

The terrestrial herpetofauna of Île des Pins, New Caledonia with an emphasis on its surrounding islands

By Anthony J. Geneva*, Aaron M. Bauer, Ross A. Sadler, and
Todd R. Jackman

Abstract

New Caledonia is recognized globally as a biodiversity hotspot due, in part, to the high levels of endemism seen among the region's unique fauna and flora. Although substantial research efforts have been dedicated to the remarkable reptile diversity of the main island, the Grande Terre, comparably few studies have focused on the Île des Pins that lies off its southern tip. The last review of the herpetofauna of the Île des Pins was 18 years ago, since then increased effort has been directed towards investigating the reptiles of the Île des Pins and its satellite islands. In this update we provide an overview of this region's lizard fauna including new reptile records and the results of surveys of previously herpetologically unexplored islands in the vicinity of the Île des Pins, all in the context of a revised taxonomy. The results presented expand the known ranges of 18 species and identify eight species not previously known from the area. The satellite islands surrounding the Île des Pins, despite their small size, contribute substantially to the biodiversity of the region and support several reptile species of conservation concern not recorded for the Île des Pins proper, nor the New Caledonian mainland.

*Corresponding author E-mail: anthony.geneva@rochester.edu

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Introduction

Due, in part, to the great diversity of endemic plants, invertebrates and reptiles, the southern Pacific territory of New Caledonia is considered a biodiversity hotspot (Meyers 1988, 1990; Meyers et al. 2000; Mittermeier et al. 1999). Reptilian diversity in New Caledonia is largely characterized by endemic groups that are the result of extensive *in situ* speciation of diplodactylid geckos and lygosomatine skinks (Bauer and Sadlier 2000, Bauer and Jackman 2006, Smith et al. 2007). Recent phylogenetic analyses reveal that much of this diversity comprises microendemic species with very limited geographic distributions (Sadlier 1986, Bauer and Jackman 2006, Bauer et al. 2006). The extent of microendemism seen in the New Caledonian lizard fauna is likely the result of several factors, including historic isolation of populations caused by fragmentation of previously contiguous habitat due to marine intrusion during periods of elevated sea level (Bauer and Jackman 2006), and contraction of forest habitat during periods of historical aridity (Sadlier et al. 2009).

The Île des Pins is a moderately large island (150 km²) that lies 50 km south of New Caledonia's main island, from which it is separated by a shallow series of straits, reefs, lagoons and passes (Figure 1). Although currently separated, these two landmasses have experienced repeated connection and disjunction with fluctuating sea level over geologic time (Balouet and Olson 1989). This history of repeated isolation suggests the Île des Pins may harbor unique lineages, resulting from the same processes that have contributed to the microendemicity found elsewhere in New Caledonia. Indeed, cockroach (Murienne et al. 2005) and land snail lineages (Trewick 2009) endemic to the Île des Pins have been identified. Alternatively, species now endemic to the Île des Pins may be the result of extirpation of mainland populations. To assess the reptile diversity of the Île des Pins region, we conducted a series of herpetological surveys on the island and its surrounding satellite islands.

Bauer and Sadlier (1994) compiled the first review of the reptiles of Île des Pins. They characterized the herpetofauna as a depauperate version of that of the southern mainland, with most widespread species present, but lacking a number of geckos and skinks that were believed to be restricted to specialized habitat types, such as humid forest, the seasonally dry sclerophyll forests of the west coast of Grande Terre and high elevation maquis. This interpretation was necessarily only preliminary as these authors spent only a short time on the Île des Pins themselves, and most of the earlier records they summarized were without specific locality. In subsequent years the herpetofauna of the Île des Pins and its satellite islands have been the focus of both scientific (Bauer and Sadlier 2000, Ineich 2006, Brischoux and Bonnet 2009) and herpetocultural (de Vosjoli and Fast 1995, Seipp and Henkel 2000, Cemelli 2009) investigations. New species records from these field studies as well as new insights into relationships between species gained from molecular analyses necessitate a new review of the reptiles inhabiting the Île des Pins and its surrounding satellite islands.

Many of the new discoveries presented here occurred not on the Île des Pins itself but rather on the small satellite islands surrounding it (Figure 2). These islands are raised fossil coral heads formed ~118,000 ybp (Dubois et al. 1974) and mostly emergent since the end of the Pleistocene (Balouet and Olson 1989). They reach no more than 10 m in elevation. Some species occur exclusively on these islets or have yet to be recorded from the Île des Pins itself. These satellite islands have no permanent human inhabitants and may have historically been less prone to human induced extirpations, although anthropogenic threats such as habitat modification, and introduced rats and invasive ants exist today (Jourdan et al. 2001). Here, we give special attention to these islands and review what is known of the habitat on those that have been surveyed.

Materials and Methods

Many of the satellite islands surrounding the Île des Pins have been, over time, referred to by a variety of names. Most islands retain French transliteration of their names in Kunyîé, the language of the Kanak people that inhabit the Île des Pins, although in some instances the Kunyîé name has been supplanted with a French name. Maps of this region often differ in their orthography and occasionally reassign names to different islands. For consistency, we use, verbatim, the names and spellings published in the 1987 edition of Institut Géographique National, map# 4838, “Île des Pins (Kunyîé).” Following this map’s convention, in instances where the French name is more commonly used, we present the French name for the island followed by the Kunyîé in parentheses.

Between 1995 and 2003 we conducted five herpetological surveys of Île des Pins and its satellite islands. From X to Y 1995 we surveyed XY and Z. From 2 to 5 October 2000 we surveyed localities on the Île des Pins, Môrô and Bayonnaise. Between 12 and 17 September 2002 we surveyed Brosse, Môrô and additional localities on the Île des Pins. In 2003 we visited the islets of Môrô, Aventure, Koé, and Kûûmo from 17 to 23 May, and the islets of Brosse, Nuû Ami, Nuû Ana, Taré, Infernal, Nă Nă, Caanawa, Kwa Wiyyèrè, Kônobutr, Mwâréya, and Dû Ana from 23 October to 11 November. We also report on the findings of an ecological study performed on Môrô from 6 June to 26 July 2004. On satellite islands we recorded the topography, general plant communities, and cataloged apparent anthropogenic habitat modifications. We present a general description that summarizes the shared features of the satellite islands. For islands visited by the authors that differ from this standard, we also present a brief synopsis of habitat as it was at the time of our last visit (2003).

Island areas, distances between islands and nearest landmass and between islands and IDP and were measured using Google Earth Pro (v6.1). We also used Google Earth Pro to examine satellite images taken on 24 August 2005 of the Île des Pins region and note any changes in land use relative to our earlier observations.

Results

The satellite islands of the Île des Pins are arranged in groups, within which similar habitats and terrestrial herpetofauna are generally shared across islands (Figure 2). The sea kraits *Laticauda laticaudata* (Linnaeus) and *Laticauda saintgironsi* Cogger and Heatwole are very common in the waters surrounding the Île des Pins and likely inhabit the shallow waters fringing all of these islands, at least seasonally. Most of the satellite islands have a typical coastal strand habitat, characterized by a fringing sandy beach with an open to semi-closed canopy composed of *Casuarina equisetifolia* Linnaeus, *Cocos nucifera* Linnaeus and small broadleaf shrubs. The interior forests of these islands (Figure 3) typically feature either a mid-height (10–15m) canopy, densely vegetated by broadleaf trees or a low (5–10m) canopy with primarily herbaceous shrubs and *Pandanus* spp. Larger islands typically include a small mature forest near the center of the island and patchy stands of *Araucaria columnaris* Hooker, particularly concentrated near raised coral shorelines. Below we summarize the physiographic and biotic features of islands and island groups in the Île des Pins region, starting the Kaaji group to the north and continuing clockwise (Figure 2). Details are provided at the island level only for those islands visited by one or more of the authors. Herpetofaunal observations of particular interest, as well as threats posed by humans and introduced and invasive animals are also described. Additional detail regarding island synonyms, island size, and remoteness can be found in Table 1 and island species lists are presented in Table 2.

Kaaji group — These ten islands lay just off the northeastern tip of Île des Pins in the Baie de Kaaji. The bay enclosed by these islands is shallow and frequented by recreational boaters. The seaward sides of these islands drop off steeply into deeper water and are unprotected by a barrier reef.

Île Nā Nā [= Île Tiantoro]

Nā Nā is a small islet comprising mainly shrubs/forest on a raised coral platform. Survey work was limited to two daytime hours. Three terrestrial reptile species were recorded (Table 2): *Bavayia* cf. *robusta*, *Bavayia sauvagii* and *Phoboscincus garnieri*. During our survey we encountered numerous indications of the impact of frequent recreational visitors, and the presence of introduced rats, *Rattus norvegicus* (Berkenhout) and invasive ants, *Wasmannia auropunctata* (Roger), as well as a feral dog. Despite the impact of visitation Nā Nā retains some intact forest and has populations of at least three reptile species. The survey time on Nā Nā was limited and the islet is likely to be home to a number of other species.

Île Caanawa [= Île Tianoa]

Like Nā Nā, recreational boaters frequently visit Caanawa, and the impact of these visits is equally apparent (i.e., *Wasmannia*, *Rattus*, as well as refuse piles near campsites). Caanawa is the only island in the Kaaji group where the gekkonid gecko *Lepidodactylus lugubris* has been found (Table 2). During a 2-day day and night survey we also encountered *Cryptoblepharus novocaledonicus* and *Bavayia* cf. *robusta*. The source of a captive *Rhacodactylus leachianus* lineage has been attributed to Caanawa but we were unable to find this species during our survey (Cemelli 2009).

Île Kwa Wiiyèrè

Kwa Wiiyèrè, unlike other islands in the Kaaji group, lacks a sandy beach and is bordered entirely by a 1–3 m high fossil coral outcrop. This serves as an effective deterrent to casual visitation and, as such, the interior of this island shows no evidence of human modification. A 2-hour daytime survey of this island recovered two reptile species: *Caledoniscincus bodoi* and *Bavayia* cf. *robusta*. Although entirely forested, the canopy of Kwa Wiiyèrè is lower and trees seem to be younger than the forests of neighboring islands, possibly reflecting more recent cyclone damage. More detailed survey work is needed to fully document the reptile community

of this island but the combination of suitable habitat and difficult recreational access makes Kwa Wiiyèrè a candidate area for conservation.

Baie de Oro — The Baie de Oro lies on the northeast corner of the Île des Pins and contains three isolated islands: Île Kônobutr, Île Mwâréya, and an unnamed island, as well as Île Kô ngéaa ké and Île Wètë, which are separated from the Île des Pins at high tide by the “piscine naturelle,” a shallow channel popular with tourists. The isolated islands have mainly intact coastal strand habitat. Kô ngéaa ké and Wètë are highly developed for tourism, although some intact forest remains.

Baie d’Upi — The large, shallow Baie d’Upi contains two forested islands and many small coral outcrops with sheer 5–10 m cliff faces and low scrubby vegetation. To our knowledge none of these visually stunning geologic features have been explored herpetologically, but their small size and sparse vegetation limit the possible residents to a few small species, such as *Cryptoblepharus novocaledonicus*. The remaining islands (Taré and Kôtomo) are large with forested tracks similar to those found in intact areas of the Île des Pins. Although some human habitat modification is apparent (logging and a small scale farm) large areas of closed canopy forest existed on Taré in 2003 and appear to be intact in satellite photography from late 2005.

Nêkââwi — Southeast of the Île des Pins, the three islands of the Nêkââwi group lie outside the primary reef of the Île des Pins but are partially protected by the Nêkââwi reef system.

Kôtô [=Nêkââwi]

Kôtô is a small strip of sand in the northern part of the Nêkââwi reef system. Tour boat operators routinely bring snorkelers and scuba divers to the area as a base for exploring the surrounding reef. The vegetation is limited to small shrubs and provides little habitat for terrestrial reptiles.

Nuu Ami [= Ami]

Nuu Ami lies in the southern portion of the Nêkââwi island and reef group. The island's southern coast is exposed to the Coral Sea. Up to 100 m of vegetationless sand and sun-bleached broken coral extend above the high tide line. *Cryptoblepharus novocaledonicus* is the only terrestrial reptile occurring in this area. Inland and throughout undisturbed areas of the remainder of the island broadleaf trees form a closed, mid-height canopy. *Araucaria columnaris* are uncommon and do not form contiguous stands. Two days of day and nighttime surveying revealed populations of five terrestrial reptiles: *Caledoniscincus bodoi*, *Cryptoblepharus novocaledonicus*, *Lioscincus nigrofasciolatus*, *Bavayia* cf. *robusta*, and *Rhacodactylus leachianus*. Nuu Ami is frequently visited by tourists and fisherman. Many areas near beachfronts are substantially modified for human use with large swept clearings and open-walled, thatch-roofed structures. *Rhacodactylus leachianus* were frequently encountered in these areas.

Nuu Ana [= Ana]

Nuu Ana is very similar to its sister island, Nuu Ami. The southern coastline lacks vegetation and the interior forest is a closed canopy of medium-sized broadleaf trees. We encountered five species over two day and night surveys: *Caledoniscincus bodoi*, *Cryptoblepharus novocaledonicus*, *Lioscincus nigrofasciolatus*, *Rhacodactylus leachianus*, and *Lepidodactylus lugubris*. Nuu Ami is significantly smaller than Nuu Ana but supports a similar community of species (Table 2) and shows far less evidence of human habitat modification.

Western islands — Islands in this loosely associated group display a wide variation in habitat, although two common features are a relatively greater density of *Araucaria columnaris* compared to other island groups and sharp habitat differences on the windward and leeward sides of these islands.

Cë [= Tje, les Sabots de la Reine Hortense]

Cē is an area of exposed reef, providing unsuitable habitat for terrestrial reptiles.

Île Aventure [=Cu]

Aventure is the only known locality near the Île des Pins for the (otherwise) Loyalty Islands endemic, *Bavayia crassicollis* (Geneva 2007). Aventure is separated from the Île des Pins by a pass only 500m wide and is unique in the western group as it is the only island completely surrounded by calm seas. The proximity to shore and the shallow surrounding bay (<10m deep) result in Aventure having homogenous vegetation and habitat throughout the island. In our two-day survey we collected seven species from Aventure: *Caledoniscincus atropunctatus*, *Caledoniscincus bodoi*, *Cryptoblepharus novocaledonicus*, *Lioscincus nigrofasciolatus*, *Bavayia crassicollis*, *Bavayia* cf. *robusta*, and *Lepidodactylus lugubris*. Human disturbance is primarily limited to the beach fringe of the island, though there are some small trails inland.

Îlot Brosse [=Mu]

Brosse has a particularly large number of *Araucaria columnaris*, concentrated in the western portion of the island (Figure 3). This large island has ample evidence of human activity, chiefly around the shoreline, where makeshift shelters, trash, and evidence of small boat haul-outs and campsites are evident. There are trails through the densely forested interior, but these appeared rarely used. During two separate full day and night surveys we encountered: *Caledoniscincus bodoi*, *Caledoniscincus haplorhinus*, and *Lioscincus nigrofasciolatus*. Seipp and Henkel (2000, 2011) report *Rhacodactylus leachianus* from Brosse. A freshly dead *Phoboscincus* from Brosse figured by Bauer and Sadlier (2000) was initially identified as a juvenile of the widespread species *P. garnieri*, but has subsequently been demonstrated to be the recently rediscovered *Phoboscincus bocourti* (Ineich 2006, Ineich 2009). As the only known locality for this critically endangered species (Ineich 2009 did not identify the island on which his specimens were found), Brosse should be considered a conservation priority.

Îlot Infernal [=Nâ Kwē]

Infernal is relatively remote (Table 1) and lies outside the reef-enclosed lagoon of the Île des Pins. Infernal was substantially damaged by Cyclone Erica in March 2003, which left few standing trees. Despite its greater elevation (~10m) this island may have been over-washed by the storm surge associated with Erica. No terrestrial reptiles were found during a 24h survey of the island.

Île Bayonnaise [=Xé Yé]

Much like Nuu Ami and Nuu Ana, the habitat on Bayonnaise changes dramatically across a West to East (windward to leeward) transect. Shrubby, xeric vegetation, as well as stands of *Araucaria* dominate the windward site of the island while the near circular coastline creates a well-protected interior with dense, higher canopy mesic forest. Although its proximity to Kuto on the Île des Pins makes this an attractive visiting spot for boaters and tourists, the access to the island can be difficult due to a lack of adequate passages through the surrounding reef (de Vosjoli 1995). *Rhacodactylus leachianus* were commonly encountered at the forest edge on the leeward side of the island and along a small series of trails passing through the interior forest of Bayonnaise.

Île Môrô [=Îlot Moro]

The coastal strand habitat ringing the perimeter of Môrô is similar to all of the western islands with the exception that there is a dense array of wedge-tailed shearwater *Puffinus pacificus* (Gmelin) burrows in the more well-drained area near the main landing beach. The central forest in Môrô lies in a partially flooded depression. This habitat is not found on any other satellite island and is the primary habitat of both *Rhacodactylus trachycephalus* and *R. leachianus*. Môrô is the most extensively studied islet in the Île des Pins region; we performed three separate 2-day surveys. Môrô was also the site of an extended ecological study of sympatric populations of these two giant gecko species (Cunkleman 2005). Cunkleman (2005) also catalogued the flora and fauna of the island, identifying six reptile (Table 2), 16 bird and three mammal species as

well as 18 species of trees and shrubs. Môrô has several small metal structures (shelters) and other evidence of frequent visits by boaters and day visitors. It is one of the most accessible of all of the satellite islands of the Île des Pins. As Môrô represents the entire confirmed range of *Rhacodactylus trachycephalus* (Bauer et al. 2012), as well as harboring populations of six additional reptile species (*Caledoniscincus bodoi*, *Caledoniscincus haplorhinus*, *Cryptoblepharus novocaledonicus*, *Lioscincus nigrofasciolatus*, *Bavayia* cf. *robusta*, and *Rhacodactylus leachianus*) it should be considered a conservation priority.

Île Koé

Koé lies within the lagoon of the Île des Pins. Its near coastal habitat consists of *Casuarina*, *Cocos* palms, and sparse coastal scrub with many petrel burrows. The island's interior is primarily low canopy dense vegetation with small areas of more mature forest. *Araucaria columnaris* are sparse throughout central forest and concentrated on western edge of the island. A two-day survey of Koé recovered four common skink species: *Caledoniscincus atropunctatus*, *Caledoniscincus bodoi*, *Caledoniscincus haplorhinus*, and *Lioscincus nigrofasciolatus*.

Île Kûûmo [=Îlot Koumo, Island A (de Vosjoli and Fast 1995, de Vosjoli 1995)]

Île Kûûmo lies within the reef system encircling the Île des Pins. The island's perimeter is a mixture of intermittent sandy beach and raised coral pavement with many small to medium sized sinkholes. Interior to the coastline, the vegetation forms a low (~10m) closed canopy comprising *Cocos nucifera*, *Casuarina equisetifolia* and small broadleaf trees including *Acacia* sp. A small stand of *Araucaria columnaris* is limited to the southwest point of the island. Kûûmo is unlike any of the other satellite islands in that its soil is more similar to the ferallitic soils of the central portion of the Île des Pins (Bauer and Sadlier 1994). Also unique to Kûûmo are the small rocks and broken coral found in forested areas. These serve as daytime refuges for *Nactus pelagicus* and *Bavayia sauuvagii*. Much of Kûûmo's forest lacks understory, this is probably attributable to a resident herd of feral goats. During two days and nights of survey work we collected eight

reptile species: *Caledoniscincus bodoi*, *Caledoniscincus haplorhinus*, *Phoboscincus garnieri*, *Lioscincus nigrofasciolatus*, *Bavayia* cf. *robusta*, *Bavayia sauuvagii*, *Rhacodactylus leachianus*, and *Nactus pelagicus*. Kûûmo has the greatest number of species present among the satellite islands, including the only locality for *Tropidoscincus aubrianus* in the Île des Pins region and therefore should be considered a priority for conservation efforts.

Distant Islands — Situated well outside the barrier reef of the Île des Pins Dû Ana, Dû Ami and Ndié are subject to the full force of oceanic storms. Of the three, only Dû Ana has been systematically surveyed for reptiles both by herpetocultural collectors and by our research group. Ndié is the most remote of the satellite islands, lying 22 km northwest of Île Giè (Figure 1). According to local fisherman, this island was completely over-washed and denuded of all vegetation following Cyclone Erica in March 2003. Georeferenced photographs of Ndié in 2007 show that a low canopy of vegetation has returned to this island.

Île Dû Ana

Tree cover is sparse on Dû Ana, *Araucaria columnaris* are absent, and only a few live *Casuarina equisetifolia* and broadleaf trees are present, although standing tree snags are common. This island and its nearby sister island of Dû Ami are remote and harbor large colonies of shearwaters, whose burrows can be found throughout the island. During a two-day survey we encountered two skink species (*Caledoniscincus bodoi* and *Lioscincus nigrofasciolatus*) as well as the geckos *Bavayia* cf. *robusta* and *Bavayia sauuvagii*. This island is reported to be the source of a captive *Rhacodactylus leachianus* lineage but we were unable to find this species during our survey (Cemelli 2009).

Species Accounts

The following accounts summarize reptile species that are newly added to the checklist of terrestrial reptiles known from the Île des Pins region or for which new taxonomic, distributional or ecological data are available. Table 2 includes a detailed list of all reptiles found in the Île des Pins region and their distributions. Complete specimen accession data can be found in the Appendix.

SCINCIDAE

Celatiscincus euryotis (Werner, 1909)

Celatiscincus euryotis was not recorded from the islets surrounding the Île des Pins, it still remains known only from a single specific locality is on the west coast of the Île des Pins, near Waa Mé Bay. The species, also including populations from the northeast Grande Terre, was treated as *Marmorosphax euryotis* by Bauer and Sadlier (1994). These skinks have subsequently been allocated to a new genus, *Celatiscincus* (Sadlier et al. 2006), and the mainland populations have been described as a new species, *C. similans*, leaving *C. euryotis* as an apparent Île des Pins endemic. It has recently been listed as Endangered under IUCN criteria (Sadlier and Whitaker 2010).

Caledoniscincus atropunctatus (Roux, 1913)

This species was recorded from a further two near shore satellite islands, in sympatry with one or two congeners (Table 2). Previously it was known in the region only from the main island of Île des Pins (Bauer and Sadlier 1994, 2000).

Caledoniscincus bodoi (Börner 1980)

This species occurs on the main island of Île des Pins (Bauer and Sadlier 1994) and was recorded during our recent surveys from 12 satellite islets. Recent investigations into the taxonomy of the

species of *Caledoniscincus* using DNA sequencing have identified highly distinctive populations in the region of the Île des Pins, for which the species name *bodoi* Börner, 1980 is available (Smith et al. 2007).

Caledoniscincus haplorhinus (Günther, 1872)

In the Île des Pins region this species has only been recorded from five satellite islands and not the Île des Pins (Table 2). The species was not recognized as distinct from *C. austrocaledonicus* at the time of the surveys by Bauer and Sadlier in 1992 but the information presented (Bauer and Sadlier, 1994) indicates it was not amongst the extensive series of specimens collected at that time, as such the species has not been recorded from the main island but could be present in coastal habitats.

Cryptoblepharus novocaledonicus (Mertens, 1928)

This coastal-strand species was reported from the Île des Pins by Bauer and Sadlier (1994). During our surveys we recorded *Cryptoblepharus novocaledonicus* from six satellite islands (Table 2).

Phoboscincus bocourti (Brocchi, 1876)

This species has recently been rediscovered on one of the Île des Pins' satellite islands (Bauer and Sadlier 2000; Ineich 2006, Ineich 2009). This is the largest skink in New Caledonia and one of the largest fully-limbed skinks in the world (Greer 2001) and was previously known from the unique type, described in 1876 (Brocchi 1876) from an unknown New Caledonian locality. The species is regarded as Critically Endangered under IUCN criteria (Sadlier et al. 2010).

Phoboscincus garnieri (Bavay, 1869)

In the Île des Pins region this skink has been confirmed from only two near shore satellite islands (Table 2) and from the Île des Pins itself, it was also collected and photographed by Fast and de Vosjoli (de Vosjoli 1995:7) on Kûûmo (Island A in de Vosjoli 1995). Elsewhere in New Caledonia *Phoboscincus garnieri* has a wide distribution throughout the Grande Terre but is not found in high densities (Bauer and Sadlier 2000).

Lioscincus nigrofasciolatus (Peters, 1869)

This arboreal skink is common and abundant on the Île des Pins as well as many of the satellite islands (Table 2). This species was less common or absent on islands harboring *Phoboscincus* populations.

Tropidoscincus aubrianus Bocage, 1873

A single *Tropidoscincus aubrianus* specimen was collected and photographed by Fast and de Vosjoli (de Vosjoli 1995:7) on Kûûmo (Island A in de Vosjoli 1995). Bauer and Sadlier (2000) list this species as occurring on the Île des Pins and Dü Ana, although re-examination of collection accounts and museum records reveals only a single specimen collected on Kûûmo. Therefore, the current distribution of this species in the Île des Pins region is restricted to Kûûmo. Elsewhere in New Caledonia the species is known from a few scattered locations in the central and northern regions of the Grande Terre (Sadlier 1987).

DIPLODACTYLIDAE

Bavayia crassicollis Roux, 1913

Previously this species had been recorded from the Île des Pins from a single individual specimen from Waa Mé Bay on the main island (Bauer and Sadlier 1994). Expanded sampling and molecular investigation (Geneva 2007) now recognize *Bavayia* cf. *robusta* as the widespread

species in the Île des Pins region, with *B. crassicolis* primarily endemic to the Loyalty Islands with the exception of the single individual from Aventure.

Bavayia cf. *robusta* Wright, Bauer and Sadlier, 2000

Bavayia cf. *robusta* is a common, widespread species in the Île des Pins region (Table 2). This taxon includes specimens previously assigned to *Bavayia cyclura* (Roux 1913) and *B. crassicolis* by Bauer and Sadlier (1994). Molecular phylogenetic analyses indicated the Île des Pins populations are reciprocally monophyletic with respect to mainland *Bavayia robusta*, although recent gene flow is indicated (Geneva 2007). The population genetics and taxonomy of these populations are currently under review.

Bavayia sauvagii (Boulenger, 1883)

This semi-terrestrial species was reported from the Île des Pins by Bauer and Sadlier (1994). We encountered this species on an additional five satellite islands spread throughout the Île des Pins region. Populations of *Bavayia sauvagii* are also known from the Grande Terre.

Eurydactylodes vieillardii (Bavay, 1869)

Populations that are most likely assignable to this species have been found on the east and west of the Île des Pins (Fast 1997; Bauer et al. 2009) but no records of this species exist from satellite islands. The species was previously considered to be restricted to the southern half of Grande Terre (Bauer and Sadlier 2000).

Mniarogekko chahoua (Bavay, 1869)

The genus *Mniarogekko* was recently erected to accommodate this taxon and its sister taxon, *M. jalu*, which are more closely related to *Eurydactylodes* than to *Rhacodactylus* sensu stricto

(Bauer et al. 2012). No museum voucher specimens of *Mniarogecko chahoua* are known from the region. The species presence on the Île des Pins is based reports in herpetocultural publications from the Île des Pins but without specific locality information (de Vosjoli 1995, de Vosjoli and Fast 1995, Seipp and Henkel 2000, 2010, Tytle 1999). Reptile breeders often offer “Pine Island” forms of *R. chahoua* but the veracity of this designation is currently untestable.

Correlophus ciliatus Guichenot, 1866

The genus *Correlophus* was recently resurrected (Bauer et al. 2012) to accommodate this and several other species formerly included in the genus *Rhacodactylus*. The species has been reported from the main island of Île des Pins (Seipp and Klemmer 1994, Storelli 1994, Kullmann 1995) and also been recorded from satellite islands of the Île des Pins (de Vosjoli 1995). Elsewhere in New Caledonia it is known from the southern Grande Terre (Girard and Heuclin 1998; Bauer and Sadlier 2001). The species was long believed to be extinct (Bauer and Vindum 1990; Bauer and Sadlier 1993) until its rediscovery in the mid-1990s, since then it has been introduced into the pet trade and is now the second most commonly kept of all geckos. However, precise localities within the Île des Pins are still not known and the conservation status of the species in the region is poorly known.

Rhacodactylus leachianus (Cuvier, 1829)

The species is found on the main island of the Île des Pins (Bauer and Sadlier 1994) and has been recorded from many satellite islands (see Table 2), where it can be quite abundant (de Vosjoli 1995, de Vosjoli and Fast 1995, Love 2007). Elsewhere in New Caledonia it has an almost island-wide distribution on the Grande Terre. Allozyme (Good et al. 1997) and multi-gene phylogenetic analyses (Bauer et al. 2012) provide no support for the recognition of the subspecies *R. leachianus henkeli* Seipp and Obst 1994, previously applied to Île des Pins

populations of *R. leachianus*, although these insular populations are phenotypically distinctive (Cemelli 2009).

Rhacodactylus trachycephalus (Boulenger, 1878)

This viviparous gecko has been reported from the Île des Pins in the type description and by some modern authors (Seipp and Henkel 2000, 2010), but Bauer and Sadlier (1994) and De Vosjoli (1995) could not verify its presence on the main island. Contemporary specimens with confirmed localities are restricted to a single satellite island, Môrô, and the entire known range of this species is 0.1 square kilometers. Recognition of this species here is based on molecular phylogenetic evidence which indicates the Île des Pins populations of *R. trachyrhynchus* for which the name *R. trachycephalus* is available, should be resurrected (Bauer et al. 2012). Recent research in to the ecology of this species (Cunkleman 2005) has found this species partitions habitat with *R. leachianus*. With such an extremely small known range, perhaps the smallest of any known reptile, *R. trachycephalus* is of extreme conservation concern and is considered Critically Endangered (Bauer et al. 2012).

GEKKONIDAE

Hemiphyllodactylus typus Bleeker 1860

This species was erroneously reported from Nuu Ami by Bauer and Sadlier (2000:119, Map 21), no other voucher or literature records exist to confirm this species' presence on the Île des Pins or its satellites and it is here removed from the list of confirmed taxa for the region.

Lepidodactylus lugubris (Duméril and Bibron, 1836)

This species was reported from the Île des Pins by Bauer and Sadlier (1994). We extend this species range to include three islets frequently visited by recreational boaters: Caanawa, Nuu

Ana, and Aventure.

Nactus pelagicus (Girard, 1858)

This gekkonid species was reported from the Île des Pins by Bauer and Sadlier (1994). Our surveys identified one additional locality, the near-shore satellite island of Kûûmo.

ELAPIDAE

Laticauda laticaudata (Linnaeus, 1758)

Laticauda laticaudata and *L. saintgironsi* occur sympatrically throughout the New Caledonian lagoon (Cogger and Heatwole 2006, Brischoux and Bonnet 2009, Brischoux et al. 2009).

Ongoing research has identified a series of ecological differences between these species including foraging location (Brischoux et al. 2007, 2009), activity time and responses to rainfall (Bonnet and Brischoux 2008), and utilization of shearwater burrows (Lane and Shine 2011c).

Unlike the complex of yellow-banded sea krait species, blue-banded sea krait populations (*L. laticaudata*) from throughout the southern Pacific comprise a single lineage experiencing ongoing gene flow (Lane and Shine 2011b).

Laticauda saintgironsi Cogger and Heatwole 2006

Populations of yellow-banded sea kraits from the waters surrounding the Île des Pins formerly assigned to *L. colubrina* are now recognized as a distinct species, *Laticauda saintgironsi*. This species is endemic to the New Caledonian region (Cogger and Heatwole 2006, Heatwole et al. 2005). Recent phylogenetic analyses support this classification (Lane and Shine 2011b).

Cunkleman and Bauer (2006) described a unique predatory behavior, feeding on crabs, of this species on Île Môrô. Extensive life history observations and ecological research have focused on *L. saintgironsi* and *L. laticaudata* from islands across the southern New Caledonian lagoon, including the Île des Pins satellite islands of Bayonnaise and Brosse (Bonnet and Brischoux

2008, Brischoux and Bonnet 2009).

Discussion

Since the last review of the herpetofauna of the Île des Pins (Bauer and Sadlier 1994) we and our colleagues have conducted five surveys (2000, 2002, spring 2003, fall 2003, and 2004) of the Île des Pins and its satellite islets. This work, coupled with the efforts of other research groups (Brischoux et al. 2007, Ineich 2009, Lane and Shine 2011a) and herpetoculturalists (de Vosjoli 1995, Love 2007, Seipp and Henkel 2000, Seipp and Henkel 2011), has substantially improved our understanding of the reptile community of the Île des Pins area. Despite these efforts much of the Île des Pins region remains to be surveyed. To date, systematic collection efforts have been limited to a small portion of the Île des Pins. Large and relatively intact stretches of forest, particularly in the northeast of the island, have yet to be investigated and may further expand the diversity and distribution of lizard species for the region. Ten of the 31 main satellite islands remain to be surveyed. Additional sampling effort on these islands will certainly produce new distributional data and could potentially yield additional species records. Infernal and Ndié could be revisited to assess rates of recolonization after cyclones that result in the local extirpation of reptiles.

This review adds eight species not represented in the previous review and removes two due to re-identification and erroneous locality data, increasing the total recorded reptile fauna of the Île des Pins and surrounding islands to a total of 23 species. Recent taxonomic studies have also refined our concepts of certain taxa resulting in the description of a new snake species, *Laticauda saintgironi*; the recognition of a gecko elevated from synonymy, *Rhacodactylus trachycephalus*, and the skink *Celatiscincus euryotis*, as an endemic to the region. We provide a catalog of all 249 museum vouchers collected since 1992 (Appendix), and an island-by-island checklist of species (Table 2), which includes eight new distribution records for species not previously recorded from the Île des Pins region and a total of 76 new island distribution records (Table 2).

Assembly of this dataset allows for post-hoc analyses of the relationships between island species richness and island area or remoteness, although due to relatively small survey effort per island these analyses have limited power. Two analyses support the suggestions of classic island biogeographic theory (MacArthur and Wilson 1967); regression of island species richness against island area recovers a significant positive relationship ($r^2 = 0.746$, $p = 7.86 \times 10^{-6}$) and a non-significant inverse trend between satellite island species richness and remoteness (distance to nearest-neighbor island $r^2 = 0.1112$, $p = 0.19$). No relationship was found between species richness and distance from the Île des Pins.

An increasingly clear trend, emphasized by more complete sampling, is the substantial contribution satellite islands make to overall species diversity. Three species with distributions on the New Caledonian mainland only occur in the Île des Pins region on satellite islands. Also, two species appear to be endemic to satellite islands, although these islands account for only a small fraction of the total land area in the Île des Pins region. A recent phylogenetic investigation of the diplodactylid geckos of New Zealand revealed a similar abundance of distinct lineages restricted near shore islands (Nielsen et al. 2011). In both New Zealand diplodactylids and New Caledonian reptiles it remains to be determined if patterns of island endemism are due to *in situ* diversification, mainland extirpation or a combination of both phenomena. Many Île des Pins area islands remain to be surveyed, leaving open the potential for additional discoveries.

The data reported here are useful for the establishment of conservation priorities in the Île des Pins region. As distinct, isolated units, islands have been used successfully in New Zealand as refuges for rare or threatened species (Towns and Ballantine 1993, Saunders and Norton 2001, Courchamp et al. 2003). Conservation areas are often designated by identifying intact habitat that harbors viable populations of recognizable species, or flagship species (Leader-Williams et al. 1990). Endemic vertebrate species regularly assume the role of flagship species and as many of New Caledonia's endemic birds are absent from the Île des Pins and surrounding islets the

reptiles (the only other diverse vertebrate group in New Caledonia) are a natural choice for the flagship species of this region.

Although the surveys performed to date are preliminary and have focused on reptiles only, some inferences on the relative importance of islands can be made. Surrounding the Île des Pins are a number of islands that harbor unique species or communities of species where conservation efforts should be focused. These islands are of high conservation significance for lizards, either by containing a significant part of that species distribution, as for the endangered skink species *Phoboscincus bocourti* and *Celatiscincus euryotis* and the critically endangered giant gecko *Rhacodactylus trachycephalus*, or by having morphologically or ecologically distinctive populations, as seen in the various islet populations of *Rhacodactylus leachianus*. Kûûmo, Môrô and Brosse are all visited frequently but have unique faunas. Île Môrô and Îlot Brosse, with total land areas of 0.1 and 0.66 km², each represent the entire confirmed range of a species. Just as New Caledonia has been recognized as a global hotspot of biodiversity (Brooks et al. 2002; Meyers et al. 2000; Mittermeier et al. 1999) due to the disproportionate distribution of endemic species relative to landmass, these two islands, which represent just 0.004% of New Caledonia's landmass harbor a disproportionate fraction of the territories endemic reptiles making these islands hotspots within a hotspot and suggests that they should be afforded special protection.

Some of the satellite islands, particularly Kûûmo, Nuu Ami, Brosse, Nă Nă and Môrô, are frequently visited by tourists or used for recreation by local residents. This use has facilitated and will continue to facilitate colonization by non-native species that could threaten the viability of the endemic lizard fauna. Conversely, islands that are heavily used and do not harbor unique communities of species have a lower conservation priority. Nă Nă, Île Caanawa, and Île Kôtô are frequently visited and have typical or depauperate reptile communities and it is to islands such as these that recreational usage should be directed.

Table 1. Names, geography, remoteness, invasive species observed in 2003–2004, use and conservation concern (single + = lowest) for each island in the Île des Pins region. Islands in grey were not visited by the authors.

Island	Synonyms	Latitude	Longitude	Area (km ²)	Shoreline (km)	Species	To IDP (km)	Nearest land (km)	Nearest landmass	Ants	Mammals	Recreational Use	Conservation Priority
Île des Pins (Kuniyé)	Kunié	22°3'636.19"S	167°28'35.52"E	141.7	74.88	18	NA	NA	NA	Yes	Rats, Domesticated animals	Yes	+
Île Gié	Île Gié	22°30'58.83"S	167°24'43.96"E	0.06	0.97	NA	2.73	0.91	Île Nā Nā				
Île Na Nā	Île Tiantoro	22°31'36.07"S	167°25'13.37"E	0.19	1.9	3	1.32	0.24	Île Caanawa		Rats, Dog	Yes	+
Île Caanawa	Île Tianoa	22°31'41.55"S	167°25'36.83"E	0.11	1.64	4	0.69	0.09	Île Nuu powa			Yes	+
Île Nuu powa	Île Napaoua	22°31'44.91"S	167°25'48.96"E	0.11	1.45	NA	0.65	0.09	Île Caanawa				
Île Lorette		22°31'50.68"S	167°24'55.36"E	0.05	1.18	NA	1.57	0.18	Île Kwa Wiyèrè				
Île Menoré	Île Moneoro	22°32'13.60"S	167°24'44.29"E	0.22	2.42	NA	1.36	0.11	Île Kwa Wiyèrè				
Île Kwa Wiyèrè		22°32'00.93"S	167°25'4.87"E	0.09	1.49	2	0.9	0.11	Île Menoré			No	++
Île Révirié		22°32'8.11"S	167°25'32.52"E	0.04	1.11	NA	0.37	0.33	Île Kwa Wiyèrè				
Île Yuaé piriù		22°32'4.84"S	167°26'14.65"E	0.01	0.66	NA	0.42	0.2	Île Yuaé				
Île Yuaé		22°32'10.10"S	167°26'24.93"E	0.07	1.63	NA	0.31	0.2	Île Yuaé piriù				
Baie de Oro													
Unnamed Island		22°33'34.69"	167°30'48.51"E	0.02	0.74	NA	0.14	0.14	IDP				
Île Kónobutr	Île Ouatomo	22°33'54.16"S	167°31'2.49"E	0.3	2.45	5	0.37	0.11	Île Mwàréya	Yes		No	+
Île Mwàréya	Île Uage	22°34'12.38"S	167°30'58.29"E	0.12	1.95	3	0.13	0.11	Île Kónobutr			No	+
Île Kó ngéaa ké	Île Kongouati	22°34'52.09"S	167°31'18.07"E	0.39	2.84	NA	NA	NA	IDP				
Île Waié		22°34'50.17"S	167°31'35.02"E	0.23	1.85	NA	NA	NA	Île Kó ngéaa ké				
Baie d'Upi													
Île Taré	Toré	22°38'27.88"S	167°32'7.57"E	0.46	3.32	6	0.38	0.38	IDP	Yes		No	+

Table 1 continued

Kótomo	Île Koutomo	22°39'37.02"S	167°31'59.71"E	13.1	28.9	NA	0.09	0.09	IDP
Nékaáwi group									
Île Kôô	Nékaáwi, Île Tomere	22°43'36.21"S	167°33'15.20"E	0.01	0.55	NA	8.04	3.17	Nuu Ana
Nuu Ami	Ami	22°45'33.32"S	167°34'12.90"E	0.31	2.4	5	10.75	2.93	Nuu Ana Yes
Nuu Ana	Ana	22°43'55.73"S	167°35'20.51"E	0.2	1.96	5	11.62	2.93	Nuu Ami Yes
Western Islands									
Cé	Tje, les sabots de la reine Hortense	22°40'46.29"S	167°28'44.42"E	NA	NA	0	0.6	0.6	IDP No
Île Aventure (Cu)		22°40'23.08"S	167°27'30.45"E	0.06	1	7	0.53	0.53	IDP No
Îlot Brosse (Mu)		22°42'31.81"S	167°27'37.62"E	0.66	3.63	5	3.67	3.67	IDP Yes
Îlot Infernal (Nâ Kwe)		22°42'02"S	167°22'09"E	0.01	0.44	0	8	8	IDP No
Île Bayonnaise (Xé Yé)		22°40'17.81"S	167°25'24.41"E	0.21	1.74	1	1.13	1.13	IDP No
Île Môrô	Îlot Moro	22°39'3.53"S	167°23'40.85"E	0.1	1.44	7	2.32	2.32	IDP Rats Yes
Île Koé		22°38'32.18"S	167°24'51.29"E	0.08	1.4	4	0.44	0.36	Île Nuui bwé No
Île Nuui bwé		22°38'19.84"S	167°24'36.40"E	0.04	0.78	NA	0.64	0.36	Île Koé
Île Kúumo	Îlot Koumo	22°37'11.46"S	167°24'40.36"E	0.34	3.2	8	0.61	0.61	IDP Goats No
Distant Islands									
Île Du Ana		22°37'32.50"S	167°18'46.90"E	0.08	1.65	5	10.31	2.05	Île Du Ami Yes
Île Du Ami		22°37'20.70"S	167°18'34.52"E	0.02	0.54	1	12.4	2.05	Île Du Ana
Îlot Ndié		22°31'11.13"S	167°11'52.65"E	0.01	0.45	NA	23.86	22.5	Île Grié

Table 2. Summary of species distribution by island. Letters refer to the origin of distributional data as follows, X: Included in Bauer and Sadlier 1994; V: Vouchered locality collected since 1994; L: No voucher, reported in peer reviewed literature; G: No voucher, reported in non-peer reviewed literature; S: Seen but not captured by authors; *: specimens with revised species designation (both now *Bavayia* cf. *robusta*). Superscript numbers refer to the following references: 1. Ineich 2009, 2. Seipp and Henkel 2000, 3. de Vosjoli and Fast 1995, 4. Seipp and Klemmer 1994, 5. Cemelli 2009.

Species	Ile des Pins	Ile Nà Nà	Ile Caanawa	Ile Kwa Wiyèrè	Ile Kônobutr	Ile Mwàréya	Ile Taré	Nuu Ami	Nuu Ana	Cè	Ile Aventure	Ilot Brosse	Ilot Infernal	Ile Bayonnaise	Ile Môrô	Ile Koè	Ile Kûlmo	Ile Du Ana	Ile Du Ami	# of Islands	new distribution records
SCINCIDAE																					
<i>Celatscincus euryotis</i>	X																			1	0
<i>Caledoniscincus atropunctatus</i>	X										V					V				3	2
<i>Caledoniscincus bodoi</i>	X			V	V	V	V	V	V		V	V			V	V	V	V		13	12
<i>Caledoniscincus haplorhinus</i>							V					V			V	V	V			5	5
<i>Cryptoblepharus novocaledonicus</i>	X		V		V		V	V	V		V				V					7	6
<i>Phoboscincus bocourti</i>												L ¹								1	1
<i>Phoboscincus garnieri</i>		S													V					2	2
<i>Lioscincus nigrofasciatus</i>	X				V		V	V	V		V	S			V	V	V	V		10	9
<i>Tropidoscincus aubrianus</i>															V					1	1
DIPLODACTYLIDAE																					
<i>Bavayia crassicolis</i>	X*										V									2	1
<i>Bavayia cyclura</i>	X*																			1	0
<i>Bavayia cf. robusta</i>	X	V	V	V	V	V	V	V	V		V				V	V	V	V		12	11
<i>Bavayia sauvagii</i>	X	V				V	V								V	V	V	V		6	5
<i>Eurydactylodes vieillardii</i>	V																			1	1
<i>Mniarogekko chahoua</i>	G ²																			1	1
<i>Correlophus ciliatus</i>	L ³																			1	1
<i>Rhacodactylus leachianus</i>	X		G ⁴		V		V	V	V		G ⁵			V	V		G ²	G ⁴	G ⁵	11	10
<i>Rhacodactylus trachycephalus</i>	X													V	V					2	1
GEKKONIDAE																					
<i>Hemidactylus frenatus</i>	X																			1	0
<i>Lepidodactylus lugubris</i>	X		V					V		V										4	3
<i>Nactus pelagicus</i>	X																V			2	1
Total Species	18	3	4	2	5	3	6	5	5	0	7	5	0	1	7	4	8	5	1	88	76

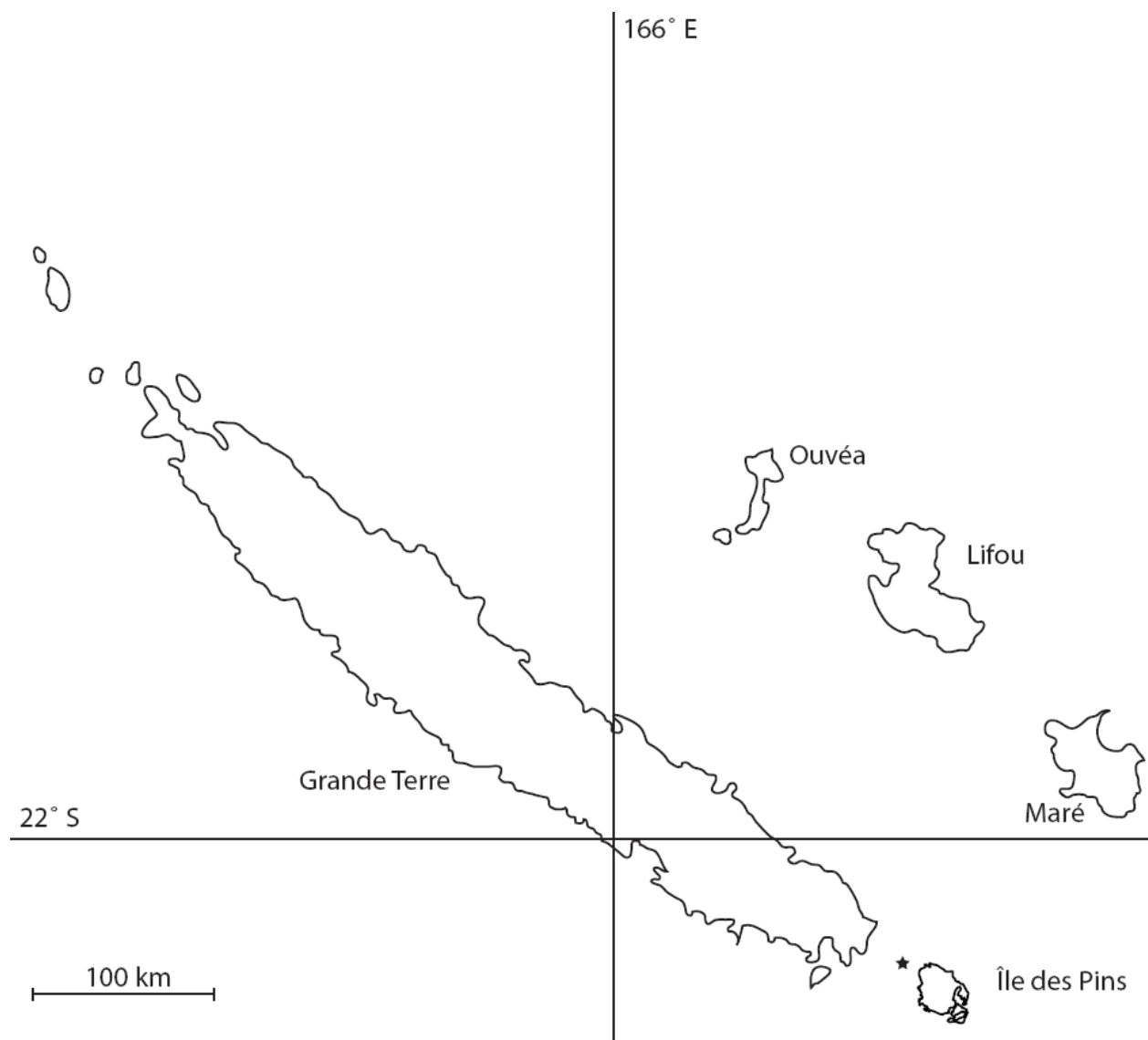


Figure 1. New Caledonia including the Loyalty Islands and the Île des Pins. The black star indicates the approximate location of Îlot Ndié.

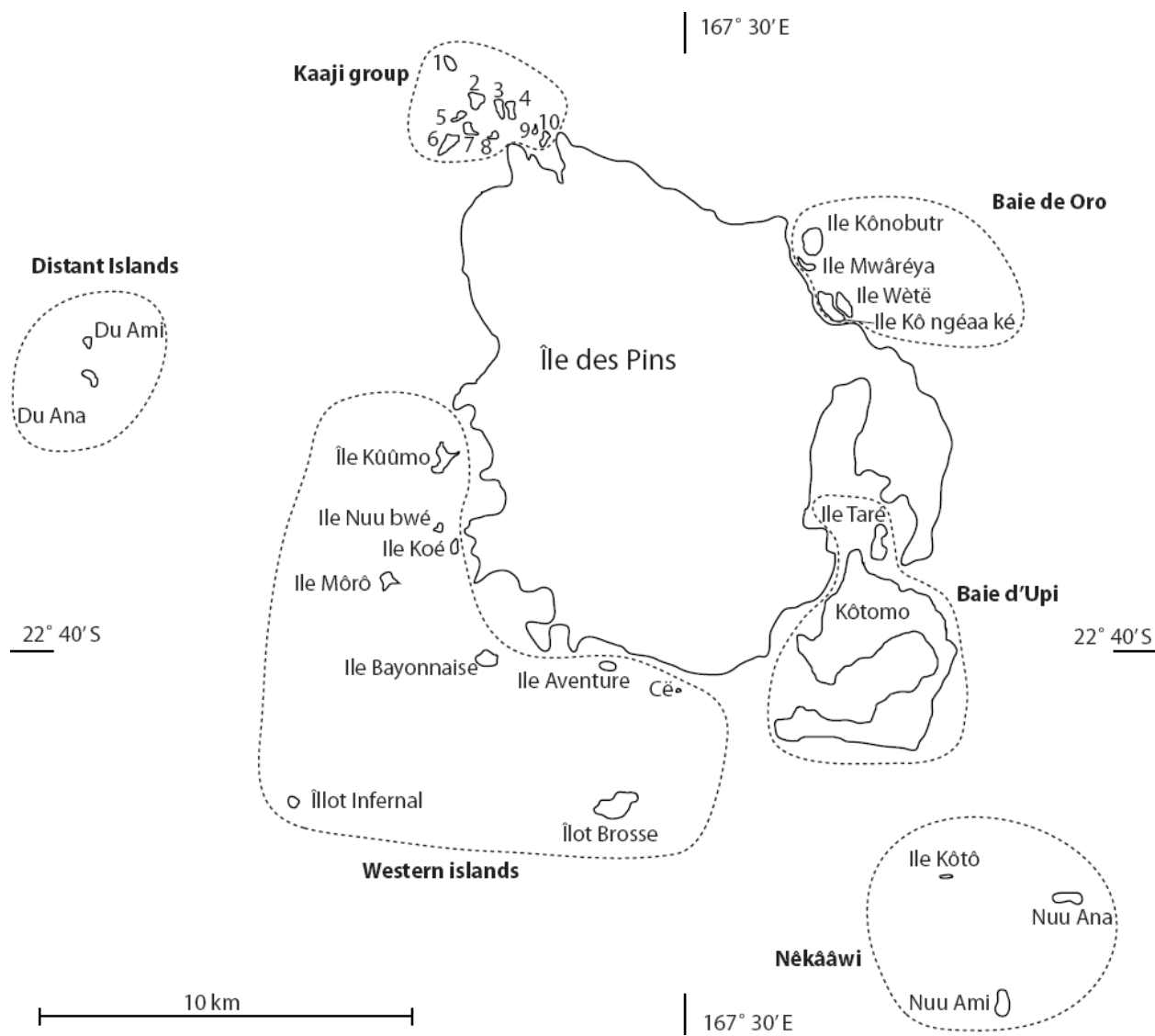


Figure 2. Île des Pins and its surrounding islets. Satellite Island groups are enclosed by dashed lines. Numbered islands are 1: Île Giè, 2: Île Nă Nă, 3: Île Caanawa, 4: Île Nuupowa, 5: Île Lorette, 6: Île Mënorë, 7: Île Kwa Wiyyèrè, 8: Île Réwiéré, 9: Île Yuuè pùrù, and 10: Île Yuèpè.



Figure 3. Typical habitats of the Île des Pins and its surrounding islets. A: Île Môrô - raised coral platform with shrubs and *Pandanus* sp. B: windward coast of Île Môrô. C: coastline of Îlot Brosse with small broadleaf trees, and *Araucaria columnaris*. D: Kuto Peninsula of the Île des Pins – foreground of *Casuarina equisetifolia* with broadleaf forest and *Araucaria columnaris*.

Literature Cited

- Balouet, J., and S. Olson. 1989. Fossil birds from late Quaternary deposits in New Caledonia. *Smithson. Contrib. Zool.* 469:1–38.
- Bauer, A. M. and T. Jackman. 2006. Phylogeny and microendemism of the New Caledonian lizard fauna. Pages 9–13 *in* M. Vences, J. Köhler, T. Ziegler, and W. Böhme, eds. *Herpetologia Bonnensis II. Proceedings of the 13th Congress of the Societas Europaea Herpetologica.* (Societas Europaea Herpetologica, Bonn, Germany.
- , Sadlier, R. A., and A. H. Whitaker. 2006. A revision of the *Bavayia validiclavis* group (Squamata: Gekkota: Diplodactylidae), a clade of New Caledonian geckos exhibiting microendemism. *Proc. Calif. Acad. Sci.* 57:503–547.
- Bauer, A. M., and R. A. Sadlier. 1993. Systematics, biogeography and conservation of the lizards of New Caledonia. *Biodivers. Lett.* 1:107–122.
- . 1994. The terrestrial herpetofauna of the Île des Pins, New Caledonia. *Pac. Sci.* 48:353–366.
- . 2000. The herpetofauna of New Caledonia. Society for the Study of Amphibians and Reptiles, Ithaca, New York.
- . 2001 [2000]. New data on the distribution, status, and biology of the giant New Caledonian geckos (Squamata: Diplodactylidae: *Rhacodactylus* spp.). *Amphib. Reptil. Conserv.* 2:24–29.
- Bauer, A. M. and J. V. Vindum. 1990. A checklist and key to the herpetofauna of New Caledonia, with remarks on biogeography. *Proc. Calif. Acad. Sci.* 47:17–45.
- Bauer, A. M., T. Jackman, R. A. Sadlier, and A. H. Whitaker. 2009. Review and phylogeny of the New Caledonian diplodactylid gekkotan genus *Eurydactylodes* Wermuth, 1965, with the description of a new species. Pages 13–36 *in* P. Grandcolas ed. *Zoologia Neocaledonica* 7. Biodiversity studies in New Caledonia. *Mém. Mus. Natl. Hist. Nat. (Paris)* 198.

- . 2012. Revision of the giant geckos of New Caledonia (Reptilia: Diplodactylidae: *Rhacodactylus*). Zootaxa 3404:1–52.
- Bonnet, X. and F. Brischoux. 2008. Thirsty sea snakes forsake refuge during rainfall. Austral Ecol. 33:911–921
- Börner, A.-R. 1980. Über neukaledonische Skinke des *Leiolopisma austrocaledonicum*—Komplexes. Misc. Art. Saurol. 5:1–15.
- Brischoux, F., X. Bonnet, and R. Shine. 2007. Foraging ecology of sea kraits *Laticauda* spp. in the Neo-Caledonian Lagoon. Mar. Ecol. Prog. Ser. 350:145–151.
- . 2009. Determinants of dietary specialization: a comparison of two sympatric species of sea snakes. Oikos 118:145–151.
- Brischoux F. and X. Bonnet. 2009. Life history of sea kraits in New Caledonia. Pages 133–147 in P. Grandcolas ed. Zoologia Neocaledonica 7. Biodiversity studies in New Caledonia. Mém. Mus. Natl. Hist. Nat. (Paris) 198.
- Brooks, T., R. Mittermeier, C. Mittermeier, G. Fonseca, A. Rylands, W. Konstant, P. Flick, J. Pilgrim, S. Oldfield, G. Magin, and C. Hilton-Taylor. 2002. Habitat Loss and Extinction in the Hotspots of Biodiversity. Conserv. Biol. 16:909–923.
- Cemelli, S. 2009. Island Giants: Your guide to the New Caledonian giant gecko. Reptiles 17(6):32–41.
- Cogger H and H Heatwole. 2006. *Laticauda frontalis* (de Vis, 1905) and *Laticauda saintgironsi* n. sp. from Vanuatu and New Caledonia (Serpentes: Elapidae: Laticaudinae) A new lineage of sea kraits? Rec. Austral. Mus. 58:245–256.
- Courchamp, F, J. L. Chapuis, and M. Pascal. 2003. Mammal invaders on islands: impact, control and control impact. Biol. Rev. 78:347–383.
- Cunkleman, A. 2005. Ecology of *Rhacodactylus leachianus* and *R. trachyrhynchus* in an area of sympatry. Unpublished M.S. Thesis. Villanova University, Villanova.

- and A. M. Bauer. 2006. *Laticauda saintgironsi* (New Caledonian yellow-lipped sea krait). Predation. Herpetol. Rev. 37:232.
- de Vosjoli, P. 1995. Notes from an herpetological field trip to New Caledonia, part one: account from the daily journals of Philippe de Vosjoli and Frank Fast. The Vivarium 6(5):4–7,12,14–17,36–38,40–43.
- . 1996. Great tales of the mad gecko hunters: Island X and riding the waves at the Mouth of Death. The Vivarium. 8(2):16–21.
- and F. Fast. 1995. Notes from an herpetological field trip to New Caledonia, part two: notes on three species of New Caledonian geckos of the genus *Rhacodactylus*. The Vivarium 6(6):26–29,53–54.
- and A. Repashy. 2003. *Rhacodactylus*: The complete guide to their selection and care. Advanced Visions, Vista, California.
- Dubois, J., J. Launay, and J. Recy. 1974. Uplift movements in New Caledonia – Loyalty Islands area and their plate tectonics interpretation. Tectonophysics 24:133–150.
- Fast, F. 1997. Great looks, small package! A glimpse of New Caledonia's elusive *Eurydactyloides* [sic] *vieillardii*. The Vivarium 9(1):48.
- Geneva, A. 2007. The phylogeography of *Bavayia cf. crassicollis*. Unpublished M.S. Thesis. Villanova University, Villanova.
- Girard, F. and D. Heuclin. 1998. Première mention du gecko *Rhacodactylus ciliatus* sur le Grande Terre (Nouvelle-Calédonie) depuis sa description en 1866. Bull. Soc. Herpétol. France 85–86:60–61.
- Greer, A.E. 2001. Distribution of maximum snout-vent length among species of scincid lizards. J. Herpetol. 35:383–395.
- Heatwole, H., S. Busack, and H. Cogger. 2005. Geographic variation in sea kraits of the *Laticauda colubrina* complex (Serpentes: Elapidae: Hydrophiinae: Laticaudini) Herpetol.

- Monogr. 19:1–136.
- Ineich, I. 2006. Bocourt's terrific skink of New Caledonia is not extinct! *Oryx* 40:136–136.
- . 2009. Bocourt's terrific skink, *Phoboscincus bocourti* Brocchi, 1876 (Squamata, Scincidae, Lygosominae). Pages 149–174 in P. Grandcolas ed. *Zoologia Neocaledonica* 7. Biodiversity studies in New Caledonia. Mém. Mus. Natl. Hist. Nat. (Paris) 198.
- Jourdan, H, R. A. Sadlier, and A. M. Bauer. 2001. Little fire ant invasion (*Wasmannia auropunctata*) as a threat to New Caledonian Lizards: Evidences from a sclerophyll forest (Hymenoptera: Formicidae). *Sociobiology* 38:283–302.
- Kullmann, B. 1995. Über die Wiederentdeckung des Kronengeckos (*Rhacodactylus ciliatus*) in Neu Kaledonien. *Elaphe* 3(2):68–71.
- Lane, A. and R. Shine. 2011a. Intraspecific variation in the direction and degree of sex-biased dispersal among sea-snake populations. *Mol. Ecol.* 20:1870–1876
- . 2011b. Phylogenetic relationships within laticaudine sea snakes (Elapidae). *Mol. Phylogenet. Evol.* 59:567–577.
- . 2011c. When seasnake meets seabird: Ecosystem engineering, facilitation and competition. *Austral Ecol.* 36:544–549.
- Leader-Williams, N., J. Harrison, and M. Green. 1990. Designing protected areas to conserve natural resources. *Sci. Prog.* 74:189–204.
- Love, B. 2007. Into the Wild: Quest for Giants. *Reptiles* 15(2):24–26.
- MacArthur, R. H., and E. O. Wilson. The theory of island biogeography. Princeton University Press, Princeton, New Jersey.
- Myers, N. 1988. Threatened biotas: “hot spots” in tropical forests. *Environmentalist* 8:187–208.
- . 1990. The biodiversity challenge: expanded hot-spot analysis. *Environmentalist* 10:243–256.

- , R. Mittermeier, C. Mittermeier, G. d. Fonseca, and J. Kent. 2000. Biodiversity hotspots for conservation priorities. *Nature* 403:853–858.
- Mittermeier, R., P. Bouchet, A. Bauer, T. Werner, and A. Lees. 1999. New Caledonia. Pages 366–377 in R. Mittermeier, N. Meyers, P. R. Gil, and C. Mittermeier, eds. *Hotspots: Earth's biologically richest and most endangered terrestrial ecoregions*. CEMEX, Mexico City.
- Nielsen, S. V., A. M. Bauer, T. R. Jackman, R. A. Hitchmough, and C. H. Daugherty. 2011. New Zealand geckos (Diplodactylidae): Cryptic diversity in a post-Gondwanan lineage with trans-Tasman affinities. *Mol. Phylogenet. Evol.* 59:1–22.
- Sadlier, R.A., 1987. A review of the scincid lizards of New Caledonia. *Rec. Austral. Mus.* 39:1–66.
- , S. A. Smith, and A. M. Bauer 2006. A new genus for the New Caledonian scincid lizard *Lygosoma euryotis* Werner 1909, and the description of a new species. *Rec. Austral. Mus.* 58:19–28.
- , S. A. Smith, A. M. Bauer, and A. H. Whitaker. (2009b) Three new species of skink in the genus *Marmorosphax* Sadlier (Squamata: Scincidae) from New Caledonia. Pages 373–390 in P. Grandcolas ed. *Zoologia Neocaledonica 7. Biodiversity studies in New Caledonia*. Mém. Mus. Natl. Hist. Nat. (Paris) 198.
- Sadlier, R. A. and A. H. Whitaker. 2010. *Celatiscincus euryotis*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>.
- Sadlier, R. A., A. H. Whitaker, and A. M. Bauer. 2010. *Phoboscincus bocourti*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>.
- Saunders, A. and D. A. Norton. 2001. Ecological restoration at mainland islands in New Zealand. *Biol. Conserv.* 99:109–119.
- Seipp, R. and F.W. Henkel. 2000. *Rhacodactylus* – Biology, natural history and husbandry. Edition Chimaira, Frankfurt am Main, Germany.

- . 2011. *Rhacodactylus* – Biology, natural history and husbandry, 2nd edition. Edition Chimaira, Frankfurt am Main, Germany.
- Seipp, R. and K. Klemmer. 1994. Wiederentdeckung von *Rhacodactylus ciliatus* (Guichenot 1866) im Süden Neukaledoniens. *Senckenb. Biol.* 24:199–204.
- Seipp, R. and F. J. Obst. 1994. Beschreibung einer neuen Unterart des neukaledonischen *Rhacodactylus leachianus* Cuvier, 1829 (Reptilia: Sauria: Gekkonidae). *Senckenb. Biol.* 74:205–211.
- Smith, S.A., R. A. Sadler, A. M. Bauer, C. C. Austin, and T. R. Jackman. 2007. Molecular phylogeny of the scincid lizards of New Caledonia and adjacent areas: evidence for a single origin of the endemic skinks of Tasmanis. *Mol. Phylogenet. Evol.* 43:1151–1166.
- Storelli, A. 1994. Gecko nouveau! On a retrouvé le *ciliatus*! *Les Nouvelles Hebdo* 230:16–17
- Towns, D. R., and W. J. Ballantine. 1993. Conservation and restoration of New Zealand Island ecosystems. *Trends Ecol. Evol.* 8:452–457.
- Trewick S., F. Brescia, and C. Jordan. 2009. Diversity and phylogeny of New Caledonian *Placostylus* land snails; evidence from mitochondrial DNA. Pages 421–436 in P. Grandcolas ed. *Zoologia Neocaledonica* 7. Biodiversity studies in New Caledonia. *Mém. Mus. Natl. Hist. Nat. (Paris)* 198.
- Tytle, T. 1999. *Rhacodactylus chahoua*: Natural history, captive maintenance and reproduction. *Gekko* 1(1):22–27.

Appendix 1. New terrestrial specimen records collected since Bauer and Sadler (1994). Within each species, records are grouped by island or locality. Museum acronyms used are: AMB – Aaron Bauer Field specimen numbers awaiting accession, AMS – Australian Museum, CAS – California Academy of Sciences, MTDK - Museum für Tierkunde Dresden, SMF – Naturmuseum Senckenberg in Frankfurt, and ZFMK - Zoologisches Forschungsmuseum Museum Alexander Koenig.

SCINCIDAE

Caledoniscincus atropunctatus (Roux, 1913)

Aventure: CAS 229508–9; Koé: CAS 229514.

Caledoniscincus bodoi (Börner 1980)

Île des Pins: AMB 7197-7200, 7205-6, AMS 165934-37; Aventure: AMS 163240,163242–43; Brosse: CAS 231943, AMS 165941; Dü Ana: CAS 231943; Nuu Ami: CAS 231947–48; Nuu Ana: CAS 231949; Môrô: AMS 163236, 163366–68, CAS 214432–4; Koé: AMS 163271; Kônobutr: CAS 231967–69; Kûûmo: AMS 163262–63, Kwa Wiyèrè: CAS 231963; Mwâréya: CAS 231972–76; Taré: CAS 231953–55.

Caledoniscincus haplorhinus (Günther, 1872)

Aventure: CAS 229507; Môrô: CAS 229503–06; Koé: AMS 162272; Kûûmo: CAS 229512; Taré: CAS 231956.

Cryptoblepharus novocaledonicus (Mertens, 1928)

Île des Pins: AMS 165929-32, CAS 231894–98; Aventure: AMS 163245; Caanawa: CAS 231962–64; Nuu Ami: CAS 231944; Nuu Ana: CAS 231952; Môrô: CAS 229516; Kônobutr:

CAS 231970–71.

Phoboscincus garnieri (Bavay, 1869)

Kûûmo: AMS 146293, 229511, CAS 229515.

Lioscincus nigrofasciolatus (Peters, 1869)

Île des Pins: AMS 146292; Aventure: AMS 163251–52; Dü Ana: CAS 231959–60, Nuû Ami: CAS 231945–46; Nuû Ana: CAS 231950–52; Môrô: CAS 229502, AMS 163365, 214435; Koé: AMS 163269–79; Kônobutr: CAS 231966; Taré: CAS 231957

Tropidoscincus aubrianus Bocage, 1873

Dü Ana: CAS 198661

DIPLODACTYLIDAE

Bavayia crassicollis Roux, 1913

Aventure: AMB 7928

Bavayia cf. robusta Wright, Bauer and Sadlier, 2000

Île des Pins: AMB 5289, 5291, 7174-83, 7194-6, CAS 203048–56; Aventure: AMS 163247–50, 163253; Caanawa: CAS 203029–35, AMB 8121–22; Dü Ana: CAS 203016–22, AMB 8115–19; Nuû Ami: AMB 8086–89, CAS 203008–15; Môrô: AMB 7193, AMS 163230, CAS 202999–3007; Kônobutr: AMB 8140–44; Kûûmo: AMS 163258–60, 163268; Kwa Wiiyèrè: AMB 8133–37; Mwâréya: AMB 8157–59, Nă Nă: AMB 8123, 8125, 8127–28; Taré: AMB 8107–10.

Bavayia sauvagii (Boulenger, 1883)

Île des Pins: CAS 203057–63; Dü Ana: AMB 8112; Kûûmo: CAS 163257, 163261, 163267;
Mwâréya: AMB 8155; Nă Nă: AMB 8124, 8126; Taré: AMB 8100.

Eurydactyloides vieillardi (Bavay, 1869)

Île des Pins: ZFMK 73577

Rhacodactylus leachianus (Cuvier, 1829)

Île des Pins: MTKD 35750, 39022, 39519, SMF 75976; Bayonnaise: CAS 203068, 214446; Nu
Ami: AMB 8090–91; Nu Ana: AMB 8097; Môrô: AMB 7188-7192; Kônobutr: AMB 8139;
Taré: AMB 8106.

Rhacodactylus trachycephalus (Boulenger, 1878)

Môrô: CAS 203064, 214440, AMB 7912.

GEKKONIDAE

Lepidodactylus lugubris (Duméril and Bibron, 1836)

Aventure: AMS 163239; Caanawa: CAS 231961; Nu Ana: AMB 8095–96.

Nactus pelagicus (Girard 1857)

Île des Pins: CAS 203044–46; Kûûmo: AMS 163254, CAS 229511.