706
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.165836	Mt. Aoupinié	JQ914707
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.141496	Grottes d'Adio	JQ914708
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.141497	Grottes d'Adio	JQ914709
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.163226	Massif de Kopéto	JQ914710
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.161107	Kaala	JQ914711
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.161803	Île Art	DQ675196
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.146343	Grottes de Koumac	JQ914712
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.161228	Forêt d'Ougne	JQ914713
<i>Caledoniscincus</i>	<i>atropunctatus</i>	AMS R.163316	Forêt d'Ougne	JQ914714
<i>Caledoniscincus</i>	<i>aquilonius</i>	CAS 231935	Rivière Nehoué	JQ743854
<i>Caledoniscincus</i>	<i>aquilonius</i>	AMS R.150712	Hienghène	JQ743855
<i>Caledoniscincus</i>	<i>auratus</i>	AMS R.157910	Forêt Tia	JQ743850
<i>Caledoniscincus</i>	<i>auratus</i>	AMS R.144298	Grottes de Koumac	JQ743851
<i>Caledoniscincus</i>	<i>austrocaledonicus</i>	AMS R.153713	Mt. Taom	JQ743860
<i>Caledoniscincus</i>	<i>austrocaledonicus</i>	AMS R.172661	Chutes Madeleine	JQ743861
<i>Caledoniscincus</i>	<i>chazeai</i>	AMS R.138515	Koulnoué	DQ675272
<i>Caledoniscincus</i>	<i>constellatus</i>	AMS R.171470	Vavouto Peninsula	JQ743845
<i>Caledoniscincus</i>	<i>constellatus</i>	AMS R.171496	Vavouto Peninsula	JQ743846
<i>Caledoniscincus</i>	<i>constellatus</i>	MNHN 2011.0228	Vavouto Peninsula	JQ743847
<i>Caledoniscincus</i>	<i>cryptos</i>	AMS R.135141	Col d'Amieu	JQ743852
<i>Caledoniscincus</i>	<i>festivus</i>	AMS R.161882	Kwa Né Mwa	DQ675200
<i>Caledoniscincus</i>	<i>festivus</i>	AMS R.165885	Pouembout	JQ743857
<i>Caledoniscincus</i>	<i>haplorhinus</i>	AMS R.161077	Île Art	JQ743858
<i>Caledoniscincus</i>	<i>haplorhinus</i>	CAS 231888	Îlot Brosse	JQ743859

.....continued on the next page

APPENDIX 2. (Continued)

Genus & Species	Voucher	Locality	GenBank Accession	
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.165933	Mt. Dzumac	JQ914715
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172618	Mt. Humboldt	JQ914716
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172609	Mt. Humboldt	JQ914717
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172610	Mt. Humboldt	JQ914718
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172613	Mt. Humboldt	JQ743848
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172614	Mt. Humboldt	JQ914719
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172617	Mt. Humboldt	JQ914720
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172622	Mt. Humboldt	JQ914721
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172648	Yaté Barrage	JQ743849
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172649	Yaté Barrage	JQ914722
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172650	Yaté Barrage	JQ914723
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172651	Yaté Barrage	JQ914724
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172652	Yaté Barrage	JQ914725
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.172653	Yaté Barrage	JQ914726
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.171400	Ni River	JQ914727
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.171426	Pourina River	JQ914728
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.171428	Pourina River	JQ914729
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.171429	Pourina River	JQ914730
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.171430	Pourina River	JQ914731
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.167465	Forêt Cachée	JQ914732
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.167466	Forêt Cachée	JQ914733
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	CAS 231902	Mt. Ouin	JQ914734
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.148087	Mt. Koghis	JQ914735
<i>Caledoniscincus</i>	<i>notialis</i> sp. nov.	AMS R.148059	Forêt Nord	JQ914736
<i>Caledoniscincus</i>	<i>orestes</i>	AMS R.149926	Mé Adéo	DQ675202
<i>Caledoniscincus</i>	<i>orestes</i>	AMS R.149983	Mt. Panié	JQ743856
<i>Caledoniscincus</i>	<i>terma</i>	CAS 198680	Mt. Mandjélia	DQ675271