Localized endemism in the southern ultramafic bio-region of New Caledonia as evidenced by the lizards in the genus *Sigaloseps* (Reptilia: Scincidae), with descriptions of four new species

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ABSTRACT

The scincid genus *Sigaloseps* is reviewed in the light of information derived from new collections made over the past 10 years. The results from field, morphological and genetic studies reveal a complex of three taxa currently masquerading under *Sigaloseps deplanchei*, two taxa under *Sigaloseps ruficauda*, and another species with no obvious morphological affinities to any described taxon. All species are restricted to habitats on ultramafic surfaces of southern New Caledonia. In the genetic analysis three taxa restricted to high-elevation habitats in the southern ranges constitute a well supported group. The speciation within this group most likely reflects contraction of forest to mountain top refugia resulting from changes in climate during the deep and recent history of the genus. Given their extremely small ranges, and the potential for loss or degradation of preferred habitat from fire and invasive species, these three high-elevation lizard species are at a moderate level of threat, and are categorized as Vulnerable when assessed under IUCN criteria. The new species described from the northern edge of the southern ultramafic region is known from only two locations, both of which are threatened,

SADLIER R. A., BAUER A. M., WOOD P. L., SMITH S. A., WHITAKER A. H., JOURDAN H. & JACKMAN T. 2014 — Localized endemism in the southern ultramafic bio-region of New Caledonia as evidenced by the lizards in the genus *Sigaloseps* (Reptilia: Scincidae), with descriptions of four new species, *in* GUILBERT É., ROBILLARD T., JOURDAN H. & GRANDCOLAS P. (eds), *Zoologia Neocaledonica 8. Biodiversity studies in New Caledonia*. Muséum national d'Histoire naturelle, Paris : 79-113 (Mémoires du Muséum national d'Histoire naturelle ; 206). ISBN : 978-2-85653-707-7.

and would be categorized as Endangered. A revised *Sigaloseps deplanchei*, now restricted mainly to the Grande Sud of southern New Caledonia, shows significant, regionally discrete, intraspecific genetic sub-structuring. One or more populations from each subgroup of *Sigaloseps deplanchei* are represented within Provincial reserves, but the majority of the range of each sub-group is likely to be in areas that are currently exploited for nickel mining or lie within areas which are under mining concessions.

RÉSUMÉ

Endémisme dans la bio-région du sud ultramafique de Nouvelle-Calédonie illustrés par les lézards du genre *Sigaloseps* (Reptile : Scincidae), avec la description de quatre nouvelles espèces.

Les scinques du genre *Sigaloseps* sont révisés à la lumière des informations obtenues à partir des collections réalisées ces dix dernières années. Les résultats du terrain, des études morphologiques et de la génétique mettent en évidence un complexe de trois taxons autrefois confondus sous le binôme *Sigaloseps deplanchei*, deux taxons identifiés comme *Sigaloseps ruficauda* et une autre espèce sans affinités morphologiques apparentes avec un autre taxon décrit. Toutes les espèces sont restreintes à des habitats situés sur des substrats ultramafiques du sud de la Nouvelle-Calédonie. Dans notre analyse génétique, trois taxons constituent un groupe bien individualisé limité à des habitats de zones d'altitude dans les massifs du sud. La spéciation à l'intérieur de ce groupe reflète probablement les contractions de la forêt vers des refuges au sommet des montagnes liées aux changements climatiques qui se sont déroulés durant l'histoire ancienne et récente du genre. Leur répartition géographique extrêmement étroite et la vulnérabilité de leurs habitats préférentiels par le feu (perte ou dégradation) et les espèces invasives rendent ces espèces d'altitude menacées et nous amènent à les ranger dans la catégorie 'Vulnérable' selon les critères de l'UICN. La nouvelle espèce décrite de la bordure nord de la région ultramafique du sud est connue seulement de deux localités, toutes deux menacées, et a été rangée dans la catégorie UICN 'En danger'. La forme révisée de *Sigaloseps deplanchei*, à présent restreinte principalement à la Grande Sud du sud de la Nouvelle-Calédonie, présente une sous-structuration génétique intra-spécifique régionale significative mais discrète. Une ou plusieurs populations de chaque sous-groupe de *Sigaloseps deplanchei* sont représentées dans des réserves naturelles provinciales, mais la majorité de la répartition géographique de chaque sous-groupe est vraisemblablement localisée dans des zones qui sont actuellement exploitées pour le nickel ou qui se situent dans des zones sous concession minière.

INTRODUCTION

Ultramafic surfaces cover about 5,500 km^2 or about a third of the total land area of the main island of New Caledonia or Grande Terre (Jaffré *et al.* 1987). These surfaces are characteristically rich in iron and magnesium, and several heavy metals, most notably nickel, and are (or will be) under considerable pressure from mining activities (Richer de Forges & Pascal 2008; Pascal *et al.* 2008). Recent fieldwork in combination with systematic studies have resulted in the discovery and description of a number of new taxa in the ultramafic ranges of the southern (Sadlier *et al.* 2006a; Bauer *et al.* 2008) and west-central/north-west regions of the island (Sadlier *et al.* 2004a, 2004b, 2006b, 2009; Bauer *et al.* 2006), identifying each area as having a rich and highly endemic lizard fauna.

The distinctiveness of the southern ultramafic region as an area of endemism for lizards has been highlighted in earlier reviews (Bauer & Sadlier 1993, 2000). Ongoing studies have revealed an extensive suite of skinks restricted to this region that includes nine species within four regionally endemic genera (*Sigaloseps* – 6(*3) species; *Graciliscincus* – 1 species; *Simiscincus* – 1 species; *Lacertoides* – 1 species), and a further six regionally restricted species within more widespread genera (*Nannoscincus mariei*; *Nannoscincus fuscus*; *Nannoscincus garrulus*(*); *Marmorosphax montana*(*); *Tropidoscincus variabilis*; *'Lioscincus' tillieri)*, five of which(*) are confined to high-elevation forest habitat on the summits of the ranges. There is also a suite of diplodactylid geckos restricted to the region (Bauer *et al.* 2008 ; 2012). The high number of lizard species restricted to the southern ultramafic ranges identifies this region as of considerable conservation significance for the endemic New Caledonian lizard fauna.

A review of the genus *Sigaloseps* (Sadlier & Bauer 1999) assessed morphological variation in the type species *deplanchei* and described a new species, *S. ruficauda*, from high-elevation habitat on Mt Mou (type locality) and nearby Mt Ouin in the southern ranges of Grande Terre. Recognition of *S. ruficauda* was at the time based on morphological criteria alone,

and its presence on Mt Ouin was represented by a single individual. Subsequently field work in the region resulted in the collection of specimens similar in morphology to *S. ruficauda* from Mt Ouin, and nearby Mt Humboldt and the Massif du Kouakoué. However, investigations using the ND2 mitochondrial DNA gene have identified significant genetic divergence between the type population of *S. ruficauda* from Mt Mou and those on Mt Ouin and Mt Humboldt. Specimens referred to each genetic lineage show no significant differentiation in scalation, but do show concordant differences in both the color pattern of the tail and the intensity of the reddish tail color. Field studies on Mt Humboldt also resulted in the discovery of a morphologically distinctive new species of *Sigaloseps* from high-elevation forest. This taxon is the sister to *S. ruficauda* sensu stricto in the genetic analyses, but with a very low level of genetic differentiation between the two taxa, indicating a recent speciation event.

Further field work in the southern region of Grande Terre in combination with broad-scale genetic studies funded by the BIONEOCAL initiative has provided information that redefines *S. deplanchei*, restricting it in distribution to the Grande Sud and identifying extensive regionally concordant genetic differentiation within the taxon. These studies also recognize a further two taxa that were previously included within *S. deplanchei*. One of the two additional taxa identified has a distribution that includes the central and northern areas of the southern ultramafic region and adjacent east-central region, and is recognized as a distinct species on both morphological and genetic criteria. The other taxon is known only from few sites in the southeast of the region, is very similar in overall appearance to *S. deplanchei*, with modal differences in the scalation associated with the eye providing a level of concordant morphological differentiation between the two lineages. However, some overlap in the distribution of character states prevents them from being completely diagnostic for each putative taxon. For this reason recognition of the new taxon draws support primarily from the genetic data which identifies the two taxa as being highly divergent in their level of genetic difference and in their relationship with each other.

As such, our investigations into *Sigaloseps* has not only identified a complex pattern of narrow-range (altitude dependent) endemism, but also broader scale (altitude independent) localized endemism within the southern ultramafic region, indicating the potential for the evolution of localized endemics in these ranges driven by cladogenic factors other than historical isolation on mountain summits. However, our understanding of the biogeography of southern Grande Terre is complicated by many areas having been not, or only poorly, investigated, particularly the summits of a number of peaks, and the current state of knowledge is likely to represent a significant underestimate of the extent of endemism in the region. As such, the ultramafic ranges of southern New Caledonia, and in particular the high elevation habitats, are here recognized as the areas of great conservation significance for lizards on the Grande Terre, and priority areas for future investigation.

MATERIALS AND METHODS

SYSTEMATICS

Acronyms. Specimen abbreviations are prefixed as follows: AMS - Australian Museum, Sydney; MNHN - Muséum national d'Histoire naturelle, Paris.

Measurements. The following characters were scored for each specimen where possible: snout to vent length - measured from tip of snout to caudal edge of anal scales; axilla to groin distance - measured from middle of base of the forelimb to middle of base of hindlimb; forelimb to snout length - measured from tip of snout to middle of base of forelimb; hindlimb length - measured from middle of base of hindlimb 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.

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 hand and foot, distal scale contains 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 counted on both sides and the mean value used; in the holotype description these values are presented as left/right values.

Phalangeal formulae for the manus and pes and the number of presacral and postsacral vertebrae (complete original tails only) were determined from radiographs prepared using a Eresco AS2 X-ray machine at exposures of 30 sec at 30 kV.

PHYLOGENETIC STUDIES

Character polarities. Follow Sadlier (2010) for morphological characters.

Genetic studies. Molecular Phylogenetics: we obtained sequence data from a 514 bp fragment of the mitochondrial NADH dehydrogenase 2 (ND2) gene from 41 samples from 17 locations determined on morphological criteria as representing the species *Sigaloseps deplanchei*. This sampling included the 4 samples later determined as a separate lineage *Sigaloseps* sp. from Riviére Bleue and Pourina River (2 locations), 13 samples from 3 locations in the north and central regions of the southern ultramafic block already determined on morphological criteria as representing a new species of *Sigaloseps*. It also included two samples representing the species *Sigaloseps ruficauda* from the type locality Mt. Mou, two samples from two high-elevation locations (Mt Ouin and Mt Humboldt) representing individuals similar in morphology *Sigaloseps ruficauda*, and three samples from high elevation at Mt Humboldt determined on morphological criteria as representing a new species of *Sigaloseps* (Appendix 1). 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 (Appendix 1).

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 theromocycler 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 GeniousTM version 5.4 (Drummond *et al.* 2011). Edited sequences were initially aligned by eye and MacClade v4.08 (Maddison and 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 (G) 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 for clade confidence we applied 1000 bootstrap pseudoreplicates via 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+G model was applied to each codon position. Two simultaneous parallel 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

All analytical methods resulted in the same tree topology except for several poorly-supported branches within *Sigaloseps deplanchei* sensu stricto and relationships strongly supported by high bootstrap values under maximum likelihood (Figure 1) were also strongly supported by Bayesian and parsimony results (not shown). The results revealed five well supported groups within *Sigaloseps* (Figure 1), each representing a distinct evolutionary lineage:

Group 1: A taxon formerly included within *Sigaloseps deplanchei* sensu lato and represented by populations from the southeast of the southern ultramafic region at Rivière Bleue and Pourina River and here described as *Sigaloseps conditus* n. sp.

Group 2: A taxon formerly included within *Sigaloseps deplanchei* sensu lato and represented by populations in the central (Tontouta valley) and northern (Pic Ningua) areas of the southern ultramafic region, and coastal ultramafic ranges in the east-central region (Nakéty) and here described as *Sigaloseps pisinnus* n. sp.

Group 3: A lineage of three taxa from the interior ranges of the southern ultramafic region: one representing populations on the adjacent peaks of Mt Ouin and Mt Humboldt formerly included under *Sigaloseps ruficauda* and here described as *Sigaloseps ferrugicauda* n. sp.; one representing the type population of *Sigaloseps ruficauda* sensu stricto from Mt Mou; and one representing a taxon from Mt Humboldt that is morphologically very distinct but shows a low level of genetic differentiation from *Sigaloseps ruficauda* and is here described as *Sigaloseps balios* n. sp.

Group 4: a widespread taxon that represents *Sigaloseps deplanchei* sensu stricto and which includes a complex of genetically discreet parapatric sub-populations distributed across ultramafic surfaces of southern Grande Terre.

The genetic data identifies Group 4 as a well supported lineage comprising the majority of samples currently assignable to *Sigaloseps deplanchei* s.s.. Populations within this lineage are diagnosable on morphological criteria from those in Group 2 (*S. pisinnus* n. sp.) and Group 3 ((*S. ferrugicauda* n. sp. (*Sigaloseps ruficauda* s.s. + *S. balios* n. sp.)), but not the Group 1 genetic lineage (*S. conditus* n. sp.) from the southeast of the region. As such, recognition of the in Group 1 populations as distinct from Group 4 draws significantly on the high level of genetic differentiation between the two lineages (14.3-18.2%, Table 1), and their placement within the scheme of genetic relationships for the genus in which the populations in Group 4 receive high support as the sister lineage to the Group 3 taxa (species in the *Sigaloseps* '*ruficauda*' group), whereas the taxon represented by Group 1 lies outside this sub-group of taxa.

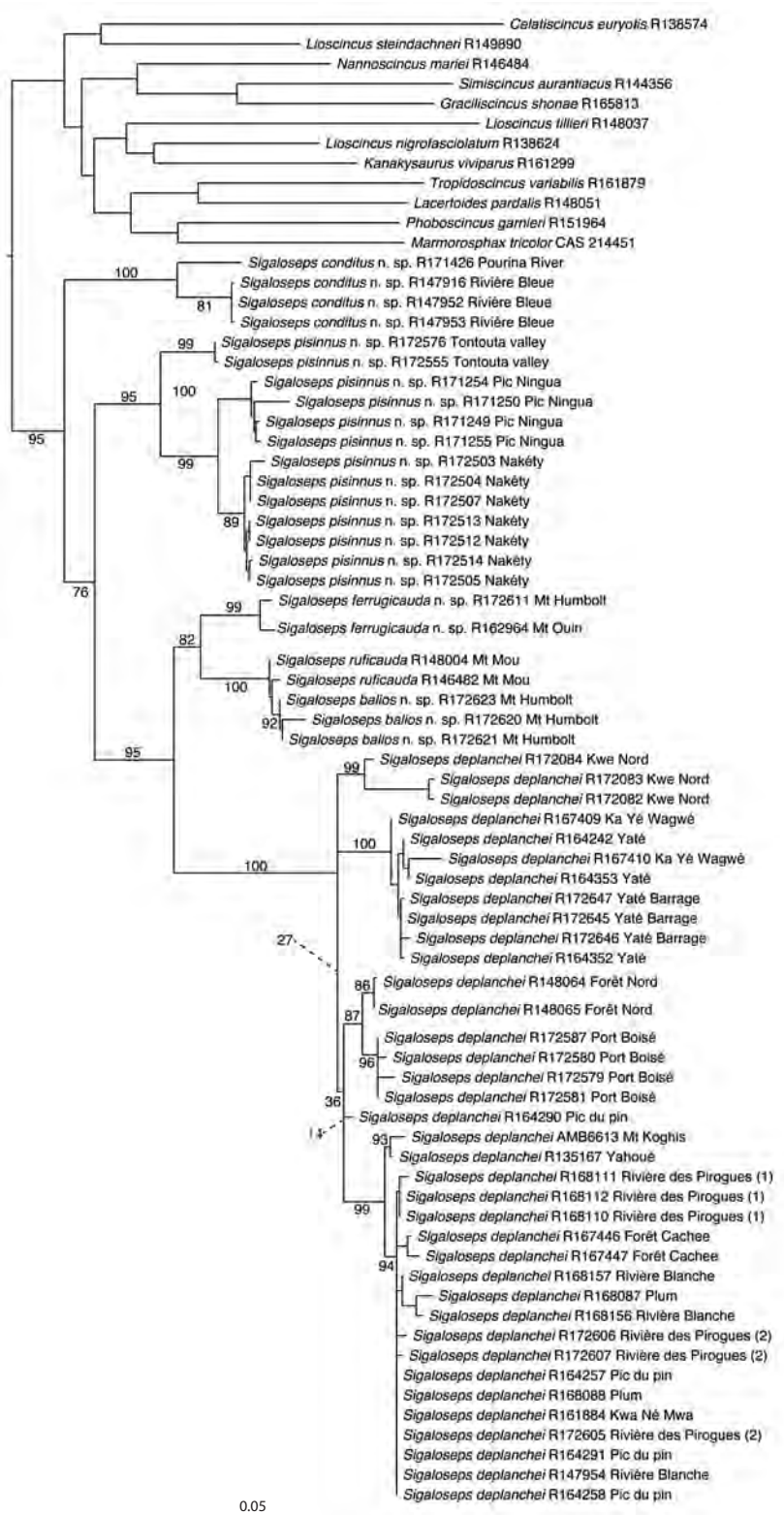

FIGURE 1

Phylogenetic relationships amongst the species and populations of *Sigaloseps*. Maximum Likelihood topology with bootstrap support values. Additional phylogenetic analyses (Maximum parsimony and Bayesian Inference) were conducted and obtained similar nodal support.

TABLE 1

Pairwise matrix of genetic distances (Uncorrected "P") between species of *Sigaloseps* (below the diagonal) and within each species (on diagonal in bold) for the ND2 mitochondrial DNA gene.

	S. deplanchei (group 4)	*S. conditus* n.sp (group 1)	*S. pisinnus* n. sp. (group 2)	*S. rufi auda* (group 3)	*S. ferrugicauda* n. sp. (group 3)	*S. balios* n. sp. (group 3)
1	**0.0-9.7** %					
2	14.3-18.2 %	**0.3-7.6** %				
3	12.5-19.4 %	13.2-16.1 %	**0.7-9.3** %			
4	11.6-16.1 %	14.4-15.6 %	12.6-15.7 %	**0.70** %		
5	10.7-15.9 %	15.5-15.8 %	12.0-15.6 %	8.0-9.1 %	**0.0-1.9** %	
6	12.2-16.9 %	14.4-16.2 %	12.6-16.0 %	0.9-2.7 %	8.7-9.8 %	**0.1-1.9** %

TABLE 2

Differences in body and tail size, and scalation between the species of *Sigaloseps*.

	S. deplanchei	*S. conditus* n. sp.	*S. pisinnus* n. sp.	*S. rufi auda*	*S. ferrugicauda* n. sp.	*S. balios* n. sp.
MBR range mean ± sd	n = 25 26-30 28.0 ± 0.62	n = 9 26-28 26.2 ± 0.67	n = 17 22-24 23.9 ± 0.48	n = 7 26-28 26.6 ± 0.97	n = 4 26-28 26.5 ± 1.00	n = 3 26-28 26.7 ± 1.15
DSR range mean ± sd	n = 25 49-55 52.4 ± 1.78	n = 9 48-52 50.2 ± 1.30	n = 17 48-55 51.6 ± 2.32	n = 7 53-60 56.6 ± 2.30	n = 4 53-56 54.5 ± 1.29	n = 3 58-61 59 ± 1.70
FFS range mean ± sd	n = 25 8-9 8.15 ± 0.30	n = 9 6-8 7.6 ± 0.60	n = 17 6-9 7.62 ± 0.65	n = 7 7-9 8.1 ± 0.75	n = 4 8-9 8.25 ± 0.50	n = 3 8-9 8.5 ± 0.50
FFL range mean ± sd	n = 24 11-14 12.2 ± 0.93	n = 9 11-14 11.9 ± 0.80	n = 17 9-11 10.3 ± 0.73	n = 7 9-15 11.8 ± 0.80	n = 4 12-13 12.75 ± 0.50	n = 3 12-14 12.8 ± 0.76
FTS range mean ± sd	n = 25 10-12 11.15 ± 0.41	n = 9 11-12 11.1 ± 0.33	n = 17 10-12 11.0 ± 0.41	n = 7 10-13 11.1 ± 1.10	n = 4 10-12 11.1 ± 0.63	n = 3 11-12 11.2 ± 0.29
FTL range mean ± sd	n = 25 23-29 26.1 ± 1.48	n = 7 25-29 26.4 ± 1.28	n = 16 20-25 22.9 ± 1.37	n = 7 21-28 24.7 ± 1.95	n = 4 24-28 26.1 ± 1.38	n = 3 23-25 24.2 ± 0.76
SVL Maximum mean	n = 25 46 40.3	n = 9 46 42	n = 17 38.5 34.1	n = 3 56 47.3	n = 4 60 56.4	n = 3 50 46.2
TL range mean	n = 9 87.5-110.8 100.8	n = 0	n = 2 128.9-139.5 128.9	n = 1 152.6	n = 0	n = 1 128.4

Populations in Group 2 (*S. pisinnus* n. sp.) from the central and northern regions of the southern ultramafic ranges and coastal ultramafic ranges of the east-central region form a well-supported and highly differentiated genetic lineage (12.5-19.4%), which although superficially similar in appearance the Group 4 taxon to (*S. deplanchei* s.s.) show significant differences in scalation (Table 2) and subtle differences in color pattern, which in combination provides strong support for recognition of this taxon as a distinct species.

The complex of high-elevation populations included in Group 3 form two moderately well-differentiated lineages (8.0-9.1% - Table 1). One lineage includes the population from Mt Mou, the type locality of *Sigaloseps ruficauda* s.s., and a morphologically distinctive taxon from Mt Humboldt (*S. balios* n. sp.). The other lineage contains populations from Mt Ouin and Mt Humboldt (*S. ferrugicauda* n. sp.), the former of these previously being included under *Sigaloseps ruficauda* senso lato (Sadlier & Bauer 1999). The taxa represented by populations from Mt Mou (*Sigaloseps ruficauda* s.s.) and Mt Ouin and Mt Humboldt (*S. ferrugicauda* n. sp.) share similarities in overall appearance, scalation and color pattern, the main morphological difference between the two being in coloration, most significantly the intensity of the red tail coloration. The third member of this complex (*S. balios* n. sp.) is readily distinguished by features of tail and ventral coloration, and some difference in scalation (Table 2). However, it shows only a low level of differentiation (0.9-2.7%) from its allopatric sister taxon *Sigaloseps ruficauda* s.s., indicating a recent and rapid divergence of these two taxa.

TABLE 3

Pairwise matrix of genetic distances (Uncorrected « P ») between major sub-groups of *Sigaloseps deplanchei* (below the diagonal) and within the sub-groups (on diagonal in bold) for the ND2 mitochondrial DNA gene.

	'western' 1	'eastern' 2	'southern' 3	Kwé Nord 4	Pic du Pin 5
1	**0-3.2** %				
2	4.6-8.4 %	**0.2-3.5** %			
3	3.5-7.2 %	3.1-7.0 %	**0-2.9** %		
4	5.3-10.2 %	4.4-11.6 %	2.4-8.3 %	**0.7-4.8** %	
5	4.0-5.3 %	4.4-6.4 %	2.6-4.1 %	3.3-7.1 %	**0**

SYSTEMATIC PART

Family SCINCIDAE Gray, 1825

Genus ***SIGALOSEPS*** Sadlier, 1986

Type species. *Lygosoma deplanchei* Bavay, 1869.

DIAGNOSIS — [*denotes apomorphic character states within the *Eugongylus* group as defined by Sadlier, (2010)]: The species of *Sigaloseps* are small in size with a maximum snout-vent length of 38.5 mm for *S. pisinnus* n. sp. to 60 mm for *S. ruficauda* s.s., have a stout body, moderately well developed limbs and digits, and a short (~100% of SVL for *S. deplanchei* s.s.) to moderately long tail (150% for *S. ruficauda* s.s.). The ear opening is moderately large and *lacks obviously enlarged lobules around the anterior edge.

Scalation. Body scales smooth; *no distinct supranasal; naris situated within a single undivided nasal scale; frontonasal broader than long; prefrontals moderately large and narrowly to moderately separated; frontal longer than wide; supraoculars four; *frontoparietals fused; interparietal distinct; parietals each bordered by a single upper secondary temporal scale and single nuchal scale; primary temporal usually single (mostly divided in *S. ruficauda* s.s. and *Sigaloseps ferrugicauda* n. sp.); lower secondary temporal single; tertiary temporals two; postlabials two; nasals moderately to widely separated; anterior loreal higher than wide; supraciliaries usually 7; upper labials 7 with the fifth subocular and contacting the lower eyelid or separated by a complete row of subocular scales; 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; *basal scales of 3rd and 4th fingers usually fused to form a single broad scale.

Osteology. Premaxillary teeth 11; *atlantal arches of first cervical vertebrae fused dorsally to each other and to the intercentrum (examined for type species only); presacral vertebrae generally 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 (examined for type species only).

The species of *Sigaloseps* are conservative in morphology with minimal diagnostic differentiation in body proportions or scalation (see Sadlier *et al*. 1999), adult females typically have a color and pattern similar to that of juveniles, that is, they retain the juvenile condition, whereas the adult males change in tail coloration and often also develop a different ventral coloration to that of adult females.

RECOGNIZED SPECIES — *Sigaloseps deplanchei* (Bavay) sensu stricto, *Sigaloseps conditus* n. sp., *Sigaloseps pisinnus* n. sp., *Sigaloseps ruficauda* Sadlier & Bauer, *Sigaloseps ferrugicauda* n. sp., *Sigaloseps balios* n. sp.

Sigaloseps deplanchei (Bavay, 1869)

Figures 2-4

Lygosoma deplanchei Bavay, 1869: 23.
Hinulia tetragonurus Günther, 1872: 420.
Sigaloseps deplanchei (Bavay, 1869) – Sadlier 1986: 50.

TYPE MATERIAL — ***Lectotype* Lygosoma deplanchei *Bavay***. BM 86.9.16.1 designated by Sadlier (1986) from two original syntypes (BM 86.9.16.1-2) in the British Museum (BM) listed by Boulenger (1887) as from 'New Caledonia' and presented by M.A. Bavay. The lectotype is an adult male; size 42 mm SVL; tail length 32 mm, regenerated; midbody scale rows 28; dorsal scale rows 50; lamellae of fourth toe 26/27. The snout-vent length and the values for scalation characters fall within the range of variation for both *Sigaloseps deplanchei* s.s. or *Sigaloseps conditus* n. sp. The condition of the lower eyelid is that of a transparent 'window' or 'disc' with fine sutures at the anterior and posterior margins, and the contact with the subocular upper labial is difficult to discern, other than it appears to have a poorly developed row of subocular scales. The description of *Lygosoma deplanchei* by Bavay alludes to the species being found at more than one locality, including the summit of forested mountains, but gives no indication of any specific locality. A series of four syntypes discovered in the Paris Museum were listed a year before Sadlier's paper (1986) by Brygoo (1985). Three of these specimens have been examined, one is in extremely poor condition, the remaining two have a snout-vent length of 39.0 and 35 mm. The values for scalation characters for these syntypes fall within the range of *Sigaloseps deplanchei* s.s. or *Sigaloseps conditus* n. sp., although there is no obvious complete subocular of scales between the upper labials and lower eyelid and the condition of the lower eyelid is that of a transparent window with the right eyelid of one individual having a fine suture at the posterior margin of the disc.

Holotype* Hinulia tetragonurus *Günther. BM 71.4.16.42 the single syntype in the British Museum listed by Boulenger (1887) as from 'New Caledonia' and presented by J. Brenchley Esq., and later identified as the holotype by monotypy by Sadlier (1986). The holotype is an adult male; size 44 mm SVL; tail length 31 mm, regenerated; midbody scale rows 28;

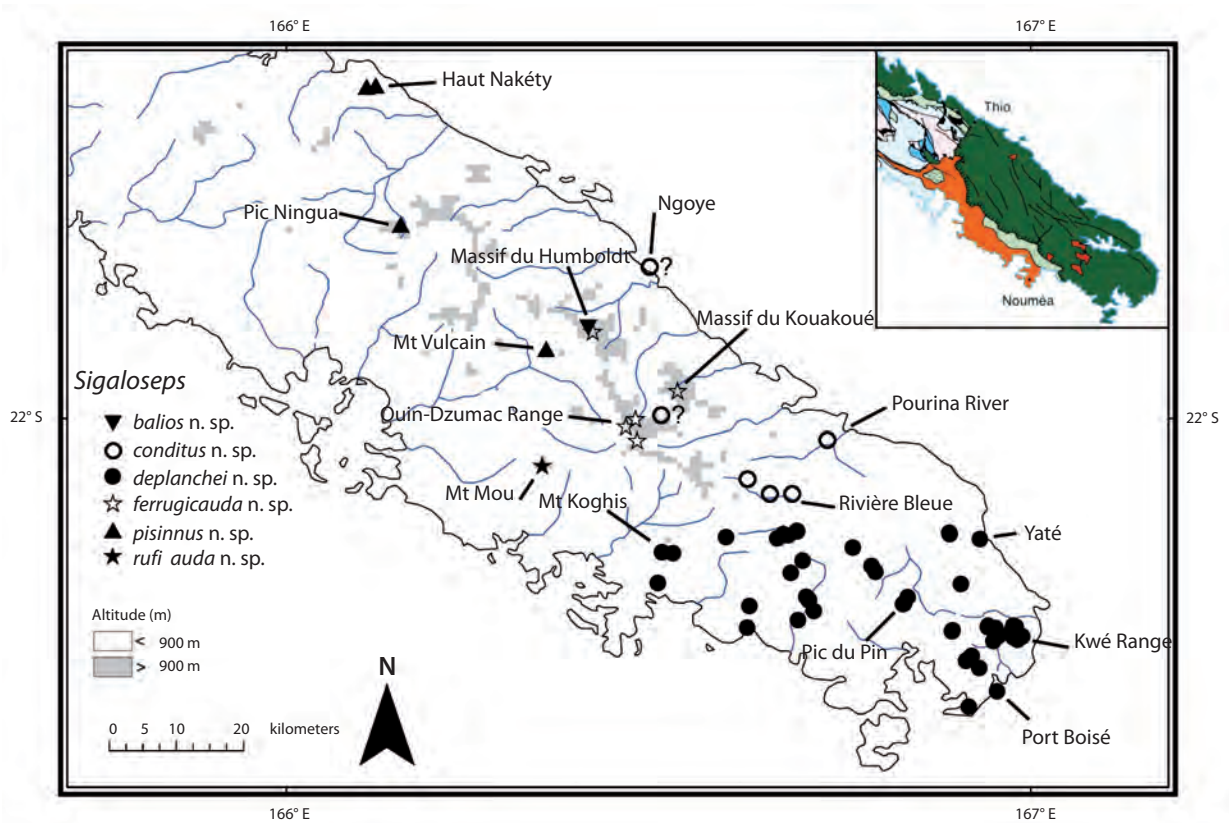

FIGURE 2

Distribution of the species and populations of *Sigaloseps* in southern New Caledonia: *Sigaloseps deplanchei* (Bavay) sensu stricto (closed circle), *Sigaloseps conditus* n. sp. (open circle), *Sigaloseps pisinnus* n. sp. (closed triangle), *Sigaloseps ruficauda* Sadlier and Bauer (closed star), *Sigaloseps ferrugicauda* n. sp. (open star), *Sigaloseps balios* n. sp. (closed inverted triangle) - inset shows extent of ultramafic surfaces (green) in southern region.

dorsal scale rows 50; lamellae of fourth toe 26/26. The snout-vent length and values for scalation characters fall within the range of *Sigaloseps deplanchei* s.s. or *Sigaloseps conditus* n. sp. However, there is no obvious complete subocular of scales between the upper labials and lower eyelid and the condition of the lower eyelid is that of a transparent window with the right eyelid divided by a fine suture medially and at the anterior and posterior margins of the disc.

No single morphological character examined is able to unequivocally assign the types of *Lygosoma deplanchei* Bavay or *Hinulia tetragonurus* Günther to the taxa identified in the genetic study. As such the lectotype of *Lygosoma deplanchei* Bavay (and syntypes) and the holotype of *Hinulia tetragonurus* Günther are not inconsistent with *Sigaloseps deplanchei* s.s. as recognised here, and there is no convincing evidence to indicate that either of the primary types is conspecific with species described here as *Sigaloseps conditus* n. sp. For this reason we adopt a conservative approach and treat the lectotype of *Lygosoma deplanchei* Bavay and holotype of *Hinulia tetragonurus* Günther as conspecific with the widespread taxon in the southern New Caledonia. Further, our investigations into the stay of the vessel H.M.S. *Curaçoa* in New Caledonia, during which journey the type of *Hinulia tetragonurus* was collected, indicate that aside from a one-day stop on the south coast of the island it was otherwise anchored in Nouméa (Brenchley 1873). As such, for the purpose of this review we regard Nouméa or its environs as most likely being the origin of Bavay's types of *Lygosoma deplanchei* and

Günther's holotype of *Hinulia tetragonurus*, and use the large sample from Mt Koghis, in the ranges close to Nouméa, as the benchmark for comparison of *Sigaloseps deplanchei* s.s. with other species and in discussing intraspecific variation.

MATERIAL EXAMINED — Mt Koghis 22°10'43"S 166°30'20"E; R.144349, Aug. 1994; R.146546-60, R.146576-84, 15 Jan. 1995 (all AMS).

DIAGNOSIS — The following features of coloration and scalation in combination will distinguish *Sigaloseps deplanchei* s.s. from all other species of *Sigaloseps* (except *S. conditus* n. sp.): small adult size, maximum SVL of 46 mm for males and 45 mm for females; subocular upper labial usually in contact with the lower eyelid; paravertebral scale rows 49-56; 4th toe lamellae scales 23-28; tail length ~100%SVL; underside of body and tail yellow and without obvious brown or black markings ; dorsal and lateral surface of tail usually brown to dull orange. *Sigaloseps deplanchei* s.s. is most similar in morphology to *Sigaloseps conditus* n. sp., with no obvious differences in scalation other than the absence of a well developed row of subocular scales in most *S. deplanchei*.

These characters allow *Sigaloseps deplanchei* s.s. to be distinguished from its congeners as follows:

- from *Sigaloseps conditus* n. sp. in having the subocular upper labial usually in contact with the lower eyelid (*vs* separated from the lower eyelid by a well developed row of subocular scales.
- from *Sigaloseps pisinnus* n. sp. by its larger adult size (maximum SVL 46 *vs* 38 mm), shorter tail (mean = ~100% *vs* 126% of SVL), a duller overall tail color (usually brown to dull orange *vs* bold reddish-brown), and in having a uniformly pale underside to the tail (*vs* spotted with small brown blotches).
- from *Sigaloseps ruficauda* by its smaller adult size (maximum SVL 46 *vs* 60 mm), fewer paravertebral scales (49-56 *vs* 53-60), shorter tail (mean ~100% *vs* 150% of SVL) and duller overall color to the tail (usually brown to dull orange *vs* bright reddish).
- from *Sigaloseps ferrugicauda* n. sp. by its smaller adult size (maximum SVL 46 *vs* 60 mm), fewer paravertebral scales (49-56 *vs* 53-60).
- from *Sigaloseps balios* n. sp. by its smaller adult size (maximum SVL 46 *vs* 50 mm), shorter tail (mean = ~100% *vs* 128% of SVL), paler yellow ventral coloration (dull yellow *vs* bold enamel yellow, and paler tail color (usually brown to dull orange *vs* nearly black).

The genetic data provides strong support for the monophyly of a widespread *Sigaloseps deplanchei* s.s., which is strongly differentiated from all its congeners (see Table 1). In particular, it places *Sigaloseps deplanchei* s.s. within a well supported subgroup that includes the species in the *S. ruficauda* group as its sister, rather than with the morphologically similar *Sigaloseps conditus* n. sp.

DESCRIPTION — The species is re-described from 13 adult males and 12 adult females from Mt Koghis, tests for sexual dimorphism in scalation found no significance differences for the scalation characters surveyed.

Measurements (adults only). Size 39-46 mm SVL; distance from axilla to groin 53.5-59.0% SVL (mean = 56.3); distance from forelimb to snout 37.0-41.9% SVL (mean = 38.9); hindlimb length 28.6-35.7% SVL (mean = 31.7); tail length of individual with most complete tail 107.1% SVL.

Scalation (all specimens). Midbody scale rows 26-30 (mean = 28.0, sd = 0.64); dorsal scale rows 49-56 (mean = 52.4, sd = 1.85); scales on top of fourth finger 8-9 (mean = 8.1, sd = 0.26); lamellae beneath fourth finger 11-14 (mean = 12.1, sd = 0.87); scales on top of fourth toe 10-12 (mean = 11.2 sd = 0.43); lamellae beneath fourth toe 23-28 (mean = 26.0, sd = 1.50).

Osteology. Presacral vertebrae 29.

Color and Pattern. Dorsal surface of body light to mid-brown. Most dorsal scales with a cluster of minute dark spots to the lateral and posterior edges of each scale, giving a dull and clouded appearance to each scale, in some individuals these markings forming dark flecks either positioned medially and running down the center of each scale or to either side of each scale. Upper lateral surface is similar in color to the dorsal surface, progressively grading in tone to a neutral cream color approaching the venter. Most adult females and some adult males with dark markings on the upper lateral surface, in females tending to coalesce and form a dark, broken, dorsolateral streak anteriorly from behind the eye to the

level of the forelimb. Side of the head is similar in color to dorsal surface, with dark markings to the labial and temporal scales and dark streak from the nasal to front of the eye. Tail above and at the sides is similar in color and pattern of dark markings as the body. In life the ventral surface of the body is pale yellow and throat pale grayish white in adult females, and in adult males (Figure 4) moderate yellow on the body and with a bright orange throat, whereas juveniles are grayish white overall Adult males have a dull (occasionally bold) reddish flush overall to the tail.

Variation. The genetic data indicates the existence of three well supported and differentiated regionally discrete sub-groups within the widespread *Sigaloseps deplanchei* s.s. from southern Grande Terre each comprising two or more populations, and a one sub-group represented by a single population:

- a 'western' group represented by samples from Mt Koghis (northwest) south to Rivière des Pirogues and extending east to Rivière Blanche and Pic du Pin.
- a 'eastern' group represented by samples from Yaté on the east coast and extending inland to Grand Lac (Ka Yé Wagwé).
- a 'southern' group represented by samples south of the Grand Lac and Lac en Huit.
- a localized group in the southeast of the region represented by samples from the Kwé Range.

The sampling of *Sigaloseps deplanchei* in the Grande Sud is reasonably extensive, and has allowed us to identify the existence of the four subgroups. This level of differentiation was unexpected, although an earlier examination of geographical variation in scalation (Sadlier & Bauer 1999) identified significant differences in several characters between 'western' samples represented by the mid-elevation population on Mt Koghis and the 'eastern' (represented by the Goro population) and 'southern' (represented by the Forêt Nord population) groups. This is confounded by the presence of significant differences in several characters between the mid-elevation population on Mt Koghis and the (albeit small) population at the base of the Koghis range.

FIgURE 3

Adult male *Sigaloseps deplanchei* s.s. from the Creek Pernod.

FIGURE 4
Throat and chin coloration of adult male (left) and adult female (right) *Sigaloseps deplanchei* s.s. from the Goro Plateau.

The subgroups of *Sigaloseps deplanchei* in the Grande Sud come into close proximity around the Plaine des Lacs region, and it is difficult to think what factors could be maintaining the discreetness of the genetic groups where they approach each other. The 'eastern' subgroup is separated from the 'western' and 'southern' subgroups by the Riviére des Lacs, Lac en Huit, Grand Lac and the marshes associated with these water bodies, and from the Kwé Range group by the Kwé Binyi River.

DISTRIBUTION AND BIOLOGY — *Sigaloseps deplanchei* has a widespread distribution across the Grande Sud of New Caledonia where it is confined to habitats on ultramafic surfaces (Figure 2). It occurs primarily in forested habitats including humid forest or canopied maquis (maquis preforestier and maquis paraforestier), extending into adjacent low-canopied maquis, open maquis or even wetland maquis where a suitably moist environment exists at ground level. It has not been recorded from areas of extensive open maquis shrubland on lateritic soils, or open maquis on a cuirasse rock surface distant from forest habitat. It occurs in the region as a number of scattered and isolated populations.

COMMENTS — Previous assessments of the distribution of *Sigaloseps deplanchei* have been composite. Samples from Pic Ningua in the far north of the southern ultramafic region are now known to represent *Sigaloseps pisinnus* n. sp., while specimens from the headwaters of the Ni River in the central mountain chain and those collected by Roux & Sarasin in 1911 (Roux 1913) from Ngoye [=Ngoi] and Yaté on the east coast (see Sadlier & Bauer 1999: 88 fig.6;) are more consistent in morphology with *Sigaloseps conditus* n. sp., than with *Sigaloseps deplanchei* s.s.

The specimens collected by Roux & Sarasin from Yaté and assigned to *Sigaloseps deplanchei* by Sadlier (1986) have a complete subocular row of scales and a secondarily scaled (= divided disk) lower eyelid, traits characteristic of *Sigaloseps conditus* n. sp. However, samples from recent collections made at Wao (3 km S Yaté) and at the Yaté Barrage Botanical Reserve (1 km NE Yaté) nested within *Sigaloseps deplanchei* s.s. in the genetic study and are morphologically consistent with that species as recognised here. As such the identity of the Roux & Sarasin specimens from Yaté is unclear. It is possible that both *Sigaloseps deplanchei* s.s. and *Sigaloseps conditus* n. sp. occur in close proximity around Yaté. Such a scenario occurs in the Parc de la Rivière Bleue where *Sigaloseps deplanchei* s.s. is recorded from several sites in the upper reaches of Rivière Blanche and *Sigaloseps conditus* n. sp. from the adjacent upper reaches of Rivière Bleue, the two taxa being separated by a straight line distance of 6 km and a series of intervening ridges to ~500 m elevation with no obvious barriers to contact between the species.

The two specimens collected by Roux & Sarasin from Ngoye and assigned to *Sigaloseps deplanchei* by Sadlier (1986) and a single specimen collected recently from the Ni River in the central mountain chain are more consistent in morphology with *Sigaloseps conditus* n. sp. rather than *Sigaloseps deplanchei* s.s.. As such, it would appear that the northern limit of *Sigaloseps deplanchei* s.s. lies along a boundary that extends from the Dumbéa Valley on the west coast to the upper reaches of Rivière Blanche in the central mountain ranges to Yaté on the west coast, although the boundary on the west coast might extend further north.

CONSERvATION STATUS — Although known from a number of locations a redefined *Sigaloseps deplanchei* has an estimated extent of occurrence of less than 1000 km^2 and area of occupancy less than 500 km2. The genetic data indicates the species comprises three, possibly four, distinct historical lineages, each of which could constitute a separate management unit. In the southern parts of the species' range it occurs on forested habitats across the Goro Plateau including tall canopied maquis (preforestier and paraforestier), and sometimes extends into adjacent low canopied maquis. The ability of the species to occupy a diversity of maquis habitats in this region is reliant on the presence of the extensive broken cap of cuirasse rock which underlies these habitats and provides a humid sub-surface microclimate in an otherwise suboptimal environment. However, these areas of cuirasse typically overlay nickel bearing soils which are now being developed or are under lease for exploitation. As such, there is the potential for extensive parts of the species' extent of occurrence to be reduced by mining activities. In the north and west of its range the species is likely to be restricted to humid forest given that much of this area is covered with lateritic soils that lack the cuirasse rock cap. Here humid forest habitat is highly fragmented and continues to be reduced in area by the impact of firing on the forest edge (*i.e.* Montagne des Sources). Other threats to this species are similar to those recently identified for the skink *Graciliscincus shonae* (Whitaker & Sadlier 2011), which has the same broad distribution, and included threats to habitat quality by introduced ungulates (deer and pigs) damaging the litter layer and disrupting cover (such as rocks and logs), and an adverse impact from the presence of the introduced ant *Wasmannia auropunctata* on populations inhabiting low to mid-elevation forests. Recent survey work across a range of habitats on the Goro Plateau and in reserves elsewhere in the Grande Sud indicate *Sigaloseps deplanchei* is still moderately abundant where it occurs, but that the threats identified above are reducing the species area of occupancy, and as such, on IUCN criteria (IUCN 2001) it would now be considered Near Threatened with the possibility of moving to a higher level of threat with escalated loss of area of occupancy.

Sigaloseps conditus Sadlier, Bauer & Wood, n. sp.

Figures 2, 5, 6

TYPE MATERIAL — Holotype: New Caledonia, MNHN 2011.0284 (formerly AMS R.147952) Rivière Bleue, 4.7 km east of Pont Germain 22°06'S 166°41'E (collected R. Sadlier & G. Shea, 21 Sep. 1995). Paratypes: AMS R.125824, AMS R.125899 Rivière Bleue, Giant Kauri 22°06'S 166°39'E (collected H. Cogger & R. Sadlier, 25 Aug. 1987); AMS R.125895 Rivière Bleue, 1 km East of Giant Kauri 22°06'S 166°39'E (collected H. Cogger & R. Sadlier, 25 Aug. 1987); AMS R.135609-11 Rivière Bleue, vicinity of Giant Kauri 22°06'S 166°40'E (collected A. Greer, 24 Dec. 1988); AMS R.147916 Rivière Bleue, Haute Rivière Bleue Walk 22°05'S 166°37'E (collected R. Sadlier & G. Shea, 20 Sep. 1995); AMS R.147953 Rivière Bleue, 4.7 km East of Pont Germain 22°06'S 166°41'E (collected R. Sadlier & G. Shea, 21 Sep. 1995): AMS R.171426 Pourina River Valley 22°01'39"S 166°43'37"E (collected R. Sadlier, 13 Nov. 2008).

ETYMOLOGY — The species epithet *conditus* is Latin for hidden or secret, and alludes to its unsuspected existence prior to the genetic studies undertaken here.

DIAGNOSIS — The following features of coloration and scalation in combination will distinguish *Sigaloseps conditus* n. sp. all other species of *Sigaloseps* except *S. deplanchei* s.s.: small adult size, maximum SVL for males 44 mm and for females 46 mm; short tail ~100% of SVL; subocular upper labial usually separated from the lower eyelid by a well developed row of subocular scales; midbody scale rows 26-28; paravertebral scale rows 48-52; 4th toe lamellae scales 25-29; underside of body and tail pale yellow without obvious brown or black markings and underside of tail without dark markings; dorsal and lateral surface of tail brown to dull orange.

Sigaloseps conditus n. sp. is most similar in overall appearance to *Sigaloseps deplanchei* s.s. from which it can be usually be distinguished in having a well developed row of subocular scales separating the lower eyelid from the subocular upper labial (*vs* subocular upper labial usually in contact with the lower eyelid). This character state will also distinguish *S. conditus* n. sp. from all other members of the genus.

The suite of character states identified above allows *Sigaloseps conditus* n. sp. to be distinguished from its congeners as follows:

- from *Sigaloseps pisinnus* n. sp. by its larger adult size (maximum SVL 46 *vs* 38 mm), significantly more midbody scale rows (26-28 *vs* 22-24), significantly more toe lamellae (25-29 *vs* 20-25), duller overall color to the tail (brown *vs* bold reddish-brown), and in having a uniformly pale underside to the tail (*vs* spotted with small brown blotches).
- from *Sigaloseps ruficauda* by its smaller adult size (maximum SVL 46 *vs* 56 mm), significantly fewer paravertebral scales (48-52 *vs* 53-60), and duller overall color to the tail (brown to dull orange *vs* bright reddish).
- from *Sigaloseps ferrugicauda* n. sp. by its smaller adult size (maximum SVL 46 *vs* 60 mm), and significantly fewer paravertebral scales (48-52 *vs* 53-56).
- from *Sigaloseps balios* n. sp. by its smaller adult size (maximum SVL 46 *vs* 50 mm), paler yellow ventral coloration (dull yellow *vs* bold enamel yellow, and paler tail color (brown to dull orange *vs* nearly black).

The high level of genetic differentiation between *Sigaloseps conditus* n. sp. and the other species in the genus provides strong support for the recognition of these evolutionary lineages as distinct taxa.

DESCRIPTION — The species is described from 3 adult males and 6 adult females.

Measurements. Size 38-46 mm SVL; distance from axilla to groin 50.0-57.1% SVL (mean = 54.2); distance from forelimb to snout 37-42.1% SVL (mean = 39.5); hindlimb length 29.3-34.2% SVL (mean = 31.2); tail length of individual with most complete tail ~100% SVL.

Scalation (all specimens). Midbody scale rows 26-28 (mean = 26.2, sd = 0.67); dorsal scale rows 49-52 (mean = 50.2, sd = 1.30); scales on top of fourth finger 6-8 (mean = 7.6, sd = 0.60); lamellae beneath fourth finger 11-14 (mean = 11.9,

FIgURE 5

Adult male *Sigaloseps conditus* n. sp. (AMS R.125824) from Rivière Bleue.

sd = 0.81); scales on top of fourth toe 11-12 (mean = 11.1, sd = 0.33); lamellae beneath fourth toe 26-29 (mean = 26.4, sd = 1.28). Lower eyelid with a semitransparent disc, tending to be divided medially and at the sides by sutures.

Osteology. Pre-maxillary teeth 11 (n = 3); presacral vertebrae 29 (n = 10); manus 2.3.4.5.3 and pes 2.3.4.5.4 (n = 9).

Color and Pattern. Dorsal surface of body light to mid-brown, most (1 in 2 or 2 in 3) dorsal scales with dark flecks usually positioned medially and running down the center of each scale. Upper lateral surface similar in color to dorsal surface but with more intense dark flecking, progressively grading in tone to a neutral cream color approaching the venter, and with the dark markings becoming progressively paler and more obscure in definition on the anterior half of the body. Head similar in color to body, the dark markings usually present as scattered blotches, occasionally more intense on the top of the head, and reducing the paler light to mid-brown base color to a series of enclosed blotches, side of head in the loreal and temporal region similarly marked and the labials predominately dark, with the dark markings on the lower margin of the jaw extending onto the ventro-lateral edge of the throat. Tail with similar dark markings to body above and at the sides, but lacking dark markings to the ventral scales. Ventral surface of the body pale.

Details of Holotype MNHN 2011.0284. Adult male; size 44 mm SVL; tail length 44 mm, near complete. Midbody scale rows 26; dorsal scale rows 50; dorsal scales of fourth finger 7/7; lamellae of fourth finger 12/11; dorsal scales of fourth toe 11/11; lamellae of fourth toe 27/26.

Variation. One individual included in the type series of *Sigaloseps conditus* n. sp. (AMS R.135610) has an incomplete row of subocular scales (both sides) allowing contact between the subocular supralabial scale and lower eyelid. It is assigned to *Sigaloseps conditus* n. sp. on the basis of it being sympatric with two other individuals, each with a complete row of subocular scales, and all three samples being within very close proximity to those used in the genetic studies. However, this does not exclude the possibility that this sample could be an individual of *Sigaloseps deplanchei* and that the two species are syntopic at this location (vicinity of Giant Kaori) at Rivière Bleue.

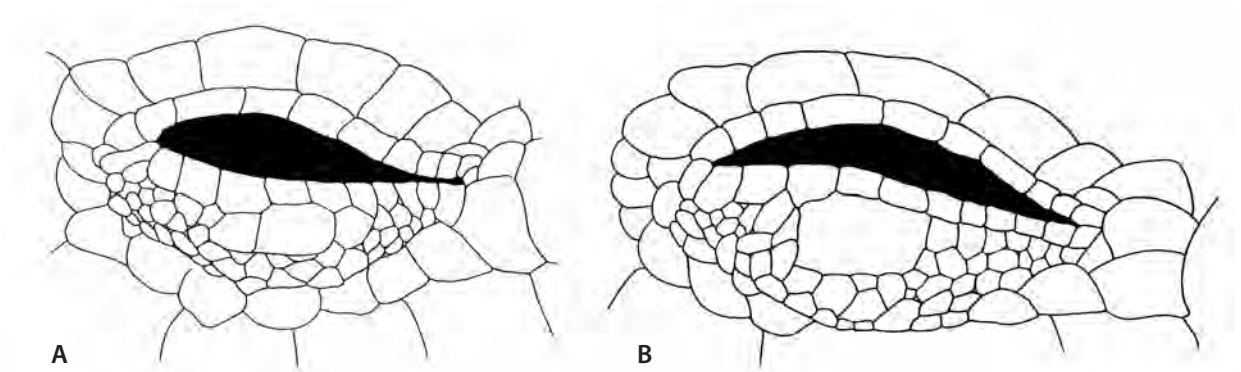

FIGURE 6

Representation of the condition between the lower eyelid in (**A**) *Sigaloseps conditus* n. sp. (AMS R.147952) showing separation from the subocular upper labial by a complete row of subocular scales and the central area of the lower eyelid divided medially by a fine suture, and the lower eyelid in (**B**) *Sigaloseps deplanchei* s.s. (AMS R.146553) showing contact between the subocular upper labial and lower eyelid, and the relatively undivided central area of the lower eyelid.

COMMENTS — Specimens from two locations north of Yaté and Rivière Bleue and for which only morphological data are available are consistent in features of scalation with *Sigaloseps conditus* n. sp., rather than *Sigaloseps deplanchei* or *Sigaloseps pisinnus* n. sp., in having a complete subocular row of scales and secondarily-scaled lower eyelid. These include a single specimen from the interior ranges at the headwaters of the Ni River examined in the review of *Sigaloseps deplanchei* by Sadlier & Bauer (1999) and assigned to that species, and two specimens collected by Roux & Sarasin from Ngoye in 1911 (Roux 1913) and examined in the initial review of New Caledonian skinks by Sadlier (1986) and assigned at that time to *Sigaloseps deplanchei*. The single individual from Ngoye assessed for scalation had 28 midbody scale rows and a snout-vent length of 40 mm, also characteristics consistent with *Sigaloseps conditus* n. sp. (rather than *S. pisinnus* n. sp.). As such the distribution of *Sigaloseps conditus* n. sp. is likely extend along the coast and adjacent ranges from the Pourina to the Ngoye River, essentially the Côte Oubliée and its hinterland.

DISTRIBUTION AND BIOLOGY — *Sigaloseps conditus* n. sp. is known from two locations in the ranges of southern Grande Terre at the Pourina River and Rivière Bleue (Figure 2), and likely extends along the Côte Oubliéeand its hinterland. The habitat at all sites from which it has been recorded are humid forest on ultramafic substrate.

CONSERVATION STATUS — The distribution of *Sigaloseps conditus* is unclear with the only positive records from Rivière Bleue and the Pourina River, although museum records that could be this species indicate it may extend further to north along the eastern watershed of the Côte Oubliée. As such there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status, and at this time is most appropriately categorized as Data Deficient (DD) under IUCN criteria (IUCN 2001).

Even if the species' distribution elsewhere on the eastern watershed of the Côte Oubliée north of the Pourina River is confirmed its estimated extent of occurrence is still likely to be less than 1500 km^2 and area of occupancy less than 500 km^2, making it a candidate for inclusion under one of the higher categories of threat. Its distribution in the region is likely to be highly fragmented given mid- to low-elevation humid forest in this area at has been reduced to small and isolated remnants in river valleys and is only present as more extensive areas at higher elevation around the Humboldt and Kouakoué massifs or as isolated patches on massifs of the southern ultramafic region. Although the catchment of the Pourina River and the rivers to its north are remote, and much of the region is inaccessible, the low- to mid-elevation humid forest remnants in the river valleys lie within extensive areas of maquis vegetation and uncontrolled

fires could significantly reduce the area of forest, particularly of smaller patches with a greater edge to area ratio. As such the species is potentially a candidate for one of the higher threat categories, but further work on determining its extent of occurrence is required.

Sigaloseps pisinnus Sadlier, Shea, Whitaker, Bauer & Wood, n. sp

Figures 2, 7

TYPE MATERIAL — Holotype: New Caledonia, MNHN 2011.0285 (formerly AMS R.171254) Pic Ningua 21°44'20"S 166°09'17"E (collected R. Sadlier & G. Shea, 3 Oct. 2008). Paratypes: AMS R.171249-53, AMS R.171255 same location as holotype (collected R. Sadlier & G. Shea, 3 Oct. 2008); AMS R.172555, AMS R.172576 Mine Galliéni Mt Vulcain, Tontouta Valley 21°54'21"S 166°20'59"E (collected A.H. Whitaker & M. Lettink, 12 Sep. 2009); AMS R.172512-13 Uwëcïa, Haut Nakéty, 8 km E Nakéty 21°33'06"S 166°07'14"E (collected A.H. & V.A. Whitaker, 26 June 2009); AMS R.172503-07, AMS R.172514 Chetoré Kwédé, Haut Nakéty, 8 km E Nakéty 21°33'13"S 166°06'31"E (collected A.H. & V.A. Whitaker, 25 June 2009).

ETYMOLOGY — The species epithet comes from the Latin *pisinnus* for small or little, and alludes to the species diminutive size relative to other species of *Sigaloseps*.

DIAGNOSIS — The following features of coloration and scalation in combination will distinguish *Sigaloseps pisinnus* n. sp. all other species of *Sigaloseps*: small adult size, maximum SVL for males and females ~38 mm; subocular upper labial contacting the lower eyelid; paravertebral scale rows 48-55; 4th toe lamellae scales 20-25; underside of body pale yellow and with obvious brown markings along the ventro-lateral surface; dorsal and lateral surface of tail dull to bright orange, the underside with regular dull brown markings (spots) to each scale.

This suite of characters readily distinguishes *Sigaloseps pisinnus* n. sp. from its congeners as follows:

- from *Sigaloseps deplanchei* s.s. by its smaller adult size (maximum SVL 38.5 *vs* 46 mm) and longer tail (126 *vs* ~100% %); in having significantly fewer midbody scale rows (22-24 *vs* 24-30, t_{71} = -11.334 P=0.000); significantly fewer 4th toe lamellae scales (20-25 *vs* 22-29, *t*71 = -7.260 P=0.000); a brighter overall color to the tail (bright orange *vs* usually brown to dull orange), and with the underside to the tail spotted with small brown blotches (*vs* relatively unmarked).
- from *Sigaloseps conditus* n. sp. by its smaller adult size (maximum SVL 38.5 *vs* 46 mm) and longer tail (126 *vs* ~100%) in having the subocular upper labial contacting the lower eyelid (*vs* subocular upper labial usually separated from the lower eyelid by a well developed row of subocular scales); a brighter overall color to the tail (bright orange *vs* usually brown to dull orange), and with the underside to the tail spotted with small brown blotches (*vs* relatively unmarked).
- from *Sigaloseps ruficauda* by its smaller adult size (maximum SVL 38.5 *vs* 56 mm) and shorter tail (126% *vs* ~150%); in having significantly fewer midbody scale rows (22-24 *vs* 26-28); significantly fewer paravertebral scales (48-55 *vs* 53-60, t_{71} = -11.334 P=0.000); and with the underside to the tail spotted with small brown blotches (*vs* relatively unmarked in adults).
- from *Sigaloseps ferrugicauda* n. sp. by its smaller adult size (maximum SVL 38.5 *vs* 60 mm); in having significantly fewer midbody scale rows (22-24 *vs* 26-28, t_{71} = -11.334 P=0.000); significantly fewer paravertebral scales (48-55 *vs* 53-56, t_{71} = -11.334 P=0.000); and with the underside to the tail spotted with small brown blotches (*vs* relatively unmarked in adults).
- from *Sigaloseps balios* n. sp. by its smaller adult size (maximum SVL 38.5 *vs* 50 mm), in having significantly fewer midbody scale rows (22-24 *vs* 26-28); significantly fewer paravertebral scales (48-55 *vs* 53-56); paler yellow ventral coloration (moderate yellow *vs* bold enamel yellow), and paler tail color (orange *vs* nearly black).

Sigaloseps pisinnus n. sp. is most similar in morphology to *Sigaloseps deplanchei* s.s. and *Sigaloseps conditus* n. sp. in that it shares a similar dorsal and lateral color pattern, but is readily distinguished from these two species by its smaller

FIgURE 7

Adult male *Sigaloseps pisinnus* n. sp. (AMS R.171254 - holotype) from Pic Ningua.

size and longer tail with small brown blotches on the underside. The morphological differentiation between *Sigaloseps pisinnus* n. sp. and the other recognized species in the genus in combination with a high level of genetic differentiation clearly identifies it as an evolutionary lineage warranting recognition as a distinct species.

DESCRIPTION — The species is described from 6 adult males and 9 adult females, and two juveniles, measurements for adults only.

Measurements. Size 33-38 mm SVL; distance from axilla to groin 51.4-57.7% SVL (mean = 55.3); distance from forelimb to snout 36.6-41.2% SVL (mean = 39.3); hindlimb length 31.1-35.3% SVL (mean = 32.7); tail length of individual with most complete tail 139.5% SVL.

Scalation (all specimens). Midbody scale rows 22-24 (mean = 23.9, sd = 0.48); dorsal scale rows 48-55 (mean = 51.6, sd = 2.30); scales on top of fourth finger 6-9 (mean = 7.6, sd = 0.65); lamellae beneath fourth finger 9-11 (mean = 10.0, sd = 0.74); scales on top of fourth toe 10-12 (mean = 11.0, sd = 0.41); lamellae beneath fourth toe 20-25 (mean = 22.9, sd = 1.37).

Osteology. Pre-maxillary teeth 11 (n = 8) - 12 (n = 1); presacral vertebrae 29 (n = 10); manus 2.3.4.5.3 and pes 2.3.4.5.4 (n = 10).

Color and Pattern. Dorsal surface of body light to mid-brown, most dorsal scales with dark flecks either positioned medially and running down the center of each scale or to either side of each scale, the lateral and posterior edges of each scale with a cluster of minute dark spots giving a dull and clouded edge at the back and side of each scale. Upper lateral

surface similar to dorsal surface, progressively grading in tone to a neutral cream color approaching the venter, and with the dark markings becoming progressively paler and more obscure in definition. Ventral surface of the body pale and with the dark markings on the lateral surface occasionally extending onto the ventro-lateral edge. Head darker overall in appearance, the dark markings dominating and forming a reticulate pattern over the scales on the top of the head, in effect reducing the paler light to mid-brown base color to a series of enclosed blotches, side of head in the loreal and temporal region similarly marked, labials predominately dark and with the dark markings of the lower law extending onto the ventro-lateral edge of the throat. Tail with similar dark markings to the body above and at the sides, and with a pattern of paler dark markings to most scales on the underside. In life the ventral surface of adult males and females has a yellow flush (absent in juveniles) and there is no distinctive color to the throat. One adult male (AM R171254) has a bold reddish flush overall to the tail, whereas this was not as pronounced in adult females. Juveniles had a similar reddish flush to the tail and to the body behind the forelimbs.

Details of Holotype (MNHN 2011.0285, Figure 7). Adult male; size 38.5 mm SVL; tail length 45 mm, regenerated. Midbody scale rows 24; dorsal scale rows 54; dorsal scales of fourth finger 8/9; lamellae of fourth finger 11/11; dorsal scales of fourth toe 11/12; lamellae of fourth toe 23/21.

FIgURE 8
Humid forest on Pic Ningua.

Variation. The genetic data indicates the presence of significant regional sub-structuring within *Sigaloseps pisinnus* n. sp., with all three known populations genetically discrete and with high levels of support for the monophyly of each. There is also strong support for a relationship between the two northern populations (Nakéty and Pic Ningua). No significant differences in scalation were detected between two northern populations, and there are too few individuals from the southern population (Tontouta valley) for statistical comparison.

ADDITIONAL MATERIAL EXAMINED — R.174959 Camp des Sapins 21°47′36″S 166°9′31″E; R.174955 Camp des Sapins 21°45′23″S 166°11′46″E; R.174956 Camp des Sapins 21°47′46″S 166°9′42″E; R.174957 Camp des Sapins 21°45′44″S 166°11′44″E; R.174960 Camp des Sapins 21°46′42″S 166°10′29″E; R.174958 Camp des Sapins 21°47′36″S 166°9′31″E; R.174968 Pic Ningua, ridge between Cidoa and Pic Ningua 21°44′36″S 166°10′43″E; R.174979 Pic Ningua, ridge between Cidoa and Pic Ningua 21°44′21″S 166°11′5″E - all collected A.H. & V.A. Whitaker, 8-15 November 2011 (all AMS) but not included in the type series.

DISTRIBUTION AND BIOLOGY — *Sigaloseps pisinnus* n. sp. is known from three locations, all on ultramafic surfaces (north to south): two sites in closed-forest remnants at around 500 m on the Haut Nakéty plateau of the near coastal ranges of the central-east region between Canala and Thio; multiple sites in mid- to high-elevation forest (Figure 8) and maquis between 400-1100 m on the Mt Çidoa-Pic Ningua-Koungouhaou Nord massif on the main axial range of the southern region between Thio and Bouloupari; and mid-elevation closed-forest at around 500 m at Mine Galliéni, on Mt Vulcain in the interior of the southern region ranges of the Tountouta valley (Figure 2).

Sigaloseps pisinnus n. sp. is exceptional amongst the *Sigaloseps* species for its occurrence in open maquis habitats. At Camp des Sapins this species was one of the most common skink species in sparse maquis on rocky ultramafic surfaces, including cuirasse.

The population from Pic Ningua is located at the northern edge of the main southern ultramafic block that covers much of the southern region. The area of ultramafic surfaces that include the coastal ranges of the Nakéty population are continuous with the extensive ultramafic surfaces to the south, but not with nearby areas of ultramafic surface to the north. *Sigaloseps pisinnus* n. sp. has not been recorded from ultramafic surfaces of the central-east region north of Nakéty that include coastal and interior ranges, despite extensive survey work in this area, and as such the break in the ultramafic surfaces between these regions may represent an historical barrier to dispersal for this group of lizards.

CONSERVATION STATUS — *Sigaloseps pisinnus* n. sp. is known from three geographically distant locations, two in the southern ultramafic region and one on ultramafic surfaces of the adjacent central-east region, and has been recorded from both high and mid-elevation. The species' extent of occurrence is unclear as only limited survey work has been undertaken in intervening areas that would give an indication as to the likely continuity of distribution across its range. Regardless, its estimated extent of occurrence is still likely to be considerably less than 1500 km^2 and area of occupancy less than 500 km2. Humid forest in the southern ultramafic region at mid- to low-elevation has been reduced to small and isolated patches in river valleys and subject to a range of threats that includes wildfires, mining, microhabitat damage by introduced ungulates (including in reserves) and the spread of the introduced ant *Wasmannia auropunctata* in low to mid-elevation forests. A similar scenario exists for forests on the ultramafic surfaces of the east-central region. On the Mt Çidoa-Pic Ningua-Koungouhaou Nord massif the maquis habitats outside the reserves of Réserve Botanique du Pic Ningua are at risk to expansion of mining activities. At this time the species meets the IUCN criteria (IUCN 2011) to be categorized as Endangered (B1, a, biii & B2 a, biii). The species' area of occurrence and area of occupancy is likely to remain under the threshold for a lower level of threat and the species' distribution, even with further sites recorded, is likely to remain severely fragmented by virtue of the distribution of available habitat in the region.

Sigaloseps rufi auda Sadlier & Bauer, 1999

Figures 2, 9

Sigaloseps ruficauda Sadlier & Bauer, 1999: 84.

MATERIAL EXAMINED — AMS R.146482 (holotype), AMS R.146196-97, MNHN 1997.3326 Mt. Mou 22°03'45"S 166°20'39"E; AMS R.146481 and AMS R.146483 Mt. Mou 22°04'01"S 166°20'34"E; AMS R.148004 Mt Mou 22°03'42"S 166°20'41"E.

DIAGNOSIS — The following features of coloration and scalation in combination will distinguish *Sigaloseps ruficauda* from all other species of *Sigaloseps* (except *S. ferrugicauda* n. sp.): moderately large adult size, maximum SVL for females 47 mm; subocular upper labial usually in contact with the lower eyelid; paravertebral scale rows 53-60; 4th toe lamellae scales 21-28; underside of body and tail yellow without obvious brown or black markings; dorsal and lateral surface of tail bright orange. *Sigaloseps ruficauda* is very similar in morphology to *Sigaloseps ferrugicauda* n. sp. with no obvious differences in scalation and only subtle differences in intensity of tail coloration and dark markings on the upper surfaces of the tail. As such, recognition of these taxa as each comprising a distinct evolutionary lineage draws heavily on the high level of genetic differentiation between them.

The suite of diagnostic characters identified above will allow *Sigaloseps ruficauda* to be distinguished from each of its congeners as follows:

- from *Sigaloseps deplanchei s. s* by its larger adult size (maximum SVL 56 *vs* 46 mm) and longer tail (150% *vs* 100%), more paravertebral scales (53-60 *vs* 46-56), and bolder overall color to the tail (bright reddish *vs* usually brown to dull orange).
- from *Sigaloseps conditus* n. sp. by its larger adult size (maximum SVL 56 *vs* 46 mm) and longer tail (150% *vs* ~100%), more paravertebral scales (53-60 *vs* 48-52), in having the subocular upper labial usually in contact with the lower eyelid (*vs* usually separated from the lower eyelid by a well developed row of subocular scales), and bolder overall color to the tail (bright reddish *vs* brown to dull orange).
- from *Sigaloseps pisinnus* n. sp. by its much larger adult size (maximum SVL 56 *vs* 38 mm), longer tail (150% *vs* 126%), in having significantly more midbody scale rows (26-28 *vs* 22-24); significantly more paravertebral scales (53-60 *vs* 48-55); and bolder overall color to the tail (bright reddish *vs* bold reddish-brown) with the underside to the tail relatively unmarked (*vs* spotted with small brown blotches).
- from *Sigaloseps ferrugicauda* n. sp. by its bolder overall color to the tail (bright reddish *vs* dull russet brown) and lack of dark markings on the upper surfaces of the tail (*vs* dark markings variably present).
- from *Sigaloseps balios* n. sp. by its larger adult size (maximum SVL 56 *vs* 46 mm), longer tail (150% *vs* 128%), paler ventral coloration (moderate yellow *vs* bold enamel yellow), and paler tail color (bright reddish *vs* nearly black).

DESCRIPTION — The species is described from one adult male, two adult females and one subadult female, and three hatchlings.

Measurements. (n = 4) for adults and subadult: 38-56 mm SVL; distance from axilla to groin 55.3-58.3% SVL (mean = 55.9); distance from forelimb to snout 35.7-39.6% SVL (mean = 38.1); hindlimb length 30.4-36.8% SVL (mean = 33.7); tail length of individual with most complete tail ~152.6% SVL. Tail length for three hatchling juveniles 129.6-144.0% SVL (mean = 137.0%).

Scalation. All specimens n = 7: midbody scale rows 26-28 (mean = 26.6, sd = 0.98); dorsal scale rows 53-60 (mean = 55.6, sd = 2.30); scales on top of fourth finger 7-9 (mean = 8.1, sd = 0.75); lamellae beneath fourth finger 9-15 (mean = 11.8, sd = 0.80); scales on top of fourth toe 10-13 (mean = 11.1, sd = 1.10); lamellae beneath fourth toe 21-28 (mean = 24.7, sd = 1.95).

Osteology. Maxillary teeth 11 (n = 2); presacral vertebrae 29 (n = 6); postsacral vertebrae 47(n = 3) and 49 (n = 1); manus 2.3.4.5.3 and pes 2.3.4.5.4 (n = 5).

Color and Pattern (Figure 9). Dorsal surface of body of adults mid to dark brown, most dorsal scales with dark flecks either positioned medially with the long axis running down the center of each scale or to one side of the scale. Dorsolateral edge with a dark bar between the eye and naris, continuing from the posterior edge of the eye and bordered above by a pale stripe (~1 scale width, with a russet tinge in life and bordered by a dark edge above) to just past the forelimbs. Side of body similar to dorsal surface uppermost but progressively grading in tone to a neutral cream color and with fewer and more scattered dark markings approaching the venter. Ventral surface of the body pale and with the dark markings on the lateral surface occasionally extending onto the ventro-lateral edge. Head with a pattern of dark spots and irregular blotches over the scales on the top of the head, side of head in the loreal and temporal region similarly marked, and the labials also with bold dark markings that extend onto the ventro-lateral edge of the throat. Tail lacking dark markings and with a bold, reddish flush overall in life.

The dorsal and lateral surfaces of the body of the single subadult (a female - incorrectly cited as an adult male by Sadlier & Bauer 1999) light brown and lacking obvious dark markings, and in life had a dull reddish suffusion to the anterior part of the body and reddish flush to the tail with brownish markings underneath.

Details of Holotype. Adult female; size 56 mm SVL; tail length 64 mm, regenerated. Midbody scale rows 26; dorsal scale rows 58; dorsal scales of fourth finger 9/9; lamellae of fourth finger 13/12; dorsal scales of fourth toe 12/12; lamellae of fourth toe 25/25.

FIgURE 9

Adult female *Sigaloseps ruficauda* Sadlier & Bauer (AMS R.146483) from Mt Mou.

DISTRIBUTION AND BIOLOGY — *Sigaloseps ruficauda* is known only from high-elevation habitats on Mt Mou on the southwest coast (Figure 2). The Mt Mou massif rises to 1200 m from the west coast plain, it lies approximately 12 km from Mt Ouin, the type locality for *Sigaloseps ferrugicauda* n. sp., and is connected to the interior massifs by a range that rarely falls below 800 m in elevation.

The species is recorded from high-elevation maquis habitat (~1100 m) adjacent to humid forest habitat. The maquis had a very dense understory of fern (*Gleichenia*), an indication that this habitat had been frequently burned and was highly disturbed. In retrospect it is considered highly likely the species also occurs in forest habitat and that its occurrence in the adjacent maquis is an artifact of proximity and its dense understory of ferns which provide a sufficiently cool and moist environment for the species to exist there, rather than as the preferred habitat type.

CONSERVATION STATUS — *Sigaloseps ruficauda* is known from a single site within La Réserve Naturelle du Mont Mou near the summit area of Mt Mou. This very restricted distribution indicates an extent of occurrence and area of occupancy of <5 km². The greatest threat to *S. ruficauda* is further habitat destruction leading to a reduction in the area of occupancy. The degraded maquis vegetation on the slopes of Mt Mou is indicative of frequent burning and this leads to habitat loss, primarily from the forest edge, due to encroachment from fires in adjacent maquis shrubland. Introduced ungulates (deer and pigs) also threaten habitat quality, particularly by damaging the litter layer. Given the species' extremely restricted distribution and the threats it faces, particularly from fire, it is most appropriately categorized as Vulnerable (D2) under IUCN criteria (IUCN 2011).

Sigaloseps ferrugicauda Sadlier, Smith, Shea & Bauer, n. sp.

Figures 2, 10

HOLOTYPE — MNHN 2011.0286 (formerly R.165803) Mt Ouin, track along northeast edge of Mt Ouin Range 22°00'S 166°28'E (collected R. Sadlier & G. Shea, 26 Dec. 2003).

PARATYPES — AMS R.148024 Mt Ouin 22°34"S 166°27'26"E (collected R. Sadlier & G. Shea, 26 Sep. 1995); AMS R.162964 Mt Ouin, saddle between Mt Ouin and Mt Dzumac 22°01'41"S 166°28'19"E (collected R. Sadlier & A. Bauer, 19 Sep. 2002); AMS R.172611 Massif du Humboldt 21°52'57"S 166°34'45"E at 1350 m (collected R. Sadlier & C. Beatson, 13 Oct. 2009).

ETYMOLOGY — The species epithet is from the Latin *ferrugineus* for rust-colored, and *cauda* for tail, alluding to the dull russet tail coloration of this species.

DIAGNOSIS — The following features of coloration and scalation in combination will distinguish *Sigaloseps ferrugicauda* n. sp. from all other species of *Sigaloseps* (except *S. ruficauda* s.s.): moderately large adult size, maximum SVL for females 60 mm; subocular upper labial usually in contact with the lower eyelid; paravertebral scale rows 53-56 (mean = 54.5); 4th toe lamellae scales 24-28 (mean = 26.1); underside of body and tail yellow without obvious brown or black markings ; dorsal and lateral surface of tail dull russet brown and with dark markings variably on the upper surfaces of the tail. *Sigaloseps ferrugicauda* n. sp. is most similar in morphology to *Sigaloseps ruficauda*, with no obvious differences in scalation and only a subtle difference in intensity of reddish tail coloration and of dark markings on the upper surface of the tail. The high level of genetic differentiation between *Sigaloseps ferrugicauda* n. sp. and *Sigaloseps ruficauda* provides strong support for the recognition of these evolutionary lineages as distinct taxa.

The suite of diagnostic characters identified above allows *Sigaloseps ferrugicauda* n. sp. to be distinguished from each of its congeners as follows:

FIGURE 10

Adult female *Sigaloseps ferrugicauda* n. sp. (AMS R.165803) from Mt Ouin (**A**), and ventral surface (**B**).

- from *Sigaloseps deplanchei* s.s by its larger adult size (maximum SVL 60 *vs* 46 mm), more paravertebral scales (53-56 *vs* 46-56).
- from *Sigaloseps conditus* n. sp. by its larger adult size (maximum SVL 60 *vs* 46 mm), more paravertebral scales (53-56 *vs* 48-52), in having the subocular upper labial usually in contact with the lower eyelid (*vs* separated from the lower eyelid by a well developed row of subocular scales).
- from *Sigaloseps pisinnus* n. sp. by its larger adult size (maximum SVL 60 *vs* 38 mm), in having significantly more midbody scale rows (26-28 *vs* 22-24); more paravertebral scales (53-56 *vs* 48-55); duller overall color to the tail (dull russet brown *vs* bold reddish-brown), and in having a relatively uniformly pale underside to the tail (*vs* spotted with small brown blotches).
- from *Sigaloseps ruficauda* by its duller overall color to the tail (dull russet brown *vs* bright reddish), and the presence (variably) of dark markings on the upper surfaces of the tail (*vs* upper surface of the tail unmarked).
- from *Sigaloseps balios* n. sp. by its larger adult size (maximum SVL 60 *vs* 50 mm), paler ventral coloration (moderate yellow-orange *vs* bold enamel yellow), and paler tail color (dull russet brown *vs* nearly black).

DESCRIPTION — The species is described from one adult male and three adult females.

Measurements. Size 54-60 mm SVL; distance from axilla to groin 53.7-56.9% SVL (mean= 55.6); distance from forelimb to snout 36.2-40.0% SVL (mean = 37.6); hindlimb length 30.0-34.7% SVL (mean = 32.3); tail of all specimens with sections either missing or reproduced.

Scalation (all specimens). Midbody scale rows 26-28 (mean = 26.5, sd = 1.00); dorsal scale rows 53-56 (mean = 54.5, sd = 1.29); scales on top of fourth finger 8-9 (mean = 8.25, sd = 0.5); lamellae beneath fourth finger 12-13 (mean = 12.75 sd = 0.5); scales on top of fourth toe 10-12 (mean = 11.1, sd = 0.63); lamellae beneath fourth toe 24-28 (mean = 26.1, sd = 1.34).

Osteology. Pre-maxillary teeth 11 (n = 1); presacral vertebrae 29 (n = 4); postsacral vertebrae unknown; manus 2.3.4.5.3 and pes 2.3.4.5.4 (n = 4).

Color and Pattern. Dorsal surface of body variable, light to mid-brown overall. Darker individuals with the dark flecks on dorsal the scales positioned medially and the long axis running down the center of each scale, or occasionally to one side of the scale. Paler individuals with the dark dorsal markings not well defined or largely absent. Dorsolateral edge with a dark bar between the eye and naris, continuing from the posterior edge of the eye and bordered above by a pale stripe (~1 scale width, with a russet tinge in life and bordered by a dark edge above) to just past the forelimbs. Side of body uppermost duller than dorsal surface but with a similar pattern of dark markings to the dorsal surface, progressively grading in tone (and in those individuals with dark markings these becoming fewer and more scattered) approaching the venter. Ventral surface of the body pale (yellow/orange in life), and the tail duller and with occasional dark spots. Head variably with scattered diffuse dark spots over the scales on the top of the head, but without obvious dark markings on the side of head. Lower labials variably with dark markings, which when present extend onto the ventro-lateral edge of the throat. Tail with a similar intensity of dark markings as the dorsal surface, tending to be more concentrated along the dorsolateral edge, and with a dull russet brown flush overall in life.

Details of Holotype MNHN 2011.0286 (Figure 10). Adult male; size 60 mm SVL; tail length 49 mm, regenerated. Midbody scale rows 26; dorsal scale rows 54; dorsal scales of fourth finger 8/8; lamellae of fourth finger 13/-; dorsal scales of fourth toe 11/11; lamellae of fourth toe 28/27.

DISTRIBUTION AND BIOLOGY — *Sigaloseps ferrugicauda* n. sp. is known from high-elevation habitats on Mt Ouin (1100 m) and Mt Humboldt (1350 m), two mountain peaks in the interior of the central ranges in southern Grande Terre, and a single specimen from the nearby Massif du Kouakoué which is here also assigned to *S. ferrugicauda* n. sp. (but not included in the type series). These three peaks lie approximately 10-15 km from each other in a rough 'V' with Mt Ouin at the southern apex, and are connected by ranges that rarely fall below 1000 m. In turn, Mt Mou, the type locality for *Sigaloseps ruficauda*, lies to the south and west of Mt Ouin by ~15 km along a near continuous range that

drops below 800 m. in elevation for part of this length and rarely rises above 900 m. on remainder of the range between Monts Couvelée and Mt Mou.

CONSERvATION STATUS — *Sigaloseps ferrugicauda* n. sp. is known from several isolated but geographically proximate high-elevation sites in the southern ultramafic region. The extent of occurrence is estimated at approximately 50 km² and the area of occupancy at <5 km². Two sites occur within protected areas, Réserve Naturelle du Mont Humboldt and La Réserve naturelle du Massif du Kouakoué, meaning some protection is afforded, but mineral exploration has occurred at the Mt Ouin in the past and mining activity is currently intensifying in the nearby Tontouta Valley system. The montane forest at all sites is at risk to peripheral damage and reduction in area of occupancy from firing in the adjacent maquis shrubland. Introduced mammals (rodents, cats and pigs) are a potential predation risk and introduced ungulates (deer and pigs) threaten habitat quality, particularly by damaging the litter layer. The species is conservatively categorized as Vulnerable (D2) under IUCN criteria (IUCN 2001) given its extremely restricted distribution, but could be moved to a higher level of threat if faced by increased loss of area of occupancy or decline in area, extent and/or quality of habitat with increased pressure from introduced species.

Sigaloseps balios Sadlier, Bauer & Wood, n. sp.

Figures 2, 11

TYPE MATERIAL — Holotype: New Caledonia, MNHN 2011.0287 (formerly AMS R.172612) Massif du Humboldt 21°52'57"S 166°34'45"E at 1350 m. (collected R. Sadlier & C. Beatson, 13 Oct. 2009). Paratypes: AMS R.172616 Massif du Humboldt 21°52'50"S 166°24'29"E at 1390 m (collected H. Jourdan, 13 Oct. 2009); AMS R.172620-21 Massif du Humboldt 21°52'50"S 166°24'29"E at 1390 m (collected R. Sadlier & C. Beatson, 15 Oct. 2009).

ETYMOLOgY — The species epithet is from the Greek *balios* for dappled, and alludes to the contrasting light and dark coloration on the underside of the tail characteristic of this species.

DIAgNOSIS — The following features of coloration and scalation in combination will distinguish *Sigaloseps balios* n. sp. from all other species of *Sigaloseps*: maximum adult size 50 mm SVL (adult females); subocular upper labial in contact with the lower eyelid; midbody scale rows 26-28; paravertebral scale rows 58-61 (mean = 59.0); 4th toe lamellae scales 23-25 (mean = 24.2); underside of body enamel yellow and underside of tail with large dark spots.

These characters allow *Sigaloseps balios* n. sp. to be distinguished from its congeners as follows:

- from *Sigaloseps deplanchei s.s* in having more paravertebral scales (58-61*vs* 46-56), longer tail (128% *vs* ~100% SVL), bolder ventral coloration (enamel yellow *vs* moderate yellow), and darker tail color (nearly black *vs* dull reddish-brown).
- from *Sigaloseps conditus* n. sp. in having more paravertebral scales (58-61*vs* 46-56), the subocular upper labial contacting the lower eyelid (*vs* separated by a complete row of subocular scales), bolder ventral coloration (enamel yellow *vs* moderate yellow), and darker tail color (nearly black *vs* dull reddish-brown).
- from *Sigaloseps pisinnus* n. sp. by its larger adult size (maximum SVL 50 *vs* 38 mm), significantly more midbody scales (26-28 *vs* 22-24), significantly more paravertebral scales (58-61*vs* 48-55), bolder ventral coloration (enamel yellow *vs* moderate yellow), and darker tail color (nearly black *vs* dull reddish-brown).
- from *Sigaloseps ruficauda* by its smaller adult size (maximum SVL 50 *vs* 56 mm), shorter tail (~128% *vs* 150%), bolder ventral coloration (enamel yellow *vs* moderate yellow), and darker tail color (nearly black color *vs* reddish).
- from *Sigaloseps ferrugicauda* n. sp. by its smaller adult size (maximum SVL 50 *vs* 60 mm), bolder ventral coloration (enamel yellow *vs* moderate yellow-orange), and darker tail color (nearly black color *vs* dull russet brown).

Sigaloseps balios n. sp. is unlikely to be confused with any other species of *Sigaloseps*. In size it is intermediate between the two largest species in the genus, *S. ruficauda* and *S. ferrugicauda* n. sp., and the other species of *Sigaloseps*. It has a

FIgURE 11

Adult female *Sigaloseps balios* n. sp. (AMS R.172612) (**A**) and ventral surface (**B**), and subadult female *Sigaloseps balios* n. sp. (AMS R.172621) (**C**) from Mt Humboldt.

number of scalation and coloration characteristics that will readily distinguish it from *S. deplanchei* sensu stricto, *S. conditus* n. sp. and *S pisinnus* n. sp. It has an elevated number of paravertebral scales (equal to or greater than 50), a feature shared with *Sigaloseps ruficauda* and *Sigaloseps ferrugicauda* n. sp., but is readily distinguished from these species by marked differences in size and tail and ventral coloration. The genetic data indicate the relationships of *S. balios* n. sp. lie with the other high-elevation endemics *S. ruficauda* and *S. ferrugicauda* n. sp. It shows a high level of genetic differentiation from *S. ferrugicauda* n. sp. with which it is sympatric on Mt Humboldt, but only a low level of differentiation from the allopatrically distributed *S. ruficauda*. However, the morphological differences between *S. ruficauda* and *S. balios* n. sp. provide strong support for the recognition of each as a distinct evolutionary lineage.

DESCRIPTION — The species is described from two adult females (AMS R.172612 & AMS R.172620) and one subadult male (AMS R.172621).

Measurements. Size 40.5-50 mm SVL; distance from axilla to groin 54.2-58.0% SVL (mean = 55.5); distance from forelimb to snout 36-40.7% SVL (mean = 38.1); hindlimb length 33.3-34.6% SVL (mean = 34.0); tail length of individual with most complete tail 128.4% SVL.

Scalation. Midbody scale rows 26-28 (mean = 26.7, sd = 1.15); dorsal scale rows 58-61 (mean = 59.0, sd = 1.73); scales on top of fourth finger 8-9 (mean = 8.5, sd = 0.5); lamellae beneath fourth finger 12-14 (mean = 12.8, sd = 0.74); scales on top of fourth toe 11-12 (mean = 11.2, sd = 0.29); lamellae beneath fourth toe 23-25 (mean = 24.2, sd = 0.76).

Osteology. Pre-maxillary teeth 11 (n = 2); presacral vertebrae 29 (n = 3); postsacral vertebrae unknown; manus 2.3.4.5.3 and pes 2.3.4.5.4 (n = 3).

Color and Pattern. Adult females-dorsal surface of body mid-brown overall with a coppery tinge, scales on the posterior half of the body with darker pigmentation on the anterior and lateral edges of each scale becoming progressively more intense approaching the hindlimbs, eventually covering much of each individual scale on the hips and down the dorsal and lateral surfaces of the tail. Side of body uppermost predominately dark brown to black, with scattered pale markings (mid-brown in color as for dorsal surface), the dark coloration progressively grading in tone and the pale markings increasing in number and covering whole individual scales approaching the venter. Top of head and neck similar in color to body, the head with scattered dark markings on larger scales. Side of neck similar to side of body but more diffuse, and side of the head with scattered light brown interspaces. Dark markings of the anterior part of the body and neck concentrated uppermost and forming a dark dorsolateral stripe that extends from the level of the forelimb to the posterior edge of the eye, and as well defined dark streak between the naris and anterior edge of the eye. Ventral surface of the body moderate to bold enamel yellow in life, not extending to the throat (some extension of the yellow color anterior of the forelimbs). Underside of tail pale (yellowish proximally but becoming white towards tip) with large dark markings to each of the subcaudal and adjacent scales.

Subadult male-dorsal surface of body mid-brown overall with a coppery tinge, scales over the hindlimbs and down the tail, becoming progressively darker on the anterior and lateral edges of each scale. Sides of body and neck a mixture of scattered dark (black in life) and pale spots, darker markings concentrated uppermost, progressively grading in tone and becoming more diffuse approaching the venter. Head and neck similar above in color to body, head without dark markings on larger dorsal head scales. Dark markings on the side of the body, neck and head concentrated uppermost and forming a dark and continuous dorsolateral stripe that extends from the level of the forelimb to the posterior edge of the eye, and between the naris and anterior edge of the eye. Ventral surface of the body and throat pale, with some extension of darker lateral markings onto ventro-lateral region and across the throat. Underside of tail pale and with large dark markings to each of the subcaudal and adjacent scales.

A single poorly preserved juvenile (27.5 mm SVL) was similar in coloration to the subadult male, but had a lighter stripe (~ one scale width) bordering the upper edge of the dark dorsolateral stripe, and the scales of the ventral surface were suffused with dark pigment variably expressed as isolated dark markings on the throat.

Details of Holotype MNHN 2011.0287 (Figure 11). Adult female; size 50 mm SVL; tail length 37.5 mm, distal 20 mm regenerated. Midbody scale rows 26; dorsal scale rows 61; dorsal scales of fourth finger 8/9; lamellae of fourth finger 12/14; dorsal scales of fourth toe 11/12; lamellae of fourth toe 24/24.

DISTRIBUTION AND BIOLOGY — *Sigaloseps balios* n. sp. is known only from high-elevation habitat on the summit area of Mt Humboldt in the interior ranges of southern Grande Terre (Figure 2). The types were collected during a survey of the Réserve Naturelle du Mont Humboldt in October 2009. Conditions during the survey were optimal with warm sunlit days, although nights were cold. The holotype was collected from dense, low maquis shrubland adjacent to high-elevation humid forest (Figure 12) and the paratypes from just inside high-elevation moss forest at its upper altitudinal limit. However, it is important to note that the species was not encountered in the interior of the moss forest despite extensive sampling under optimal conditions over an altitudinal range of 1250-1390 m.

The largest adult female collected in October had a single enlarged ovarian follicle either side, and the slightly smaller female a single large egg.

CONSERVATION STATUS — *Sigaloseps balios* n. sp. is known from a single site near the summit of Mt Humboldt and within La Réserve Naturelle du Mont Humboldt. The extent of occurrence and the area of occupancy are estimated at <5 km^2. The greatest threat to *S. balios* n. sp. is loss or degradation of habitat leading to a reduction in the area of occupancy. Introduced ungulates (deer and pigs) threaten habitat quality, particularly by damaging the litter layer, and wildfires in adjacent maquis shrubland can degrade the forest edge and reduce the extent of closed forest. Introduced mammals (rodents, cats and pigs) pose a potential predation risk. The species is conservatively categorized as Vulnerable (D2) under IUCN criteria (IUCN 2001) because of its extremely restricted distribution, but could move to a higher threat category if faced with an increased decline in area, extent and/or quality of habitat.

FIGURE 12
Humid forest on Mt Humboldt.

DISCUSSION

Recent investigations have identified the ultramafic massifs of the north-west/central-west and southern regions of Grande Terre as discrete biogeographic regions for skinks, each with a number of endemic taxa. These two regions also account for the majority of localized narrow-range skink species, most restricted to humid forest habitat which is now often only present as isolated remnants. While some of these remnant forests are likely to be the legacy of extensive historical fragmentation their boundaries are now confused by recent human-induced fragmentation. Of particular interest are the species of skink in the genera *Nannoscincus*, *Sigaloseps* and *Marmorosphax* that are found primarily in high-elevation humid forest habitats of these ultramafic regions. Each of these genera belong to a separate evolutionary group (Smith *et al.* 2007) within a primarily endemic New Caledonian skink radiation as defined by the genetic data (Smith *et al.* 2007, Chapple *et al.* 2009), evidence the forces driving speciation in taxa with specialized biologies dependent on humid environments has impacted broadly across the skink fauna. The pattern of narrow-range endemism for these genera is comparable to the model of allopatric speciation associated with niche conservatism proposed by Wiens (2004) in which natural selection favours traits that keep individuals within the preferred niche and species fail to adapt to new conditions during vicariant events. It is such a scenario that has likely resulted in the evolution of a number of morphologically similar, yet genetically distinct, species in the genus *Sigaloseps* that are restricted to relictual forests near the summits of massifs, and as previously highlighted for *Marmorosphax* by Sadlier *et al.* (2009).

The genetic relationships between the species of *Sigaloseps* indicate patterns of broad scale regional vicariance across the southern region early in the history of the group, with subsequent deep and recent historical isolation of massifs giving rise to the evolution of the narrow-range, high-elevation endemic species seen within the '*ruficauda* group'. The low level of genetic divergence between the populations of S. *ferrugicauda* on Mt Ouin/Dzumac and the Humboldt massif indicate some degree of historical connectivity between these sites, and by inference connectivity of the high-elevation forest habitat. The morphological similarity of the population of *S. ferrugicauda* on the Kouakoué massif (albeit a single individual) with individuals from the Mt Ouin/Dzumac and Humboldt massifs indicates this connectivity of forest at high elevation probably extended to the Kouakoué massif, although this inference would benefit greatly from genetic data for the population on the Kouakoué massif. Conversely, the high level of genetic divergence between *S. ferrugicauda* and *S. ruficauda* would indicate a long-term isolation of the two taxa and the low level of morphological differentiation speciation by isolation consistent with niche conservatism model outlined above, inferring Mt Mou was isolated historically by contraction of preferred habitat (forest). However, the extremely low level of genetic differentiation between *S. ruficauda* and *S. balios*, and the distribution of these two species implies recent connectivity of preferred habitat (forest) across the ranges connecting these two sites. The apparent absence of *S. balios* (or a near relative) from the intervening ranges (Mt Ouin/Dzumac) between itself on Mt Humboldt and its sister taxon S. *ruficauda* on Mt Mou is difficult to explain, particularly given the inference from the genetic data genetic data for a level of recent historical connectivity between populations of S. *ferrugicauda* on Mt Humboldt and the Ouin/Dzumac range. *Sigaloseps balios* has only been recorded from habitat above 1300 m on Mt Humboldt. One possibility is that it was once more widespread along the high-elevation ridges in the region during cooler and moister climatic conditions but is now restricted to a higher elevational envelope (more so than other members of the '*ruficauda* group') accounting for its absence from the area investigated between 900-1100 m elevation on the Mt Ouin/Dzumac range.

Pintaud (2001) hypothesized the southern massif as one of four areas that would have sufficiently high rainfall to support rainforest refuges during periods of Pleistocene aridity, and as such it is possible these areas also acted as moist refugia during periods of aridity deeper in the past. The relatively deep split in the '*ruficauda* group' between *S. ferrugicauda* and (*S. ruficauda* + *S. balios*) would support evolution of two lineages via niche conservatism where the ancestral taxon was forced to high elevation areas on the ranges, with the lineage on Mt Mou becoming isolated and genetically divergent from populations on the interior ranges. The low genetic and morphological diversification seen within *S. ferrugicauda* would appear to support a pattern of relative stability between the constituent populations along the high-elevation interior ranges connecting Mt Humboldt, Ouin/Dzumac and Kouakoué, and by inference a long-term stability in the forest habitat at high elevation in these interior ranges. The extremely shallow level of genetic divergence

between *S. balios* and *S. ruficauda* and the apparently anomalous distribution of these sister taxa indicates that forest habitat in these ranges has both expanded and contracted significantly in more recent times, consistent with inferences made by Pintaud (2001) that historical distribution patterns have been blurred by Pleistocene climatic fluctuations and resulted in the present day patterns of distribution.

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 and Province Sud 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 Manauté, Directeur Parc Provincial de la Rivière Bleue, Direction de l'environnement de la province Sud. 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) and Vale-Nouvelle Calédonie for access to sites under their control and in certain instances commissioning the fieldwork. IRD Nouméa provided important logistical backing for our research in New Caledonia; Vivienne Whitaker, Cecilie Beatson, Glenn Shea and Marieke Lettink collaborated in field work. Michael Elliot of the Collection Informatics Unit, Australian Museum produced the map of distribution (figure 3). Ivan Ineich of the Muséum national d'Histoire naturelle provided the French resumé. 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 (P. Grandcolas).

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APPENDIx 1

A list of specimens used in the genetic study. For museum acronyms see materials and methods.

gENUS	SPECIES	vOUCHER	LOCALITY	gENBANK ACCESSION
Outgroup				**ND2**
Celatiscincus	*euryotis*	AMS R.138574	île des Pins	DQ675204
Graciliscincus	*shonae*	AMS R. 165813	Mt. Ouin	DQ675207
Kanakysaurus	*viviparus*	AMS R.161299	île Pott,îles Belep	DQ675209
Lacertoides	*pardalis*	AMS R.148051	Kwa Néie	DQ675211
Lioscincus	*nigrofasciolatus*	AMS R.138624	île des Pins	DQ675216
Lioscincus	*steindachneri*	AMS R.149890	Mé Adéo	DQ675218
Lioscincus	*tillieri*	AMS R.148037	Mt. Vulcain	DQ675220
Marmorosphax	*tricolor*	CAS 214451	Mt. Koghis	DQ675227
Phoboscincus	*garnieri*	AMS R.151964	Mt. Dore	DQ675237
Simiscincus	*aurantiacus*	AMS R.144356	Mt. Koghis	DQ675250
Tropidoscincus	*variabilis*	AMS R.161879	Monts Kwa Né Mwa	DQ675242
Ingroup				
Sigaloseps	*deplanchei*	AMS R.172579	Port Boisé	KC164579
Sigaloseps	*deplanchei*	AMS R.148065	Plaine des Lacs	DQ675238
Sigaloseps	*deplanchei*	AMS R.172580	Port Boisé	KC164580
Sigaloseps	*deplanchei*	AMS R.172581	Port Boisé	KC164581
Sigaloseps	*deplanchei*	AMS R.172587	Port Boisé	KC164582
Sigaloseps	*deplanchei*	AMS R.172605	Riv. des Pirogues (2)	KC164583
Sigaloseps	*deplanchei*	AMS R.172606	Riv. des Pirogues (2)	KC164584
Sigaloseps	*deplanchei*	AMS R.172607	Riv. des Pirogues (2)	KC164585
Sigaloseps	*deplanchei*	AMS R.172645	Yaté Barrage	KC164586
Sigaloseps	*deplanchei*	AMS R.172646	Yaté Barrage	KC164587
Sigaloseps	*deplanchei*	AMS R.172647	Yaté Barrage	KC164588
Sigaloseps	*deplanchei*	AMS R.164353	Yaté	KC164589
Sigaloseps	*deplanchei*	AMS R.164352	Yaté	KC164590
Sigaloseps	*deplanchei*	AMS R.164242	Yaté	KC164591
Sigaloseps	*deplanchei*	AMS R.168087	Plum	KC164592
Sigaloseps	*deplanchei*	AMS R.168088	Plum	KC164593
Sigaloseps	*deplanchei*	AMS R.168110	Riv. des Pirogues (1)	KC164594
Sigaloseps	*deplanchei*	AMS R.168111	Riv. des Pirogues (1)	KC164595
Sigaloseps	*deplanchei*	AMS R.168112	Riv. des Pirogues (1)	KC164596
Sigaloseps	*deplanchei*	AMS R.168156	Rivière Blanche	KC164597
Sigaloseps	*deplanchei*	AMS R.168157	Rivière Blanche	KC164598
Sigaloseps	*deplanchei*	AMS R.147954	Rivière Blanche	KC164599
Sigaloseps	*deplanchei*	AMS R.172082	Kwé Nord	KC164600
Sigaloseps	*deplanchei*	AMS R.172083	Kwé Nord	KC164601
Sigaloseps	*deplanchei*	AMS R.172084	Kwé Nord	KC164602
Sigaloseps	*deplanchei*	AMS R.148064	Forêt Nord	KC164603
Sigaloseps	*deplanchei*	AMS R.148065	Forêt Nord	DQ675238
Sigaloseps	*deplanchei*	AMS R.164290	Pic du Pin	KC164604
Sigaloseps	*deplanchei*	AMS R.164291	Pic du Pin	KC164605

Sigaloseps	*deplanchei*	AMS R.164257	Pic du Pin	KC164606
Sigaloseps	*deplanchei*	AMS R.164258	Pic du Pin	KC164607
Sigaloseps	*deplanchei*	AMS R.161884	Kwa Né Mwa	KC164608
Sigaloseps	*deplanchei*	AMS R.167409	Ka Yé Wagwé	KC164609
Sigaloseps	*deplanchei*	AMS R.167410	Ka Yé Wagwé	KC164610
Sigaloseps	*deplanchei*	AMS R.167446	Forêt Cachée	KC164611
Sigaloseps	*deplanchei*	AMS R.167447	Forêt Cachée	KC164612
Sigaloseps	*deplanchei*	AMB 6613	Mt Koghis	KC164613
Sigaloseps	*deplanchei*	AMS R.135167	Yahoué	KC164614
Sigaloseps	*conditus* n. sp.	AMS R.171426	Pourina River	KC164615
Sigaloseps	*conditus* n. sp.	AMS R.147916	Rivière Bleue	KC164616
Sigaloseps	*conditus* n. sp.	AMS R.147952	Rivière Bleue	KC164617
Sigaloseps	*conditus* n. sp.	AMS R.147953	Rivière Bleue	KC164618
Sigaloseps	*pisinnus* n. sp.	AMS R. 172503	Nakéty	KC164619
Sigaloseps	*pisinnus* n. sp.	AMS R. 172504	Nakéty	KC164620
Sigaloseps	*pisinnus* n. sp.	AMS R. 172505	Nakéty	KC164621
Sigaloseps	*pisinnus* n. sp.	AMS R. 172507	Nakéty	KC164622
Sigaloseps	*pisinnus* n. sp.	AMS R. 172512	Nakéty	KC164623
Sigaloseps	*pisinnus* n. sp.	AMS R. 172513	Nakéty	KC164624
Sigaloseps	*pisinnus* n. sp.	AMS R. 172514	Nakéty	KC164625
Sigaloseps	*pisinnus* n. sp.	AMS R.171249	Pic Ningua	KC164626
Sigaloseps	*pisinnus* n. sp.	AMS R.171250	Pic Ningua	KC164627
Sigaloseps	*pisinnus* n. sp.	AMS R.171254	Pic Ningua	KC164628
Sigaloseps	*pisinnus* n. sp.	AMS R.171255	Pic Ningua	KC164629
Sigaloseps	*pisinnus* n. sp.	AMS R.172555	Tontouta valley	KC164630
Sigaloseps	*pisinnus* n. sp.	AMS R.172576	Tontouta valley	KC164631
Sigaloseps	*ruficauda*	AMS R.146482	Mt Mou	DQ675239
Sigaloseps	*ruficauda*	AMS R.148004	Mt Mou	KC164632
Sigaloseps	*ferrugicauda* n. sp.	AMS R.172611	Mt Humbolt	KC164633
Sigaloseps	*ferrugicauda* n. sp.	AMS R.162964	Mt Ouin	KC164634
Sigaloseps	*balios* n. sp.	AMS R.172620	Mt Humboldt	KC164635
Sigaloseps	*balios* n. sp.	AMS R.172621	Mt Humboldt	KC164636
Sigaloseps	*balios* n. sp.	AMS R.172623	Mt Humboldt	KC164637