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The herpetofauna of the Kei Islands (Maluku, Indonesia): Comprehensive report on new and historical collections, biogeographic patterns, conservation concerns, and an annotated checklist of species from Kei Kecil, Kei Besar, Tam, and Kur

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Abstract. In 2011 and 2014, we conducted two expeditions to four islands in the Kei Island group in Maluku Province of eastern Indonesia. We documented and collected 33 species of lizards, snakes, and frogs, and after reviewing historical occurrences in the island group, we accounted for a total of 39 species present in the Kei Islands (26 lizards, 10 snakes, 3 frogs). Here we present a checklist with species accounts and a key to all lizards, snakes, and frogs presently known from the Kei Islands, and discuss potentially erroneous previous records. As presently described, the Kei Islands hold four endemic lizards, though we expect some Kei Island populations of species thought to be widespread will be described as distinct species in the future. We report four species that have not previously been documented from the Kei Islands, including three species of gecko (*Lepidodactylus*), as well as one frog (*Litoria* cf. *bicolor)*, which raises the number of known amphibians from two to three. We reassess the biogeography of the Kei Islands in the context of this new survey and suggest that rather than simply being part of a filter zone between the Sunda and Sahul Shelves, a substantial proportion of the fauna of small eastern Indonesian islands such as the Kei Islands shows an allegiance with other oceanic islands in the South Pacific. Finally, we discuss conservation of herpetofauna and overall biodiversity in the Kei Islands.

Key words. biodiversity survey, frogs, lizards, snakes, Kai Islands, Moluccas

INTRODUCTION

"It is interesting to observe among the islands themselves, how a shallow sea always intimates a recent land connection. The Aru Islands, Misool, and Waigeou, as well as Japen, agree with New Guinea in their species of mammalians and birds much more closely than they do with the Moluccas, and we find that they are all united to New Guinea by a shallow sea. In fact, the 100-fathom line round New Guinea marks out accurately the range of the true Paradise birds" (Wallace, 1869, p. 23). "Now, to show the real effect of such a barrier, let us take the island of Seram, which is exactly the same distance from New Guinea [as the Aru Islands], but separated from it by a deep sea…at least twenty genera [of birds], which are common to New Guinea and Aru, do not extend into Seram, indicating with a force which every naturalist will appreciate, that the two latter countries have received their faunas in a radically different manner" (Wallace, 1869, p. 175).

The dramatic faunal transitions along the Indo-Australian Archipelago have prompted centuries of research and contributed to Alfred Russell Wallace independently formulating the concept of evolution by natural selection (Darwin & Wallace, 1858). Wallace noticed the striking faunal differences along the eastern edge of the Sunda Shelf for which Wallace's Line is named (Wallace, 1860), and also discussed the transition along the western edge of the Sahul Shelf across Lydekker's Line (Lydekker, 1896; Fig. 1). The biogeographic region of Wallacea represents the area set between the Sunda and Sahul continental shelves, and is comprised of thousands of islands with a distinctive, spatially variable, and highly endemic fauna. Whereas the land areas composing the Sunda and Sahul Shelves were periodically united by reduced sea levels during Pleistocene glaciations, the islands in the intervening region remained disconnected from these mainland regions, separated by deep channels even in periods of glacial maxima (Lohman et al., 2011), allowing for isolation and diversification. The region has traditionally been regarded as a transition zone

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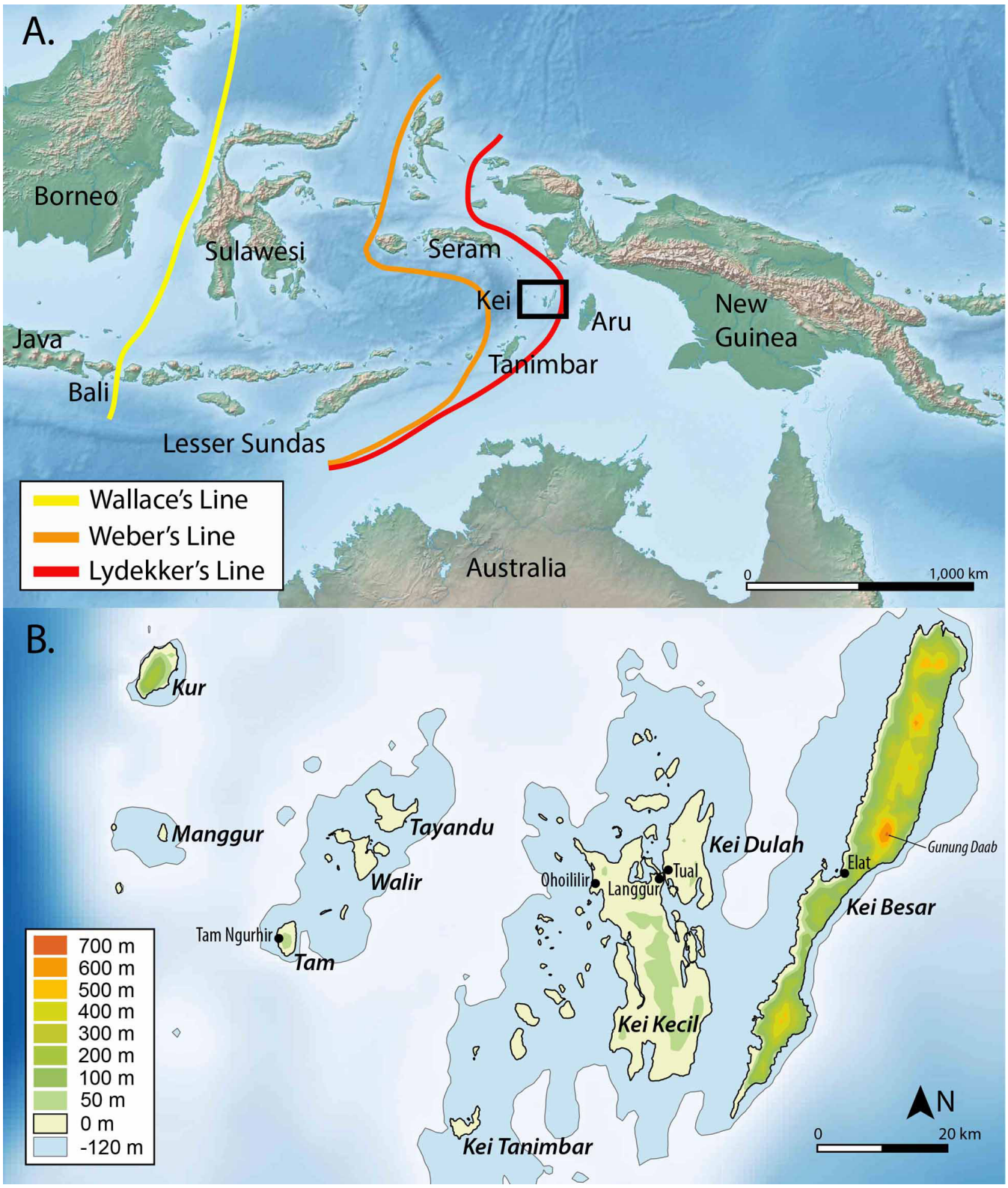

Fig. 1. A, Overview map of Indonesia showing Wallace's, Weber's and Lydekker's Lines and inset rectangle showing location of Kei Islands; B, Topographic map and ocean bathymetry of the Kei Islands, generated from GEBCO bathymetric data (http://www.gebco.net/) and island coasts from DIVA-GIS administrative areas (http://www.diva-gis.org/). The 120 m depth contour is displayed to show regions that were likely connected during Pleistocene glacial cycles causing sea level drops up to 120 m in this region. Major islands and localities discussed in the text are labeled.

between the biotas of the Sunda and Sahul Shelves (Lohman et al., 2011).

The Kei Islands (variously spelled Ke, Ké, Kai, Key, and Kay) are an island group at the far eastern edge of the biogeographic region of Wallacea approximately 130 km from the coast of New Guinea. They are comprised of six major islands among a total of about 74 islands covering 1,266 km^2 (analysis in QGIS; QGIS Development Team, 2017). The close proximity (120 km) yet strikingly different faunas of the Kei and Aru Islands has prompted substantial curiosity by biogeographers. While the fauna of Aru is nearly identical to that of New Guinea with birds of paradise, cassowaries, and marsupials such as tree kangaroos and cuscus, the Kei Islands fauna is relatively depauperate and shows much more similarity to other islands in Maluku and the larger Wallacean region (Doria, 1875, p. 326; Barbour, 1911, p. 45–47; Sternfeld, 1918, p. 376–377). As Wallace initially considered (Wallace, 1860, p. 174–6), the allegiance of the Aru Islands fauna to New Guinea is due to its placement on the Sahul Shelf and periodic land connection to New Guinea and Australia.

The geologic history of the Kei Islands is complex, but fairly well understood. The Kei Islands were formed from uplift and accretion from the eastward pushing Banda Arc thrust front over the past five million years (Charlton et al., 1991). The area can be divided into three regions with different geologic histories: (1) Eastern Province consisting of the mountainous Kei Besar that is undergoing active accretion and extension; (2) Central Province including Kei Kecil, Kei Dulah, and the Tayandu Islands (including Tam), composed of low-lying limestone formed from coral reef uplifted during the Quaternary; and (3) Western Province including Kur and Fadol Islands that were formed from late Miocene accretion and uplift of high-grade metamorphic rock overlain with sandstone and recent limestone (Charlton et al., 1991). All of the Kei Islands are therefore oceanic, meaning they formed from mid-sea uplift and have never been connected by land to adjacent continental shelves. As such, all terrestrial taxa represented on the Kei Islands must have arrived by overwater dispersal from surrounding landforms during the past five million years.

In this manuscript, we synthesise new and published data to present an updated checklist of the herpetofauna of the Kei Islands. This includes our recent collections from four islands in the Kei Island group: Kei Kecil, Kei Besar, Tam, and Kur. We present accounts for all species that have been noted to occur on these islands, and also comment on previous records that we suspect may be erroneous. Finally, we discuss the biogeographic implications of this updated inventory, with an emphasis on our understanding of the source populations for herpetofauna in these Wallacean islands.

HISTORY OF HERPETOLOGICAL COLLECTIONS IN THE KEI ISLANDS

Early expeditions. Salomon Müller and Heinrich Christian Macklot conducted the first known zoological expedition to the Kei Islands between 1828 and 1829 (Johnstone & van Balen, 2013). We can find no records of herpetological specimens from the Kei Islands from this expedition, and it appears they only collected birds and aquatic animals. Likewise, Alfred Russell Wallace visited Kei Besar for one week in January 1857 and collected 13 bird species; 194 insect species; and 3 kinds of land-shells (Wallace, 1860). Although he collected no reptiles, he did observe on the forest floor "…little green lizards, with tails of the most 'heavenly blue'…" (Wallace, 1860, p. 189), which we assume are *Emoia reimschisseli*, the only lizard known from the island with a blue tail. C. B. H. von Rosenberg made a two-month visit in 1865 (Johnstone & van Balen, 2013) and collected presumably the first herpetological specimen from the Kei Islands, *Acanthophis laevis* (RMNH.RENA 5376).

Below is a chronological list of all known expeditions that made herpetological collections in the Kei Islands, the number of reptile and amphibian species collected, and if known, the locations of specimens and resulting publications. Citations are from Johnstone & van Balen (2013) unless otherwise noted.

C.B.H. von Rosenberg. 1865. 1 species (Leiden NCB)
O. Beccari. 1873. 13 species pluralis (Doria, 1875; Peters & Doria, 1878; Genoa MGD)
H.M.S. Challenger. 1874. 4 species pluralis (Boulenger, 1885a, b, 1887; BMNH)
Delivered by Captain G. Langen. 1885. 8 species pluralis (Boulenger, 1893, 1894, 1896; BMNH)
C.J.M. Wertheim. 1888–1889. 1 species (Oudemans, 1894)
S. Schädler. 1897. 1 species (Leiden NCB)
H. Kühn. 1897–1899. at least 2 species pluralis (Roux, 1910)
M. Weber. 1899. 1 species (van Kampen, 1907)
[dubious] Unknown collector, reported by F. Werner. 1910. 2 species pluralis (Werner, 1910)
W. Stalker. 1910. Kei Besar. 2 species pluralis (British Museum)
Roux and Merton. 1908. Kei Kecil, Kei Besar. 30 species pluralis (Roux, 1910)
H.C. Siebers. 1922. Kei Besar. 1 species (Leiden NCB)
T. Mortensen. 1922. Kei Kecil, Kei Besar. 3 species pluralis (ZMUC)
F. Kopstein. 1923. Kei Besar. 6 species pluralis (Kopstein, 1926)
D. Smyth, S.J. Mathews, H. Geier, and A. Geier. 1971. Tam. 5 species pluralis (ANWC)
R.A. How, R.E. Johnstone, and D.J. Kitchener. 1992. Kei Besar. 20 species pluralis (WAM)
P. German and L. Tasker. 1993. Kei Besar. 12 species pluralis (AM)
J.A. McGuire. April 1998. Kei Kecil. 10 species pluralis (TNHC)
B.R. Karin, A.L. Stubbs, U. Arifin. 2011. Kei Kecil, Tam. 28 species pluralis (this study; MVZ, MZB)
A.L. Stubbs, L.M. Bloch, G. Ramadhan. 2014. Kei Kecil, Kei Besar, Kur, 31 species pluralis (this study; MVZ, MZB)

Historical documentation of the Kei Islands herpetofauna. In 1873, Italian naturalist Dr. Odoardo Beccari made the first

major herpetological collection in the Kei Islands (Doria, 1875). After a trip to New Guinea in 1872 with his colleague Luigi D'Albertis followed by approximately six months in the Aru Islands (D'Albertis, 1880), Beccari travelled to the Kei Islands from 10 July to 14 October 1873 (Doria, 1875; Johnstone & van Balen, 2013). In November 1873, he mailed a shipment of specimens from this collection to Italian naturalist Giacomo Doria at the Museo Civico di Storia Naturale in Genova, Italy (Doria, 1875). Shortly after receiving the shipment, Doria (1875) published the results of this expedition including Beccari's samples from Ambon and the Aru Islands. The species list from the Kei Islands was relatively brief (as was Beccari's stay), but contained 13 species (showing current taxonomy): *Emoia reimschisseli*, *E. atrocostata*, *Gekko vittatus*, *G. monarchus*, *Hemidactylus platyurus*, *Varanus* cf. *indicus*, *Acanthophis laevis*, *Boiga irregularis*, *Dendrelaphis keiensis*, *Laticauda colubrina*, *Malayotyphlops kraalii*, *Simalia amethistina*, and *Stegonotus cucullatus* (Doria, 1875). Peters & Doria (1878) later reported on four additional species from Beccari's Kei Island collections bringing the herpetofaunal inventory to 17 species: *Carlia beccarii*, *Lamprolepis smaragdina*, *Indotyphlops braminus*, and a final skink species they could not confidently identify.

In the following year, on its ambitious global circumnavigation and scientific expedition, the HMS Challenger (Great Britain) visited the Kei and Aru Islands from 9–27 September 1874 (Günther, 1880), with naturalists aboard collecting oceanographic data and making zoological collections. Specimens collected (reported from "Dualau" [=Tual/Dulah]) from the Kei Islands were deposited in the British Museum of Natural History and later catalogued by Boulenger (1885a, 1885b, 1887). Boulenger described four lizard species based on specimens collected from the Kei Islands by the HMS Challenger: *Carlia beccarii*, *Hemidactylus frenatus*, *Tiliqua gigas*, and *Varanus* cf. *indicus*, (Boulenger, 1885a, 1885b, 1887).

In 1885, Captain G. Langen performed a survey of the geography and anthropology of the Kei Islands in 1885 and delivered several herpetological specimens (primary collector unknown) to Boulenger (1893, 1894, 1896) at the British Museum. Langen (1888) described in detail the culture and interactions of the indigenous people of the Kei Islands. He also noted that the name of the Kei Islands originated when Malay traders from Makassar originally visited and asked the locals the name of the island. The locals, not understanding the question, replied in their native language: "Kay?" which translates roughly to "What do you say?", and the Malay traders took this as the name of the Kei Islands. Langen (1888) also described the forests of the Kei Islands as lush with enormous trees and vegetation covering every square foot. Langen, however, did not record the specific localities or collectors of the specimens he later delivered to Boulenger. Boulenger reported on Langen's snake collections from the Kei Islands, documenting the following 8 species: *Acanthophis laevis*, *Aipysurus laevis*, *Boiga irregularis*, *Dendrelaphis keiensis*, *Laticauda colubrina*, *Malayotyphlops kraalii*, *Ramphotyphlops multilineatus*, and *Stegonotus cucullatus* (Boulenger, 1893, 1894, 1896). Langen also donated one lizard, *Lygisaurus* cf. *novaeguineae*, to the British Museum (BMNH 1888.8.30.4), which represents the first definite record for this species on the Kei Islands, however the record was never formally published as far as we can ascertain.

Franz Werner (1910) described five *Draco* specimens from the Kei Islands in the Hamburg Natural History Museum. Two females he assigned to the *D. lineatus* group, while the three male specimens he described as a new species, *D. ochropterus* (Werner, 1910). Multiple authors, however, have exhibited skepticism as to the validity of the locality of these specimens (Roux, 1910; McGuire et al., 2007), and they may in fact represent specimens collected from another locality, such as Seram or Ambon (see species accounts for further detail). We, and McGuire et al. (2007) have been unable to find any information on the original collector of these specimens, as Werner is known to have obtained specimens from local collectors and did not collect himself.

In December 1899, German academic Max Weber made collections on the Kei Islands as part of the ambitious Dutch Siboga Expedition. The expedition was focused on collecting oceanographic data and marine organisms, but Weber collected the first known amphibian from the Kei Islands, *Litoria infrafrenata* (van Kampen, 1907).

The Swiss and German zoologists Jean Roux and Hugo Merton, at the suggestion of Weber (de Beaufort, 1913), traveled to the Kei and Aru Islands for five months in 1908 (Roux, 1910) and conducted the most extensive historical zoological expedition to the Kei Islands. Roux and Merton reported the discovery of a number of new species not previously recorded from the Kei Islands, including *Cryptoblepharus keiensis*, *Cyrtodactylus sp.*, *Emoia longicauda*, *Gehyra* cf. *barea*, *Lepidodactylus lugubris*, *Lophognathus temporalis*, *Lygisaurus* cf. *novaeguineae*, *Sphenomorphus capitolythos*, *S. melanopogon*, and *S. undulatus* (Roux, 1910). Roux (1910) also reported the second frog from the Kei Islands, *Cornufer papuensis*. Roux purchased two of the specimens included in his manuscript, *L. temporalis* and *Lygosoma kuhnei* [=*Sphenomorphus melanopogon*], from natural history dealer Hermann Rolle who received them from Heinrich Kühn, an entomologist who lived for several years in Tual on Kei Kecil and who sent many specimens (particularly birds) to scientists in Europe (Roux, 1910; Shea, 2012). However, the localities for both of these specimens may be in error (see species account below for further details). The locality of the *L. kuhnei* specimen was specifically questioned by Shea (2012), as Heinrich Kühn traveled to many other islands in the vicinity of the Kei islands, including Damar, Banda Besar, Wetar, and Babar (Shea, 2012) as well as to Tam and Kur in the Kei Islands (Johnstone & van Balen, 2013). In addition to newly reported species from the Kei Islands listed above, Roux and Merton also made large herpetological collections providing additional records of 11 species of lizards (*Carlia beccarii*, *C. fusca*, *Emoia atrocostata*, *E. reimschisseli*, *Gekko monarchus*, *G. vittatus*, *Hemidactylus frenatus*, *H. platyurus*,

Lamprolepis smaragdina, *Tiliqua gigas*, and *Varanus* cf. *indicus*), eight species of snakes (*Acanthophis laevis*, *Boiga irregularis*, *Dendrelaphis keiensis*, *Laticauda colubrina*, *Malayotyphlops kraalii*, *Ramphotyphlops multilineatus*, *Simalia amethistina*, and *Stegonotus cucullatus*), and one frog (*Litoria infrafrenata*) (Roux, 1910).

In 1915 and 1917, Dutch herpetologist Nelly de Rooij published monographs summarising all reptile species records from the Indo-Australian Archipelago, including the Kei Islands (de Rooij, 1915, 1917) and reported 36 species of snakes and lizards from the Kei Islands. However, she only examined specimens specifically from the Kei Islands for a subset of these taxa: *Carlia beccarii*, *Cryptoblepharus keiensis*, *Emoia reimschisseli*, *Lamprolepis smaragdina*, *Tiliqua gigas*, *Varanus* cf. *indicus*, *Aipysurus laevis*, *Laticauda colubrina*, *Malayotyphlops kraalii*, and *Stegonotus cucullatus*. These specimens were apparently derived from either Dr. L. F. de Beaufort or Mr. F. K. van Dedem whom she listed as the collectors of specimens she examined from Maluku (though it is possible she reexamined Boulenger's specimens on loan from the British Museum) (de Rooij, 1915). She also reported three new species records on the Kei Islands, *Gehyra mutilata*, *G.* cf. *barea*, and *Hypsilurus dilophus* (possibly erroneous, see species account for further detail), however she did not examine any material for these species and we are unaware where she obtained these locality records (de Rooij, 1915). de Rooij (1917) also reported the first herpetological record from Kur Island, the sea snake *Laticauda colubrina*, though we are unaware who collected this specimen and where it may be located now.

On a two-year expedition to Maluku in 1922–1924, Kopstein (1926) visited Kei Besar and made a small collection of six species, describing a new subspecies and species of lizard. First, he described a new subspecies of gecko, *Nactus pelagicus undulatus*, from a single male specimen. Second, he described a skink, *Lygosoma keiensis*, however this was later changed to *Sphenomorphus capitolythos* (Shea & Michels, 2008) due to homonymy. We believe this form is the same species collected by Roux (1910), and referred to as *Lyogosoma* [=*Sphenomorphus*] *muelleri* (see species account below). Kopstein's (1926) single specimen of *L. aruanum* may in fact be *S. undulatus* (see species account below). In addition to these collections, Kopstein re-surveyed three species on Kei Besar collecting samples of: *Cyrtodactylus sp.*, *Emoia reimschisseli*, and *Cryptoblepharus keiensis* (Kopstein, 1926).

After a long hiatus of collections in this region, in April and May 1971, a group of students including D. Smyth, S. J. Mathews, H. Geier, and A. Geier from the Australian National University, Canberra (ANU) led an expedition to Tam that collected 19 herpetological specimens (as well as 46 mammals and 40 birds) for the Australian National Wildlife Collection (ANWC) (Schodde & Mathews, 1977). These specimens included five species of reptiles and amphibians: *Carlia fusca*, *Cryptoblepharus keiensis*, *Hemidactylus frenatus*, *Lophognathus temporalis*, and *Simalia amethistina* (species list from field catalog provided by ANWC).

The Western Australian Museum (WAM) and the Museum Zoologicum Bogoriense, Indonesia (MZB) conducted a major survey of the Lesser Sundas and the Inner and Outer Banda Arcs between 1987 and 1993 (How et al., 1998). During these expeditions, in 1992, R. A. How, R. E. Johnstone, and D. J. Kitchener visited Kei Besar and collected 20 species of reptiles and amphibians comprising of twelve lizards (*Carlia beccarii*, *Cryptoblepharus keiensis*, *Cyrtodactylus sp.*, *Emoia atrocostata*, *E. reimschisseli*, *Gekko monarchus*, *Hemidactylus frenatus*, *H. platyurus*, *Lamprolepis smaragdina*, *Lygisaurus* cf. *novaeguineae*, *Tiliqua gigas*, and *Varanus* cf. *indicus*), six snakes (*Acanthophis laevis*, *Boiga irregularis*, *Dendrelaphis keiensis*, *Laticauda colubrina*, *Simalia amethistina*, and *Stegonotus cucullatus*), and two frogs (*Cornufer papuensis* and *Litoria infrafrenata*) (http://vertnet.org/). While, none of the species collected were novel records from the Kei Islands as a whole, these new collections spurred more comprehensive analyses of morphological variation among taxa in the Banda Arcs (e.g., How et al., 1996, 1998).

P. German and L. Tasker from the Australian Museum (AM) also made a brief visit to Kei Besar on 19–20 June 1993 and collected 11 species, comprising of eight lizards (*Carlia fusca*, *C. beccarii*, *Cryptoblepharus keiensis*, *Cyrtodactylus sp.*, *Gehyra mutilata*, *Emoia reimschisseli*, *Lamprolepis smaragdina*, and *Lygisaurus* cf. *novaeguineae*), two snakes (*Boiga irregularis* and *Stegonotus cucullatus*), and one frog (*Litoria infrafrenata*) (http://vertnet.org/).

J. A. McGuire made a small collection on Kei Kecil from 21–23 April 1998. He collected from the following sites: Ohoider, Ohoililir Beach, a site along the road about 5 km from Tual, and within the city of Tual itself. He collected 10 species, comprising *Carlia beccarii*, *Cryptoblepharus keiensis*, *Cyrtodactylus sp.*, *Emoia atrocostata*, *E. remischisseli*, *Gehyra* cf. *barea*, *Hemidactylus frenatus*, *H. platyurus*, *Lamprolepis smaragdina*, and *Lepidodactylus* sp., which are deposited in Texas Memorial Museum, The University of Texas at Austin, USA (TNHC).

DESCRIPTION OF ISLANDS SURVEYED

Kei Besar. (Figs. 2, 3) The largest of the Kei Island group, Kei Besar is a long and thin island that extends approximately 85 km north to south and only 3–10 km east to west. Just 7 km to the west are the large islands of Kei Kecil and Dulah. Kei Besar is the easternmost of the Kei Islands, and to its east are the Aru Islands, separated by 120 km of ocean and the Aru Trough reaching 3.6 km in depth (Jongsma et al., 1989). New Guinea lies 130 km to the north and Yamdena (Tanimbar) 180 km to the southwest.

Our survey of Kei Besar was brief, from 19–22 July 2014. The majority of effort was spent surveying Gunung Daab (ca. 800 m a.s.l.), approximately 10 km Northeast of Elat, the largest town on Kei Besar. The habitat near Elat is very disturbed and dominated by coconut palm (*Cocos nucifera*), with a smaller number of Areca palms (*Areca sp.*) and Banana (*Musa sp.*). The hills continuing up from Elat are

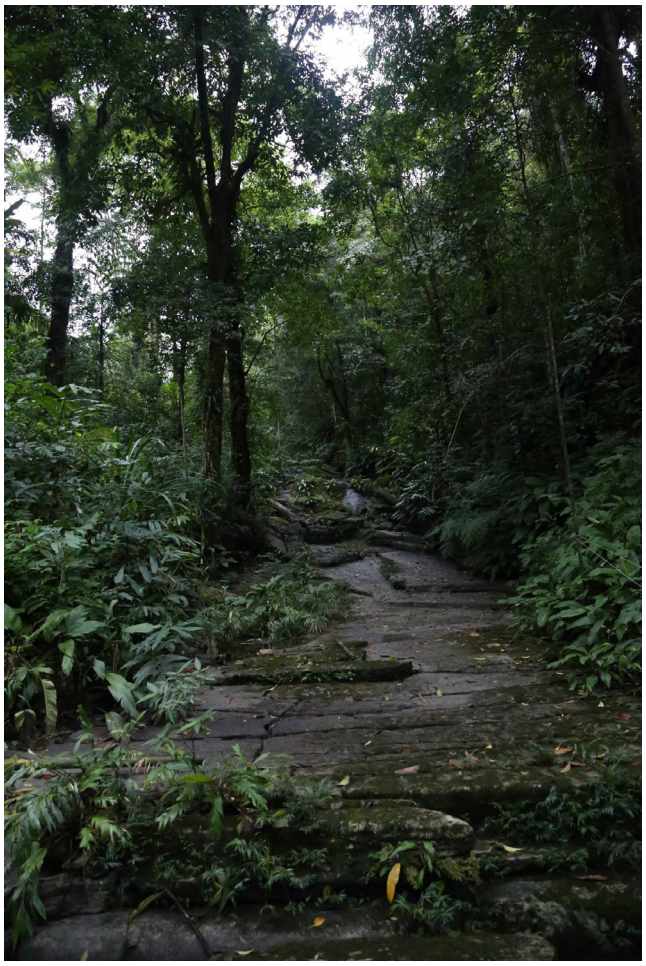

Fig. 2. A lowland stream on Kei Besar that descends from Gunung Daab.

almost exclusively covered in coconut palm (*C. nucifera*), and little or no original habitat appears to remain. Taller and less disturbed secondary forest was not observed until exiting the main road and hiking along trails leading into the mountains. The forest leading up Gunung Daab is tall secondary forest with a canopy reaching ca. 20 m, with few emergent trees reaching ca. 40 m. The trail to Gunung Daab is scattered with religious sites, which likely explains why the forest has not been logged. Upper slope forest on Gunung Daab was lush with a relatively dense underbrush and high canopy but little-to-no mid-canopy. The undergrowth is composed of short palms, scattered ferns, and metre-high broad-leaved plants. Creek beds of exposed stair-like layered rock provided useful pathways through the forest (see Fig. 3).

Kei Kecil. (Figs. 4, 5) Kei Kecil is the second largest island in the Kei Islands after Kei Besar, and extends approximately 40 km from north to south and 12 km from east to west. It is a low-lying limestone island that is generally covered in disturbed or second-growth forest. The population center and administrative offices for the Kei Islands are Tual/Langgur (Tual is on adjacent Dulah but connected by a short bridge to Langgur, which is on Kei Kecil proper). Correspondingly, the higher population density may have led to increased forest modification and agriculture on this island. We spent the most time on Kei Kecil, mainly at a field site at Ohoililir

Fig. 3. Stone creek bed on Gunung Daab on Kei Besar near the top of the peak.

Fig. 4. Photo of habitat on Kei Kecil near Ohoililir. This view is standing near the coast looking inland.

Fig. 5. View of Ohoililir beach and limestone rock outcroppings along the beach.

Beach, and cumulatively spent 43 days at this locality and on other parts of the island (16–18 September 2011, 3–18 October 2011, 14–19 July 2014, 22–24 July 2014, and 1–18 August 2014).

Tam. (Fig. 6) Tam is a small island located about 50 km west of Kei Kecil and is part of the Tayandu Island group (comprised of six major islands). Tam is the southernmost

Fig. 6. View from Sea of Tam Island, and the town of Tam Ngurhir.

of the Tayandu Islands, and is oval in shape, extending 6 km from north to south and 3 km from east to west. It is low-lying and reaches an elevation of approximately 120 m. Several small sandy beaches occur on the coastline, separated by rocky limestone intrusions into the water. The forests on Tam are generally primary, with some areas converted to gardens or plantation by local villages. In comparison to observations in 1971 by Schodde & Matthews (1977) who described the island as mostly covered in low, dense, primary forest, it seems that much more of the island has been affected by human disturbance including selective logging and gardens. In general, the trees on Tam are small in diameter, likely due to the thin soils overlying the limestone bedrock. The major villages on Tam are Ngurhir on the west coast, and a smaller village, Ohitoom, about 1 km to the south. We travelled to Tam by taking the weekly car ferry that travels from Tual to Tam to Tayandu, disembarking on Tam and returning to Tual the next day. Given the ferry limitations, our survey on Tam was brief (11–12 October 2011). In this time period we were able to hike east from Ngurhir through the center of the island to the eastern side, then walk around the northern coast of the island back to Ngurhir. The eastern side of the island appeared drier than the western side.

Kur. Kur is a small island located about 45 km northwest of Tam, and about 75 km from Kei Kecil. Similar in its ovular shape to Tam, Kur is 10 km long and 5 km wide. Kur has a distinct geologic history compared to the other island surveyed (see Introduction), and rises much more steeply out of the ocean up to approximately 425 m in elevation. The island habitats have been heavily impacted by cultivation of nutmeg and cloves over the last two centuries. In most surveyed areas, the forest is dominated by large nutmeg trees (*Myristica fragrans*). Alexander L. Stubbs (ALS) spent 13 days on Kur from 6–19 August 2014 conducting herpetological surveys.

MATERIAL AND METHODS

Collecting permits (0196/SIP/FRP/VI/2011) were approved and issued by the Indonesian Ministry of Research, Technology, and Higher Education (Kementerian Riset Teknologi Dan Pendidikan Tinggi) and sponsored by D. T. Iskandar at the Bandung Institute of Technology and E. Arida at Museum Zoologicum Bogoriense (MZB). All foreign researchers received KITAS work visas and other required permissions for travel and research in Indonesia. Export of specimens from Indonesia and import to the Museum of Vertebrate Zoology (MVZ) were approved through appropriate Indonesian administration and the United States Department of Fish and Wildlife.

All specimens collected were preserved in the field in 10% buffered formalin solution and later transferred to 70% ethanol and housed at either MVZ or MZB. Samples of liver tissue were collected for each specimen and preserved in RNA-later with duplicates stored at both the MVZ and MZB. Measurements were taken from preserved specimens using Mitutoyo digital calipers accurate to 0.1 mm. Specimens that have not yet been accessioned into MZB or MVZ are designated with the field codes for Benjamin R. Karin (BRK) and Alexander L. Stubbs (ALS).

Additional species lists for the collections of the Australian Museum (AM), the Western Australia Museum (WAM), the Australian National Wildlife Collection (ANWC), and the Zoological Museum of the University of Copenhagen (ZMUC) were downloaded from the VertNet collections database (http://www.vertnet.org/).

We conducted a survey of the islands over two separate 2011 and 2014 expeditions. We spent the following number of days surveying each of the following islands: Kei Kecil (43 days), Kei Besar (4), Tam (2), and Kur (13). Unless otherwise noted, the specimens collected from Kei Kecil are from the vicinity of Ohoililir Beach (–5.64733, 132.63896; WGS84). On Kei Besar, we collected largely in the vicinity of Gunung Daab with our camp located at (–5.6092, 133.0523). On Tam, we stayed at Desa Tam Ngurhir (–5.72950, 132.17279) and also sampled the opposing eastern side (–5.74776, 132.19798) and across the central region of the island (–5.74360, 132.19425). On Kur we sampled largely around Desa Sermaaf (–5.3346, 131.9726). Both Tam and Kur are so small that we were able to walk across and survey the entire island in less than a day, and we therefore do not designate multiple distinct localities on each island but rather try to give relevant ecological habitat details for the specimens collected.

RESULTS

We collected 33 species of reptiles and amphibians during our surveys of the Kei Islands. By combining our recent survey data with that of previous expeditions, and after accounting for 3 likely erroneous records (*Draco lineatus*, *D. ochropterus*, and *Hypsilurus dilophus*; see comments in species accounts), we infer a total fauna of 39 species of

Table 1. Inventory of species collected from the four islands we surveyed in the Kei Islands. The (+) sign denotes specimens collected by our team. Previous collections after 1970 are also listed, including the following expeditions (see text for details): the 1971 expedition to Tam (ANWC), the 1992 Western Australian Museum and Museum Zoologicum Bogoriense expedition to Kei Besar (WAM), the 1993 expedition by the Australian Museum to Kei Besar (AM), Jimmy A. McGuire in 2007 to Kei Kecil (JAM). Historical expeditions prior to 1970 that collected species from islands with no later records are listed (Pr), but not specifically referred to (see text for details). Species that have a type locality in the Kei Islands are also designated (Ty).

Group	Family	Species	Kei Kecil	Kei Besar	Tam	Kur
Lizards	Agamidae	*Lophognathus temporalis*	–	–	+, ANWC	+
	Gekkonidae	*Cyrtodactylus* sp.	+, JAM	+, AM, WAM	+	+
	Gekkonidae	*Gekko monarchus*	Pr	WAM	–	–
	Gekkonidae	*Gekko vittatus*	+	–	+	+
	Gekkonidae	*Gehyra* cf. *barea*	+, JAM	–	+	+
	Gekkonidae	*Gehyra mutilata*	+	AM	+	–
	Gekkonidae	*Hemidactylus frenatus*	+, JAM	WAM	+, ANWC	+
	Gekkonidae	*Hemidactylus platyurus*	+, JAM	WAM	+	+
	Gekkonidae	*Lepidodactylus lugubris*	–	–	–	+
	Gekkonidae	*Lepidodactylus pantai**	+	–	–	+
	Gekkonidae	*Lepidodactylus* cf. *novaeguineae*	+	–	–	–
	Gekkonidae	*Lepidodactylus* sp.*	–	–	–	+
	Gekkonidae	Nactus pelagicus	–	Pr	–	–
	Scincidae	*Carlia beccarii**	+, JAM	+, AM, WAM	+	–
	Scincidae	*Carlia fusca*	+	AM	ANWC	+
	Scincidae	*Cryptoblepharus keiensis**	+, JAM	AM, WAM	+, ANWC	+
	Scincidae	*Emoia atrocostata*	+, JAM	WAM	–	–
	Scincidae	*Emoia longicauda*	Pr	Pr	–	+
	Scincidae	*Emoia reimschisseli*	+, JAM	+, AM, WAM	–	+
	Scincidae	*Lamprolepis smaragdina*	+, JAM	AM, WAM	+	+
	Scincidae	*Lygisaurus* cf. *novaeguineae*	+	+, AM, WAM	+	+
	Scincidae	*Sphenomorphus capitolythos**	–	Pr,Ty	–	–
	Scincidae	*Sphenomorphus melanopogon*	Pr[1]	–	–	+
	Scincidae	*Sphenomorphus undulatus*	Pr	+	–	+
	Scincidae	*Tiliqua gigas*	+	+, WAM	–	–
	Varanidae	*Varanus* cf. *indicus*	+	WAM	–	–
Snakes	Colubridae	*Boiga irregularis*	+	AM, WAM	–	–
	Colubridae	*Dendrelaphis keiensis*	+	WAM	–	+
	Colubridae	*Stegonotus cucullatus*	+	AM, WAM	–	+
	Elapidae	*Acanthophis laevis*	+	+, WAM	–	–
	Elapidae	*Aipysurus laevis*	Pr[2]	Pr[2]	–	–
	Elapidae	*Laticauda colubrina*	+	WAM	–	+
	Pythonidae	Simalia amethistina	+	WAM	ANWC	+
	Typhlopidae	*Indotyphlops braminus*	–	–	+	+
	Typhlopidae	*Malayotyphlops kraalii*	–	Pr,Ty[3]	–	–
	Typhlopidae	*Ramphotyphlops multilineatus*		Pr	–	–
Frogs	Ceratobatrachidae	*Cornufer papuensis*	–	+, WAM	–	–
	Hylidae	*Litoria* cf. *bicolor*	+	–	–	–
	Hylidae	*Litoria infrafrenata*	+	AM, WAM	–	–

*Endemic (as presently described)

[1]Collection locality somewhat dubious (Shea, 2012; see text).

[2]Unknown locality.

[3]Collection localities not specified by Doria (1875) or Boulenger (1893), but type locality inferred from collections by Roux (1910) and in 1922 by H. C. Siebers on Kei Besar.

lizards, snakes, and frogs on the Kei Islands (see Table 1). In total, we resurveyed 29 species out of 35 that had previously been recorded. The remaining six species that have been previously recorded, but not seen by us, include a marine snake (*Aipysurus laevis*), two enigmatic fossorial blind snakes known from few specimens, (*Malayotyphlops kraalii* and *Rhamphotyphlops multilineatus*), a secretive endemic lizard (*Sphenomorphus capitolythos*), and a gecko known only from a single specimen in the Kei Islands (*Nactus pelagicus*). The sixth species we did not recollect is *Gekko monarchus*, but the species was recently collected by the WAM expedition to Kei Besar. Conversely, we encountered four species that have not previously been documented on the Kei Islands: *Lepidodactylus pantai* which was recently described from Kei Kecil and is also present on Kur (Stubbs et al., 2017), *L.* cf. *novaeguineae* on Kei Kecil, an undescribed *Lepidodactylus* from Kur, and *Litoria* cf. *bicolor* on Kei Kecil. The discovery of *L.* cf. *bicolor* brings the number of known amphibians on the Kei Islands from two (*L. infrafrenata* and *Cornufer papuensis*) to three. Scincids (12 species) and gekkotans (12 species) make up the majority of the species diversity on the Kei islands, comprising 24 of 39 species.

DISCUSSION

Biogeography. As far back as Wallace (1860), biogeographers have noted the striking difference in fauna between the Kei Islands and the adjacent Aru Islands. Here Lydekker's Line divides the islands by tracing the edge of the Sahul Shelf, which was often exposed during sea-level reductions in the Pleistocene (Lydekker 1896; de Beaufort, 1913). Wallace's Line (Wallace, 1860) represents a similar biogeographic boundary at the edge of the Sunda Shelf between Bali and Lombok and between Borneo and Sulawesi. As a result of the extensive discussion of this transition zone, Dickerson (1928) termed this intermediate region Wallacea, and though the boundaries have been adjusted (Mayr, 1944), the region between Wallace's Line and Lydekker's Line is still known by the same name and considered to have a unique, often endemic fauna that varies substantially across the region (Whitten et al., 1987; Lohman et al., 2011).

Because the islands of Wallacea are oceanic and have not been connected to either the Sunda or Sahul shelves, the Wallacean fauna within must have arrived via over-water dispersal. Historically, biogeographers have attempted to classify the fauna of a particular island as either 'Asian origin' or 'Australo-Papuan origin', referring to the continental shelf from which they initially dispersed to enter Wallacea (e.g., Pelseneer, 1904; Roux, 1910; Mayr, 1944). This pattern of dispersal from two opposite ends of the region has left a general west-to-east clinal pattern of community compositions on the various islands with respect to Asian and Australo-Papuan origin species, and as a result has been described as a 'two-way filter' (Carlquist, 1965, p. 52; Whittaker & Fernández-Palacios, 2007, p. 54). Weber's Line of faunal balance (Weber, 1902) attempts to split Wallacea in two based on an island's proportion of Asian or Australo-Papuan origin species, and runs between the Outer Arc Islands of Babar and Tanimbar, approximately 300 km southwest of the Kei Islands (Mayr, 1944). However, given the biogeographic patterns observed for Kei Islands herpetofauna as discussed below, we argue in agreement with Simpson (1977) that this paradigm of classifying a Wallacean species as Asian or Australo-Papuan oversimplifies the biogeography of the region.

The substantial historical interest specifically in the differences between the fauna of the Kei and Aru Islands (Doria, 1875; Roux, 1910; de Beaufort, 1913; Sternfeld, 1918) warrants a renewed discussion of the biogeographic affinities of this unique fauna. Together, by assessing distributional patterns from our new species inventory for reptiles and amphibians in the Kei Islands and by utilising results of molecular analyses to infer dispersal patterns within some lineages (e.g., Austin et al., 2011; Linkem et al., 2013), we can synthesise and understand the biogeography and unique fauna of the Kei Islands in greater detail.

As would be expected given the proximity of the Kei Islands to New Guinea, most species are derived directly from the Sahul Shelf as a source. Excluding seven species that are commonly dispersed by humans and marine snakes, 17 of 29 species on the Kei Islands are originally derived from the Sahul Shelf (see Table 2). Some of the clearest examples include *Gekko vittatus*, *Lepidodactylus* cf. *novaeguineae*, *Lygisaurus* cf. *novaeguineae*, *Sphenomorphus undulatus*, *Tiliqua gigas*, *Acanthophis laevis*, *Simalia amethistina*, *Cornufer papuensis*, *Litoria* cf. *bicolor*, and *L. infrafrenata*. In addition, 22 of 29 species on the Kei Islands (even those that may not have colonised the Kei Islands directly from New Guinea) are co-distributed on New Guinea (see Table 2). Three of the species not found on New Guinea are endemic to the Kei Islands and have a close relative on the Sahul Shelf (*Carlia beccarii*, *Cryptoblepharus keiensis*, and *S. capitolythos*). As western New Guinea has not been extensively surveyed, the remaining four species may still occur on New Guinea, including *Cyrtodactylus sp*., *Gehyra* cf. *barea*, *Lepidodactylus sp.*, and *Malayotyphlops kraalii*. These patterns indicate, as expected, the close association of the Kei Islands herpetofauna with New Guinea.

Unsurprisingly, there are only a few examples of taxa in the Kei Islands with clear Sundaic origins, and each case includes the caveat that the species may have colonised New Guinea before dispersing to the Kei Islands (see Table 2). This is not surprising as a species that is capable of dispersing to the Kei Islands should also be capable of dispersing to New Guinea. For example, several Asian derived lineages that exist on the Kei Islands are also widespread and present on New Guinea and Australia, including *Dendrelaphis keiensis* (as part of the *D. calligastra* complex) and *Boiga irregularis*. Two dispersal scenarios are possible and are difficult to distinguish: (1) that these lineages dispersed through Wallacea using the Kei Islands as a stepping-stone to New Guinea (MacArthur & Wilson, 1967); or (2) that they initially dispersed to New Guinea and back-colonised the Kei Islands later.

Table 2. Biogeography, habitat type, and distribution of species in the Kei Islands. We excluded seven species that are commonly dispersed by humans (*Gekko monarchus*, *Gehyra mutilata*, *Hemidactylus frenatus*, *H. platyurus*, *Lepidodactylus lugubris*, *Nactus pelagicus*, and *Indotyphlops braminus*) and two marine snakes (*Aipysurus laevis* and *Laticauda colubrina*). "Clear origin" refers to the ancestor of a species, not necessarily the species as presently named. Habitat occupancy is categorised as "marginal" (includes coastal, open, or heavily disturbed habitats) or "forest" (includes interior primary or secondary forested habitats). E=Endemic; M=Maluku; NT=Nusa Tenggara; Su=Sulawesi; S=Sunda Shelf; NG=New Guinea; A=Australia; SP=South Pacific.

Family	Species	Primarily Wallacean	Clear Sahul Origin	Clear Sunda Origin	Marginal / Forest	E	M	NT	Su	S	NG	A	SP
Agamidae	*Lophognathus temporalis*	–	×	–	M	–	×	–	–	–	×	×	–
Gekkonidae	*Cyrtodactylus* sp.	×	–	×	M+F	–	×	×	–	–		–	–
Gekkonidae	*Gekko vittatus*	–	×	–	M	–	×	–	–	–	×	×	–
Gekkonidae	*Gehyra* cf. *barea*	–	×	–	M					–			
Gekkonidae	*Lepidodactylus pantai*	–	–	–	M	–	–	–	–	–	×	–	×
Gekkonidae	*Lepidodactylus* cf. *novaeguineae*	–	×	–	M	–	–	–	–	–	×	–	–
Gekkonidae	*Lepidodactylus sp.*	–	–	–	M	×	–	–	–	–	–	–	–
Scincidae	*Carlia beccarii*	×	×	–	M+F	×	–	–	–	–	–	–	–
Scincidae	*Carlia fusca*	–	×	–	M	–	×	–	–		×	–	×
Scincidae	*Cryptoblepharus keiensis*	×	×	–	M+F	×	–	–	–	–	–	–	–
Scincidae	*Emoia atrocostata*	–	–	–	M	–	×	×	×	–	×	×	×
Scincidae	*Emoia longicauda*	–	×	–	M	–	–	–	–	–	×	×	–
Scincidae	*Emoia reimschisseli*	×	–	–	M	–	×	–	–	–	–	–	–
Scincidae	Lamprolepis smaragdina	×	–	×	M+F	–	×	×	×	–	×	–	×
Scincidae	*Lygisaurus* cf. *novaeguineae*	×	×	–	M+F	–	×	–	–	–	×	–	–
Scincidae	*Sphenomorphus capitolythos*	–	–	–	F	×	–	–	–	–	–	–	–
Scincidae	*Sphenomorphus melanopogon*	×	–	–	F	–	×	×	–	–	–	–	–
Scincidae	*Sphenomorphus undulatus*	–	×	–	F	–	–	–	–	–	×	–	–
Scincidae	*Tiliqua gigas*	–	×	–	M	–	×	–	–	–	×	–	–
Varanidae	*Varanus* cf. *indicus*	–	×	–	M+F	–	×	–	–	–	×	–	–
Colubridae	*Boiga irregularis*	–	–	×	M	–	×	×	×	×	×	×	×
Colubridae	*Dendrelaphis keiensis*	×	–	–	M	–	×	×	×	×	×	×	×
Colubridae	*Stegonotus cucullatus*	–	×	–	M+F	–	×	–	–	–	×	×	–
Elapidae	Acanthophis laevis	–	×	–	M	–	×	–	–	–	×	–	–
Pythonidae	*Simalia amethistina*	–	×	–	M+F	–	×	–	–	–	×	×	–
Typhlopidae	*Malayotyphlops kraalii*	×	–	–	?	–	×	–	–	–	–	–	–
Typhlopidae	*Ramphotyphlops multilineatus*	–	×	–	?	–	–	–	–	–	×	–	–
Ceratobatrachidae	*Cornufer papuensis*	–	×	–	M+F	–	×	–	–	–	×	–	–
Hylidae	*Litoria* cf. *bicolor*	–	×	–	M	–	–	–	–	–	×	×	–
Hylidae	*Litoria infrafrenata*	–	×	–	M	–	×	–	–	–	×	×	–

While it is very likely true that all Wallacean taxa or their ancestors originally dispersed from the Sunda Shelf or Sahul Shelf into the region, we are in agreement with Simpson (1977) that designating an island as either Asian or Australo-Papuan is difficult and sets up a false dichotomy, as specifying the appropriate taxonomic level to assess species origin is often complicated. For Asiatic fauna dispersing eastwards and arriving in New Guinea and radiating there, Simpson (1977) questions at which stage should they be considered no longer of Asian origin in the Australo-Papuan fauna. In the Kei Islands, it is difficult to assess the origin of *Sphenomorphus melanopogon* depending on the taxonomic scale used. At the genus level, the *Sphenomorphus* group is expected to have originated in Southeast Asia, but *S. melanopogon* is part of a nearly exclusively Australo-Papuan clade (Linkem et al., 2011). Further complicating the story, *S. melanopogon* is distributed throughout most of the Lesser Sundas and some islands in Maluku (including Kur; this study), but is also found on Palau Deli and Palau Tinjil (on the Sunda Shelf) off the southwest coast of Java (Shea, 2012). Therefore, depending on the evolutionary scale examined, *S. melanopogon* could be considered both Asian origin and Australo-Papuan origin, but we argue that we should simply classify *S. melanopogon* as a primarily Wallacean taxon. In other cases, in situ diversification has occurred within Wallacea, and members of the group later dispersed back to the Sunda or Sahul Shelves (e.g., Evans et al., 2003). For instance, *Lamprolepis smaragdina* has congeners on the Sunda Shelf (though absent there) indicating an initial western origin, but it diversified substantially in Wallacea and has subsequently crossed onto the Sahul Shelf (Papua) (Linkem et al., 2013). Molecular analysis show that it colonised the Kei Islands from northern Maluku and another clade separately colonised eastern New Guinea from Wallacea (Linkem et al., 2013). Therefore, *L. smaragdina* is of Asian origin based on its evolutionary history, and of Australo-papuan origin based on its present distribution, but we argue that it should be specified primarily as a Wallacean taxon based on the distribution of diversity.

In contrast to previous assessments of the Kei Islands, a substantial portion of the fauna is shared with other small islands in the South Pacific rather than with Wallacea alone. All of these taxa are similar in that they have high dispersal capability and can inhabit marginal, often coastal or early successional habitats such as savannah on small islands (see Table 2). For example, *Lepidodactylus lugubris* originated in the South Pacific or Philippines and colonised much of the South Pacific and Wallacea (Radtkey et al., 1995; Oliver et al., 2018); *L. pantai* has a close relative on Palau and is likely to be more widely distributed (Stubbs et al., 2017); *Nactus pelagicus* is present in much of the western Pacific as well as northern Australia and New Guinea (Zug & Moon, 1995); the *Carlia fusca* species complex likely originated on New Guinea but has dispersed widely in eastern Indonesia and other distant islands including Guam (Austin et al., 2011); the *Emoia cyanura* complex, which includes *E. reimschisseli,* is distributed across the Indo-Australian archipelago as well as small Pacific islands including Guam, New Caledonia, and Tahiti, and members of the complex are clear oceanic specialists (Brown, 1991); and the *Varanus indicus* complex reaches Guam and Micronesia (Uetz & Hošek, 2017). Thus, despite the proximity to New Guinea, the shared oceanic fauna on the Kei Islands suggests that small islands allow for unique faunal assemblages composed of species with high dispersal capability that can inhabit marginal habitats compared to larger landmasses. This pattern is particularly striking on Kur, where there are three species of *Lepidodactylus* geckos in coastal areas on the island. A striking majority of species of reptiles and amphibians on the Kei Islands inhabit marginal and/or disturbed habitats (see Table 2). These patterns suggest that small island size and comparatively depauperate fauna may allow for the persistence of highly-dispersing marginal taxa on small islands that if occurring on continental land-masses are marginalised to peripheral areas (Oliver et al., 2018).

Given the distributional patterns of fauna in the Kei Islands and throughout Wallacea as a whole, we argue that a taxon on an island should not be classified as specifically 'Asian' or 'Austalo-Papuan' as this framework has clear issues (explained above and in detail by Simpson, 1977), and instead we should focus on the differential characteristics that enabled different species to colonise the area in unique ways. We suggest that future biogeographic analyses of insular Wallacean fauna consider the organisms not as a transitional collection of species between two sources, but as a melting pot of animals with different dispersal capabilities and habitat specialisation. Overall, the herpetofauna of the Kei Islands shows that limited colonisation of oceanic islands can lead to a unique faunal assembly characterised by species with strong dispersal capability that are specialised for marginal habitats as compared to those on the continental shelves.

Conservation. Early explorers in the Kei Islands remarked at the exceptional and impressive quality of the forests there. For example, during Wallace's visit to Kei Besar in 1857, he wrote:

"The most trodden path from the beach led us into a shady hollow, where the trees were of immense height and the undergrowth scanty…It is everywhere covered with luxuriant forests, and in its bays and inlets the sand is of dazzling whiteness…Tall clean trunks, many of them buttressed, and immense trees of the fig family, with aerial roots stretching out and interlacing and matted together for fifty or a hundred feet above the ground, were the characteristic features" (Wallace, 1860).

The timber industry came to the Kei Islands in 1882 when a German national, Adolph Langen, was given permission to establish a timber export business and develop local agriculture in the Kei Islands (Thorburn, 2002). When Langen arrived, the forests were still mostly pristine, and Langen remarked:

"Every island belonging to the [Kei] group is covered, down to the water's edge, with dense tropical jungle, gigantic creepers winding themselves from one tree to another, thus forming a close network and great impediment to traveling.

These forests contain the choice kinds of timber [=ironwood], which formed one of the principal inducements for the establishment of the present German colony" (Langen, 1888, p. 765).

Soon after, by 1888, much of the forests of the Kei Islands had been clear-cut (Ellen, 1997). Today the Kei Islands seem to be mostly composed of secondary growth, disturbed forests, with garden and plantation areas limited in size relative to many other islands in Indonesia. The Kei Islands are covered with low-density human settlements that at their present size do not seem to have an extremely destructive impact on remaining secondary forest. However, even though primary forests are already depleted, logging companies may continue to exploit the remaining timber resources from the island in the future and large-scale agricultural conversion may also be a threat. Recently in the neighboring Aru Islands a large company was given permission to extract timber and build a 484,000 ha sugarcane plantation that would cover most of the island group (total land area on Aru is 629,000 ha) but was stopped after being met with harsh local opposition (Moran, 2014). There is no doubt this project would have severely negatively affected the biodiversity of the Aru Islands. Modern, large-scale logging and plantation operations could have a similarly detrimental impact on the biodiversity of the Kei Islands, and any plans to enact them should be closely monitored.

The most threatened species from pressure in the pet trade is the blue-tongue skink (*Tiliqua gigas*). Indonesian blue-tongue skinks are popular pets in Europe and America, and the Kei Islands subspecies (*T. g. keiensis*) is highly coveted. Indonesian blue-tongue skinks are not commonly bred in captivity, and therefore the majority of individuals in the pet trade have been collected from the wild, through either legal or illegal means. *Tiliqua gigas* is currently listed as a protected species in Indonesia (Iskandar & Erdelen, 2006). The population sizes and genetic diversity of *T. gigas* on the Kei Islands remain unknown, and therefore it is unknown if they can sustain the pressure from the pet trade. Nevertheless, we hope that pet traders will focus more on captive breeding of blue-tongue skinks in order to alleviate this pressure.

Two other species on the Kei Islands already have some protections. All monitor lizards (including *Varanus* cf. *indicus*) and pythons (including *Simalia amethistina*) are listed under CITES appendix II, prohibiting these species from international trade without special permits. *Varanus* cf. *indicus* shares further protections, along with *Tiliqua gigas*, under the Indonesian protected species list (Iskandar & Erdelen, 2006). Monitor lizards and pythons are often removed for the pet trade, the skin trade, or for food (Auliya et al., 2016). From our experience, monitor lizards were quite abundant on the Kei Islands, and on Kei Kecil in particular, and we therefore expect that these protections are adequate to sustain this population under current pressures. The amethystine python (*S. amethistina*) is a popular snake in the pet trade, but the CITES designation for this species has likely led traders to focus on captive bred individuals that can sustain the demand (though 80% of pythons exported from Indonesia claimed to be captive-bred may truly have been from the wild; (Lyons & Natusch, 2011). From our experience, we do not expect local consumption to be a major pressure on these species at this time, but international demand for python parts including skins and gall bladders has the potential to pose a threat.

The majority of lizards, snakes, and frogs on the Kei Islands seem to thrive even in disturbed or marginal habitats (see Table 2). Low-lying small islands have an increased susceptibility to damage from storms, and this may put a selective pressure against organisms that cannot respond well to disturbance. Anthropogenic disturbance may have a similar effect. Some species, however, are likely restricted to forested areas and may be threatened from human disturbance. For example, we did not collect the endemic lizard *Sphenomorphus capitolythos* and based on its morphology we expect that it may be restricted to leaf-litter in densely forested areas. In addition, nothing is known of the ecology of the blind snakes *Malayotyphlops kraalii* and *Ramphotyphlops multilineatus*, but they are candidates for species that may be more strongly affected by anthropogenic disturbance. Furthermore, the localised distribution and rarity of *Lepidodactylus*, including recently-described *L. pantai*, an undescribed species on Kur, and a single specimen of *L.* cf. *novaeguineae*, suggests these species may have undergone local extirpation and may be susceptible to forces of disturbance. *Nactus pelagicus undulatus* has not been resurveyed since the 1920s and may be rare or locally extinct.

The possibility of introduction of invasive species also poses a major threat to the Kei Islands fauna. On Christmas Island, four endemic lizards appear to have recently gone extinct in the wild (Andrew et al., 2018) likely due to predation by introduced wolf snakes, *Lycodon capucinus*, and mammals (Smith et al., 2012). This presents a sobering example of the potential impact of invasive species on small islands with endemic gecko and skink faunas. Wolf snakes also seem to have been a primary cause of skink and gecko extinctions in the Mauritius island group (Michaelides et al., 2015). The snake was recently reported from Maluku in Ambon, Seram, Buru, and most of the Lesser Sundas as far east as Babar (Kuch & McGuire, 2004) suggesting it could be introduced to the Kei Islands in the near future (Monk et al., 1997 listed L. capucinus occurring in the Kei Islands but this is likely an error). In addition, the Asian common toad, *Duttaphrynus melanostictus*, has been introduced by humans from the Sunda Shelf eastwards into the Indo-Australian archipelago, including to Bali, Sulawesi, Ambon, Seram, and New Guinea (Iskandar & Colijn, 2000; Wogan et al., 2016; Reilly et al., 2017), and even to Madagascar (Vences et al., 2017). Similar to the sometimes destructive impact of the cane toad, *Rhinella marina*, in Australia (Shine, 2010), invasion of the Asian common toad to the Kei Islands could have cascading ecological effects. For these reasons, introduction of these invasive species and others should be monitored in the Kei Islands.

Fig. 7. Photo in life of *Lophognathus temporalis* from Tam (BRK 177).

Fig. 8. Photo in life of *Cyrtodactylus* sp. from Tam (BRK 205).

SPECIES ACCOUNTS

Lizards
(28 species reported, 26 surveyed)

Family Agamidae

***Lophognathus temporalis* (Günther, 1867)**
(Fig. 7)

Type locality. Port Essington, Northern Territory, Australia.

Distribution in the Kei Islands. Known only from Tam and Kur. Apparently absent from both Kei Kecil and Kei Besar.

Natural history. These lizards were abundant in savannah habitat on both Kur and Tam. They seemed to prefer to bask on wide branches on trees, but were also observed on the ground. We never encountered them in dense, closed forest.

Field identification. A large semi-arboreal lizard with a black head and mottled brown to grey dorsum and with a distinct thick white dorsolateral stripe beginning at the tip of the snout and continuing to the hind limbs. This is the only agamid lizard known definitively from the Kei Islands. Adult males possess a conspicuous dorsal and nuchal crest while in females and juveniles it is much more indistinct. Dorsal scales are keeled and form longitudinal lines. Tail long, does not autotomise. SVL to 100 mm, tail to 300 mm or more.

Remarks. Melville et al. (2011) found that populations on Tanimbar and in northwestern Australia were genetically similar, though somewhat divergent, and together the species was found to be quite divergent from other taxa currently placed in this genus. Melville et al. (2011) recommended that that *L. temporalis* be transferred to a new genus, and Wilson & Swan (2013, p. 408) and Cogger (2014, p. 741) temporarily placed the species in *Gowidon* with *Gowidon longirostris*. We retain the generic name *Lophognathus* here pending future action. Our molecular analysis places the Tam population as most similar to the Tanimbar population (unpublished data), although we lacked samples from the geographically most proximate populations in New Guinea.

This large agamid was listed as present in the Kei Islands by Roux (1910). We found them in abundance on Tam and Kur, yet on our surveys of of Kei Kecil and Kei Besar we did not encounter this species and local people were unfamiliar with the species. While Roux and Merton's collections from the Kei Islands were extensive, they did not collect *Lophognathus temporalis* or another species *Sphenomorphus kühnei* [=*melanopogon*], but instead reported them based on specimens purchased from a natural history dealer, Hermann Rolle, in Berlin (Roux, 1910, Shea, 2012). Hermann Rolle received the specimens from a collector (Mr. Kühne) living in Tual on Kei Kecil, but who also made expeditions to surrounding islands such as Damar and Babar where both *L. temporalis* and *S. melanopogon* are present (Shea, 2012). We collected *S. melanopogon* on Kur and *L. temporalis* on both Tam and Kur less than 50 km west of Kei Kecil (the ANWC expedition to Tam in 1971 also collected *L. temporalis*), so it is possible that the specimens could have been collected from these small islands rather than Kei Kecil itself. Interviews with local people on Kei Kecil and Kei Besar suggest it is not present. The local people on Tam call this lizard "sringat" in their local language and it co-occurs with *Varanus* there. On Kur this lizard is often referred to as a "soa soa" which is the generic name for a large lizard in Bahasa Ambon (this is the term used for *Hydrosaurus* on Sulawesi) and can refer to either *Varanus* or large Agamid species in Maluku.

Family Gekkonidae

***Cyrtodactylus* sp.**
(Figs. 8, 9)

Distribution in the Kei Islands. All islands. We collected a species of *Cyrtodactylus* from Kei Kecil, Tam, and Kur, of which the latter two represent new records for these islands. The AM and WAM expeditions collected an unidentified species of *Cyrtodactylus* from Kei Besar that we expect to be the same species.

Fig. 9. Dorsal and ventral views of *Cyrtodactylus* sp. collected from Kei Besar (ALS 767; ALS 771).

Natural history. This small-bodied *Cyrtodactylus* is abundant on Kei Kecil and Kei Besar and is common at night on limestone outcroppings within relatively dense forest. They can sometimes be found on the trunks of trees, though less often.

Field identification. *Cyrtodactylus* sp. and *Nactus pelagicus* are the only geckos on the Kei Islands that lack dilated scansors on the digits. *Cyrtodactylus* sp. is easily distinguished by its uniformly-distributed keeled tubercles across the body, as opposed to being arranged in distinct rows in *Nactus*. We examined 11 females and 9 males collected from Kei Kecil in 2011. Head and eyes large; forehead concave; limbs and digits elongate; postorbital stripe extending posteriorly from the orbit to above the ear opening; body colour inconsistent among samples, usually speckled or uniform dark, sometimes pale with small dark spots; posterior half of tail banded. SVL to 80 mm.

Remarks. Roux (1910) was the first to report a *Cyrtodactylus* from the Kei Islands and referred the specimens to *C. marmoratus* and subsequent collections have maintained this identification without further investigation. Confusion over the type of *C. marmoratus* associated with a type series from multiple clades on Java was clarified by Mecke et al. (2016). *Cyrtodactylus* across Indonesia are very diverse with many undescribed species (Wood et al., 2012) and the population in the Kei Islands is likely undescribed.

Gekko monarchus (Schlegel, 1836)

Type locality. Ambon, Indonesia.

Distribution in the Kei Islands. We found no *Gekko monarchus* on the Kei Islands, though it was previously reported present by Roux (1910) and de Rooij (1915). The WAM expedition collected *G. monarchus* from Kei Besar, and Roux (1910) collected it from Kei Dulah.

Natural history. This is a common human commensal across Southeast Asia. Found at night on human structures with dim lighting, feeding on insects and other geckos.

Field identification. This species is distinguished from *Gekko vittatus* populations in Maluku by its more mottled colouration and lack of a white dorsal stripe bifurcating at the neck. Dorsal colouration mottled grey to tan. All digits possess a claw, have little to no webbing, are slightly dilated, and possess undivided scansors. Tail cylindrical, sometimes with dark bands especially pronounced in juveniles. Across its range, males possess a series of 32–40 femoral pores, SVL to 95 mm, tail to 110 mm (de Rooij, 1915, p. 54–55).

Gekko vittatus Houttuyn, 1782
(Fig. 10)

Type locality. Unknown.

Distribution in the Kei Islands. All islands. We collected *Gekko vittatus* on Kei Kecil, Tam, and Kur, and Roux (1910) collected this species on Kei Besar.

Natural history. This species was quite common on all surveyed islands around human settlements and could easily be found on outdoor wooden structures with dim lighting at night.

Field identification. *Gekko vittatus* is one of the largest geckos found in the Kei Islands. It is easily identified by the prominent white dorsal stripe that bifurcates along the back of the head, forming a "Y" shape along the dorsum, though this colour pattern can vary with light conditions. All digits possess a claw, have slight webbing, and are moderately dilated with enlarged scansors. Tail slender, subcylindrical, sometimes with alternating whitish and black bands that are especially pronounced in juveniles. Males with a series of 25–29 femoral pores, SVL to 128 mm (Boulenger, 1885a, p. 185–186).

Fig. 10. Photo in life of *Gekko vittatus* from Tam (BRK 209).

Fig. 11. Photo in life of *Gehyra mutilata* from Kei Kecil (ALS 387)

***Gehyra* cf. *barea* Kopstein, 1926**

Type locality. Teun and Serua Islands, Maluku.

Distribution in the Kei Islands. All islands. We collected several specimens of this species from Kei Kecil, Tam, and Kur, and Roux (1910) collected it on Kei Besar.

Natural history. This species is found commonly on limestone rocks at night and also can be found on human-made structures and human-impacted garden areas (known as "kebun" in Bahasa Indonesia).

Field identification. All species of *Gehyra* lack a claw on their innermost digit. *Gehyra* cf. *barea* is the largest of two species of *Gehyra* (SVL to 100 mm) in the Kei Islands and possesses grey skin that sits very loosely on the body and can easily slough off when handled. Ventral side and tail on Kei individuals are often cream or yellow in colour. Large fold of skin present along the sides of the throat, body and hindlimbs. Digits half webbed, innermost digit clawless.

Remarks. Here, we place previous records for *Gehyra oceanica* (Lesson, 1830) and *G. marginata* Boulenger, 1887 together as *Gehyra* cf. *barea*, though it is possible that both are present in the Kei Islands. The species we collected is clearly part of the larger *G. barea – G. baliola* complex due to the presence of a notched rostral, widely separated nasals and partially-divided scansors (Oliver et al., 2010).

***Gehyra mutilata* (Wiegmann, 1834)**
(Fig. 11)

Type locality. Manila, Philippines.

Distribution in the Kei Islands. We collected *Gehyra mutilata* on Kei Kecil and Tam, and the AM expedition collected this species on Kei Besar. No specimens were found on Kur, however it may be present on these islands as well, since *G. mutilata* is known to be a human commensal.

Natural history. A widespread human commensal, found in and around wooden homes as well as in forest, particularly in association with limestone rock formations near water.

Field identification. Superficially similar to *Gehyra* cf. *barea*, but distinguished by smaller maximum body size and divided subdigital lamellae. Pale grey to dark brown dorsum with dark brown flecks and pale spots. Tail depressed with a lateral fringe on each side. Third and fourth toes with some basal webbing, less webbed than *G.* cf. *barea*. Pads of fingers and toes widely dilated with divided scansors. Innermost digit clawless. Skin folds less pronounced compared to *G.* cf. *barea*, sometimes with a narrow fold along the body and usually along the posterior of the hindlimb. SVL to 55 mm (Cogger, 2014, p. 362).

***Hemidactylus frenatus* Schlegel, 1836**

Type locality. Java, Indonesia.

Distribution in the Kei Islands. We collected this species on Kei Kecil and Tam, and the WAM expedition collected it on Kei Besar. We observed this species on Kur, though we did not collect specimens.

Natural history. *Hemidactylus frenatus*, a common human commensal, has probably been dispersed by humans to most inhabited islands in Indonesia. It commonly emerges in and around houses at night to feed on small insects attracted to the lighting. They were occasionally found in natural habitat on Kur.

Field identification. A common house gecko most easily identified by possessing unwebbed digits with 7–10 scansors and body and tail lacking distinct lateral fringes compared to *Hemidactylus platyurus*. Claws are present on all digits. Pale to dark grey or brown above, sometimes with dark flecks. Whitish below. Tail moderately long, depressed with spines. Males with 20–40 femoral pores, SVL to 60 mm (Cogger, 2014, p. 368).

***Hemidactylus platyurus* (Schneider, 1797)**

Type locality. Unknown.

Distribution in the Kei Islands. We collected *Hemidactylus platyurus* on Kei Kecil and Tam, and the WAM expedition

collected five specimens from Kei Besar. We observed this species on Kur, though we did not collect specimens.

Natural history. This species is common at night indoors and outdoors around human habitations.

Field identification. A common house gecko identified by possessing half-webbed digits with 7–9 scansors, and body and tail with distinct fringes. Pale grey to dark grey above, sometimes with a dark postocular stripe. Tail flattened, with distinct fringe.

***Lepidodactylus pantai* Stubbs, Karin, Arifin, Iskandar, Arida, Reilly, Bloch, Kusnadi & McGuire, 2017**—New Record
(Figs. 12, 13)

Type locality. Desa Ohoililir, Kei Kecil.

Distribution in the Kei Islands. Known only from Kei Kecil and Kur Island.

Natural history. This species was found at night on rocks along the intertidal zone on Kei Kecil and Kur. It is apparently restricted to the area immediately around the high tide line and seems to be associated with limestone rocks. We found it on low-energy beaches and also in mangroves associated with limestone outcrops on Kur.

Field identification. A moderate-sized bisexual species of *Lepidodactylus*, SVL 36.9–40.5 (mean = 38.3) mm for five adult males and 32.0–40.5 (mean = 37.4) for five adult females. Pale grey to brown in colour, dorsum often with thick dark diagonal marks that nearly join in center. Distinguished from other species of *Lepidodactylus* by the following combination of characters: 113 rows of scales around the mid-body; subdigital scansors 10–12 on toe IV, and 7–9 on toe I; terminal scansor is divided on digits II through V on both the fingers and toes; 3 scansors on 4th toe divided or deeply notched; interdigital webbing small, less than 1/5th the 4th toe length; 18–24 pores in precloacal and femoral regions of male. Tail nearly cylindrical without lateral serrations (Stubbs et al., 2017).

Fig. 12. Photo in life of *Lepidodactylus pantai* from Kei Kecil.

Remarks. We expect that *Lepidodactylus pantai* may also occur on Kei Besar and Tam though we were unable to survey suitable habitats on those islands. ALS has observed morphologically-similar individuals in Raja Ampat, Indonesia and genetic results (Stubbs et al., 2017) show *Lepidodactylus* associated with intertidal habitats are part of a closely related clade that ranges to French Polynesia.

***Lepidodactylus lugubris* (Duméril & Bibron, 1836)**

Type locality. Tahiti.

Distribution in the Kei Islands. This species was reported present on the Kei Islands by Roux (1910), who surveyed Kei Besar. We only collected this species on Kur.

Natural history. This parthenogenic species is widely distributed across the Indo-Australian archipelago and Oceania, and is often found in houses as well as in forests.

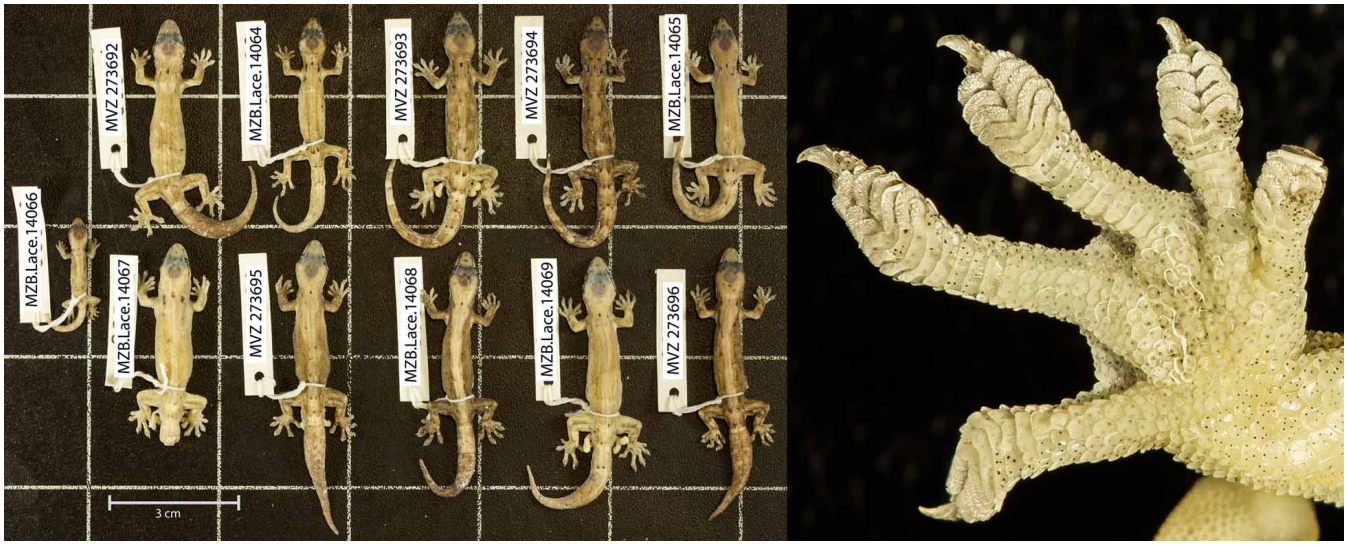

Fig. 13. The type series of *Lepidodactylus pantai* from Kei Kecil, with close-up of right hindfoot of MZB.Lace.14069 (from Stubbs et al., 2017).

Fig. 14. Dorsal, ventral, and close-up left hindfoot of single specimen of *Lepidodactylus* cf. *novaeguineae* from Kei Kecil (MZB.Lace.14063).

Field identification. *Lepidodactylus lugubris* possesses a depressed tail with lateral serrations, and divided terminal scansors on toes II–V followed by two to three divided scansors. Digits slightly webbed. Colour light pinkish-grey to brown, often with several pairs or dark dorsal spots. SVL to 45 mm, tail to 51 mm (de Rooij, 1915, p. 49–50).

***Lepidodactylus* cf. *novaeguineae* Brown & Parker, 1977**
— New Record
(Fig. 14)

Type locality. Lake Sentani, Papua, Indonesia.

Distribution in the Kei Islands. So far, only known from a single specimen on Kei Kecil.

Natural history. We collected a single specimen from a small twig approximately 2 m off the ground and 20 m inland from the high tide in secondary-growth forest on Kei Kecil.

Field identification. The single specimen collected from the Kei Kecil has undivided terminal scansors followed by two divided terminal scansors, placing it in Group II of Brown & Parker (1977). Colour pale grey, with seven pairs of small brown spots along dorsum.

Remarks. The specimen is very similar to *Lepidodactylus novaeguineae sensu stricto* in all morphological features assessed, so we include *L. novaeguineae*'s measurements in parenthesis for comparison: 37.4 mm snout-vent length (vs. 36.7–41.0 mm), 14 lamellae under toe IV (vs. 11–14), 7 lamellae under toe I (vs. 8–11), 17 preanal pores (vs. 12–18), 2 divided scansors on the 4th toe (vs. 1–3). However, genetically it is quite distinct, as it shows substantial divergence (18.7% raw pairwise distance in ND2) from putative *L. novaeguineae* from Papua New Guinea (Stubbs et al., 2017). This specimen may therefore represent a distinct species.

***Lepidodactylus* sp.** — New Record
(Fig. 15)

Distribution in the Kei Islands. Known only from Kur.

Natural history. This species is abundant on Kur Island just above the high tide line associated with trees growing near the beach. We never encountered this species on rocky substrates, a marked difference with *L. pantai.* High population densities were observed, often with five or more lizards visible on a single large tree approximately 1-metre diameter at breast height. One specimen was collected approximately 500 metres inland, also on a tree buttress root at night, suggesting that this species may also be present inland.

Field identification. This species has much shorter limbs than other species of *Lepidodactylus* currently known from the Kei Islands. It also has much more pronounced skin folds along the body and limbs, and distinctly webbed digits.

Remarks. We expect that these specimens represent an undescribed species of *Lepidodactylus*. It matches Group II in having an undivided terminal scansor followed by three divided scansors on toe IV (Brown & Parker, 1977). It is also genetically divergent from *L.* cf. *novaeguineae* on Kei Kecil (unpublished data).

***Nactus pelagicus undulatus* (Kopstein, 1926)**
(Fig. 16)

Type locality. Elat, Kei Besar (Kopstein, 1926).

Distribution in the Kei Islands. We did not collect this species on any of our surveys, but Kopstein (1926) reported it from Elat, Kei Besar.

Natural history. As this subspecies is known only from a single specimen on Kei Besar, little is known regarding its natural history. Across its range it is terrestrial and commonly found foraging on the forest floor at night (Cogger, 2014, p. 376).

Fig. 15. Dorsal colouration of variation of the undescribed *Lepidodactylus* sp. population from Kur, and close up view of the left hindfoot (ALS 879).

Fig. 16. Photo of Leiden Naturalis Biodiversity Center specimen of the subspecies holotype of *Nactus pelagicus undulatus* collected by Kopstein in 1923 (RMNH. RENA.5095).

Field identification. *Cyrtodactylus* and *Nactus* are the only gecko genera present in the Kei islands that lack dilated toepads. The holotype of *N. pelagicus undulatus* shows distinct rows of tubercles along the back, which is in contrast to the relatively disorganised tubercle arrangement on *Cyrtodactylus* on Kei. In addition, *Cyrtodactylus* from the Kei islands possesses a ventrolateral fold whereas *Nactus* normally does not. We present a photo of Kopstein's original specimen that was provided by Naturalis Biodiversity Center, Leiden (Fig. 16). The holotype possesses 10 precloacal pores, 12 rows of tubercles on the back, and a pattern consisting of wavy V-shaped cross-bands. The holotype also lacks the enlarged postmental scales typical of *Cyrtodactylus* (Bauer & Henle, 1994).

Remarks. *Nactus pelagicus* is usually composed of unisexual parthenogenetic female populations on Pacific Islands, though many bisexual populations do exist including several on New Guinea (Zug & Moon, 1995). There are many undescribed species of *Nactus* remaining (Zug & Moon, 1995), and thus the subspecies *undulatus* may warrant recognition as a full species upon further examination.

Family Scincidae

***Carlia fusca* (Duméril & Bibron, 1839)**
(Fig. 17)

Type locality. Waigeo, Indonesia.

Distribution in the Kei Islands. We collected this species from Kei Kecil, Kei Besar, and Kur. We observed this species on Tam, though we were unable to collect a specimen.

Natural history. *Carlia fusca* is abundant in heavily disturbed areas where direct sunlight penetrates to the ground. We often encountered them on and around recently fallen trees in cleared areas. They are often active in leaf litter terrestrially and rarely climb. They are much more abundant in open, highly disturbed habitat than *C. beccarii* on islands where the two co-occur but appear to be displaced by *C. beccarii* in more closed, pristine habitat.

Field identification. *Carlia* and *Lygisaurus* are the only skinks with four fingers on the Kei Islands. *Lygisaurus* is comparatively smaller and more gracile, with reduced leg length in proportion to the body. *Carlia fusca* on Kei is a uniform brown colouration in life, sometimes with two dark dorsolateral stripes along the body, while *C. beccarii* is much more patterned with black sides and a much more robust, stocky body. SVL 46–59 mm, 30–36 mid-body scale rows, 26–35 fourth toe subdigital lamellae (Zug, 2004).

Remarks. Zug (2004) referred to the Kei Islands *Carlia fusca* group lizards as "Kai unicolor" and did not wish to taxonomically assign this population without further sampling. Our morphological and molecular analysis (unpublished data) place this population within what is referred to as *C. ailanpalai* (Zug, 2004) by Austin et al. (2011) and the populations from Kei are closely related to Clades B and C of their study that have colonised Papua New Guinea, Guam, Palau, New Britain, and New Ireland, likely through human-mediated dispersal. Our genetic results also show very little genetic differentiation in this clade of

Fig. 17. A photo of a *Carlia fusca* from Palau Ai (Banda Islands). No photo was available for the Kei Islands population, but it is similar in morphology.

Fig. 18. Photo in life of *Carlia beccarii* from Tam (BRK 185).

lizards and we choose to use the name *C. fusca* to maintain stability.

***Carlia beccarii* (Peters & Doria, 1878)**
(Figs. 18, 19)

Type locality. Tual, Kei Islands, Indonesia.

Distribution in the Kei Islands. Endemic to the Kei Islands. We collected large series of *Carlia beccarii* from Kei Kecil, Kei Besar, and Tam, all of which clearly match the original species description of Peters & Doria (1878). This species was not found on our expedition to Kur Island, and we suggest that it may not be present there.

Natural history. Individuals are commonly encountered amongst the leaf litter in disturbed and primary forest.

Field identification. *Carlia beccarii* is a robust lizard with four digits on the forelimbs and dark black patterned sides and silver/gold spots of colour along the dorsal surface in life. In comparison, *Carlia fusca* is of more gracile build and is a uniform brown with two dorsolateral stripes in some individuals. SVL 60–80 mm, 36–41 mid-body scale rows, 30–34 fourth toe subdigital lamellae (Zug, 2004).

***Cryptoblepharus keiensis* (Roux, 1910)**
(Fig. 20)

Type locality. Elat, Kei Besar, Kei Islands, Indonesia.

Distribution in the Kei Islands. The type locality at Elat, Kei Besar was sampled extensively by the AM and WAM expeditions. We collected additional material for *Cryptoblepharus keiensis* from Kei Kecil, Tam and Kur.

Fig. 19. Comparison of dorsal colour pattern of *Carlia beccarii* from the Kei Islands (left three; ALS 111, ALS 384, ALS 410) and from Tam (right three; BRK 180, BRK 182, BRK 184).

Fig. 20. Photo in life of *Cryptoblepharus keiensis* from Kei Kecil (ALS 520).

Natural history. This species was common in disturbed and secondary forest and found on the trunks of medium to large trees. We often found it active in the morning on Kei Kecil, slowly climbing coconut palms.

Field identification. A small arboreal skink with five tan to yellow longitudinal stripes separated by six black stripes running from the head to the base of the tail. On the tail, the stripe dissolves into a series of black spots. Some individuals have a nearly white head. *Cryptoblepharus* are known as "snake-eyed skinks" as they lack moveable eyelids. Mid-body scale rows 22–24 (Roux, 1910). SVL to 43 mm.

***Emoia atrocostata* (Lesson, 1830)**
(Fig. 21)

Type locality. Qualan Island, Caroline Islands.

Distribution in the Kei Islands. Doria (1875) was the first to report this species from the Kei Islands. We collected this species on Kei Kecil, and the WAM expedition collected additional specimens on Kei Besar. We did not collect any specimens from Tam or Kur though we expect this species may be present there as it occurs on many islands in Maluku.

Natural history. This species is diurnally active and very common on beachside rocks in the Kei Islands. Throughout its range it is also found in lowland forests, coastal scrubs, grasslands, and mangroves (Cogger, 2014, p. 550).

Field identification. A medium-sized skink with a brown to greyish-brown dorsum with pale spots and dark flecks; a broad rough-edged dark brown to black dorsolateral stripe from behind eyes to base of tail; Mid-body scale rows 32–42; 32–42 smooth fourth toe subdigital lamellae; SVL to 100 mm (Cogger, 2014, p. 550).

***Emoia longicauda* (Macleay, 1877)**

Type locality. Darnley Island, Torres Strait, Queensland, Australia.

Fig. 21. Photo in life of *Emoia atrocostata* from Kei Kecil (ALS 392).

Distribution in the Kei Islands. Roux (1910) reported this species from the Kei Islands, though it is unclear if this refers to Kei Kecil or Kei Besar. We collected one specimen of *E. longicauda* from Kur from a coconut grove, and it is possible that it is also present on the other islands as well.

Natural history. The one specimen we observed of this species was approximately 4 m above ground on the trunk of a coconut tree in a large coconut grove on Kur Island. We have also observed this species in secondary forest or coconut groves on the nearby Banda and Aru Islands. It is known to be arboreal through the rest of its range, and able to easily jump between branches (Wilson & Swan, 2013, p. 264).

Field identification. This species is one of two large, mostly green arboreal skinks in the Kei Islands. It is distinguished from *Lamprolepis smaragdina*, by its more gracile build, longer tail and present (though reduced) supranasals. *Emoia longicauda* has a greenish-bronze dorsum with small, dark flecks on individual scales. Ventral surface bright green. 24–26 mid-body scale rows; 55–70 fourth toe subdigital lamellae, basal most smooth; SVL to 80 mm (Cogger, 2014, p. 551).

Remarks. *E. cyanogaster keiensis* Sternfeld, 1918, a subspecies of *Emoia* from the *E. cyanogaster* species complex, was described from the Kei Islands, though the subspecies was later synonymised by Brown (1991) with *E. longicauda* (Shea & Michels, 2008). Brown (1991) noted that while the specimens he examined from the Kei and Aru Islands were more similar to *E. longicauda* than to *E. cyanogaster*, it would require further material to resolve the status of the subspecies, and we agree with this assessment.

***Emoia reimschisseli* Tanner, 1950**

Type locality. Morotai, Indonesia.

Distribution in the Kei Islands. We collected a large series of *Emoia reimschisseli* from Kei Kecil, and also collected this species on Kei Besar and Kur.

Natural history. This species was extremely common in the leaf litter and among rotting logs of secondary growth forest in rocky soil.

Field identification. A small to medium sized skink with three narrow, yellow longitudinal stripes on a blackish dorsum. Tail bright blue in juveniles, white to dirty white in adults. *Emoia reimschisseli* shows nearly identical morphology to *E. caeruleocauda* and *E. cyanura* with which Kei Islands specimens have been formerly been referred to. They are distinguished only by the number of subdigital lamellae and in some populations by the number of mid-body scale rows (though mid-body scale rows often do not differ) (Brown, 1991; How et al., 1998). 29–35 mid-body scale rows (rarely more than 30); 32–39 rounded lamellae under the fourth toe; SVL 39–57 mm (Brown, 1991).

Remarks. Originally reported as *Emoia cyanura* (Doria, 1875; Roux, 1910; de Rooij, 1915), the WAM expedition to Kei Besar reported a subsequently described yellow-lined *Emoia*, *E. reimschisseli* (How et al., 1998). *Emoia reimschisseli* was described from Morotai and Halmahera (Tanner, 1950), and also inhabits the Aru Islands and a single specimen was collected from Selaru in the Tanimbar group that is morphologically divergent and may represent a distinct species (How et al., 1998).

Lamprolepis smaragdina (Lesson, 1826)
(Fig. 22)

Type locality. Ebon Atoll, Marshall Islands.

Distribution in the Kei Islands. Kei Kecil, Kei Besar, Tam, and Kur. We collected this species on all islands we surveyed, except Kei Besar, though the AM and WAM expeditions collected several specimens there.

Natural history. This arboreal species was very common and encountered on exposed trees bathed in sunlight in disturbed and plantation forest. This species is also abundant in local coconut plantations.

Field identification. Medium-large robust arboreal skink; anterior half of body emerald green; posterior half brown; snout long and pointed; body and limbs strong; digits slender; 20–26 mid-body scale rows; 28–35 smooth fourth toe subdigitial lamellae; SVL to 103 mm; tail to 156 mm (de Rooij, 1915, p. 199–200).

Remarks. *Lamprolepis smaragdina* has colonised most of Wallacea without anthropogenic assistance (Linkem et al., 2013). It shows deep mitochondrial genetic differentiation across regions of Wallacea, with the Kei Islands population part of a larger Maluku clade (Linkem et al., 2013) that can be attributed to the subspecies *L. s. moluccarum* (Barbour, 1911).

Fig. 22. Photo in life of *Lamprolepis smaragdina* from Kei Kecil.

Lygisaurus cf. *novaeguineae* (Meyer, 1874)
(Figs. 23, 24)

Type locality. Islands of the Torres Strait, Australia.

Distribution in the Kei Islands. We collected *Lygisaurus* on all islands surveyed, including Kei Kecil, Kei Besar, Tam, and Kur.

Natural history. This *Lygisaurus* species is extremely abundant in the leaf litter of shaded forest throughout the Kei Islands.

Field identification. *Lygisaurus* and *Carlia* are the only genera of lizards known from the Kei islands that have only four front toes. *Lygisaurus* is differentiated from the two species of *Carlia* present in the area by having much shorter leg length (adpressed fore and hind limbs do not contact), a smaller maximum size (SVL less than 40 mm) and generally a more fossorial build. In life, breeding male *Lygisaurus* can appear bright red while females vary from a uniform brown/black colouration to black with a golden bar across the back and tail.

Remarks. Originally reported from the Kei Islands as *Lygosoma* [=*Lygisaurus*] *novaeguineae* Meyer, 1874 (Roux, 1910), the population on the Kei Islands is genetically distinctive from New Guinea samples and may represent a new species (Stubbs et al., in prep).

Fig. 23. Two different colour morphs of *Lygisaurus* cf. *novaeguineae* from Kei Kecil, showing gold morph (left; ALS 513) and a male in red breeding colouration (right; ALS 538).

Fig. 24. Variation in dorsal colour pattern in *Lygisaurus* cf. *novaeguineae* from Kei Kecil after preservation in alcohol. Upper row shows uniform dorsal colour, and bottom row displays faint dorso-lateral stripe.

Fig. 25. Photo of holotype of *Sphenomorphus capitolythos* from the Naturalis Biodiversity Center collected by Kopstein in 1923 (RMNH.RENA.5088).

***Sphenomorphus capitolythos* Shea & Michels, 2008**
(Fig. 25)

Type locality. Elat, Kei Besar, Indonesia.

Distribution in the Kei Islands. This enigmatic, endemic species is only known from Kei Besar by specimens collected independently by Roux (1910) and Kopstein (1926). We did not collect any specimens of this species on our expeditions.

Natural history. Unknown, likely to be a semi-fossorial leaf-litter inhabitant based on body form.

Field identification. A medium-sized skink, SVL to 81 mm, with short limbs that are widely separated when adpressed. Kopstein (1926) described the colouration of the recently preserved specimen as follows: brown with irregularly arranged dark flecks, half a scale in size; the sides of the neck with faded grey reticulations; the lateral surfaces lighter brown; venter uniform yellowish (Shea & Michels, 2008). According to Shea & Michels (2008), "the combination of grooved subdigital lamellae, a scaly lower eyelid lacking a central window, four supraoculars, third pair of chin shields medially separated by three scales but in lateral contact with the infralabials, no postsupraocular scale, and temporal region with no fragmentation or division of the last two supralabial scales, single primary temporal scale or upper and lower secondary temporal scales, and with the upper secondary temporal overlapping the lower secondary temporal, will differentiate this species from all other members of the *Sphenomorphus* group of lygosomine skinks (Greer, 1979) in Indonesia, the New Guinea region, and Australia."

Remarks. Kopstein (1926) originally described a new species from the Kei Islands, *Lygosoma keiensis*, however, the name was later found to be unavailable as it was already reserved as a junior synonym of *Emoia cyanogaster* [=*Lygosoma cyanogaster keiensis* Sternfeld, 1918] (Shea & Michels, 2008). Given this, Shea & Michels (2008) designated a replacement name for the species, *Sphenomorphus capitolythos*. Roux (1910) previously reported collections that he assigned to a morphologically similar species, *Lygosoma* [=*Sphenomorphus*] *muelleri*, from Kei Besar that closely matches the description of *S. capitolythos*. Given the morphological similarity, we consider this early record of *S. muelleri* as the initial discovery of *S. capitolythos* though we have not examined the specimens.

***Sphenomorphus melanopogon* (Duméril & Bibron, 1839)**
(Fig. 26)

Type locality. Timor.

Distribution in the Kei Islands. Roux reported this species on Kei Kecil, and we collected it only on Kur.

Natural history. This species was abundant in suitable habitat, and typically favored large tree buttress roots in closed forest. They were particularly common in the old nutmeg and clove trees on Kur. *Sphenomorphus melanopogon* ranges across southern Maluku and the lesser Sunda islands (Shea, 2012) but the closest population to Kur is likely the Banda Islands if it is indeed absent from Kei Kecil (see remarks).

Field identification. *Sphenomorphus melanopogon* is most readily identified by the presence of a black throat that usually occurs in both males and females. Males usually have black throats and venters, while females may possess only a black throat or no darkened throat at all (Shea, 2012). Finely striated dorsal scales; imbricate scales on the dorsal surface of the pes extending onto the plantar surface between the fourth and fifth digits; three or more supraoculars contacting the frontal; 40–42 mid-body scale rows (36–47 in other populations); 30 smoothly rounded fourth toe subdigital lamellae (26–34 in other populations); SVL to 66 mm in males (Shea, 2012).

Remarks. This species was originally described as *Lygosoma kühnei* [=*Sphenomorphus kuehnei*] by Roux (1910), but Shea (2012) later placed *S. kuehnei* as a junior synonym of *S. melanopogon*. Roux's specimens, in addition to *Lophognathus temporalis*, were not collected by Roux himself, but purchased from a natural history dealer, Herman Rolle, that received the specimens from collector Herrn Kühne (Roux, 1910; Shea, 2012). Shea (2012) believed the true locality for the *S. kuehnei* types to be Damar or Babar, as Kühne was known to travel there, and since *L. temporalis* is known from there. However, given that we have recently surveyed *L. temporalis* from Tam and Kur, it is plausible that one of these islands may represent the true locality for both species collected by Kühne and purchased by Roux. Furthermore, Tam and Kur have often been called part of the Kei Islands, and therefore it is possible that Kühne listed specimens from Tam and Kur as from the Kei Islands when he shipped them abroad. Therefore, if the population on Kur is found to constitute a separate species from *S. melanopogon,* the name *kuehnei* could be considered available. It is also possible that this is the only island in the Kei Islands where *S. melanopogon* occurs.

Fig. 26. Dorsal and ventral colouration of *Sphenomorphus melanopogon* from Kur (ALS 874; ALS 875; ALS 877). Males (center) show distinct black throat and ventral colouration, while females (left and right) show unpatterned venters.

Fig. 27. Specimens of *Sphenomorphus undulatus* collected from Kei Besar (ALS 785; ALS 787) and from Kur (ALS 1007). Males (leftmost) do not show different colour pattern to females (right two).

***Sphenomorphus undulatus* (Peters & Doria, 1878)**
(Fig. 27)

Type locality. New Guinea.

Distribution in the Kei Islands. We found this species on Kei Besar and Kur, and Roux (1910) reported it from Kei Kecil.

Natural history. These lizards were collected on Kur by flipping pieces of wood found on the forest floor, and on Kei they were captured using sticky traps placed along rocks and pieces of wood. We caught specimens in sticky traps early in the morning, suggesting it is active at this time. However, nothing more is known about the natural history of this species.

Field identification. A small to medium sized *Sphenomorphus*; elongate in shape with small, well-developed limbs; pale brown with brown spots or crossbands and a dorsolateral series of dark spots; seven supralabials; prefrontals separated; 24–34 mid-body scale rows; 17–23 keeled fourth toe subdigital lamellae; SVL 35–66 mm (Greer & Shea, 2004).

Remarks. The specimens we collected key out to *Sphenomorphus undulatus* using the key provided by Greer & Shea (2004), and this is concordant with Roux's (1910) attribution to this species presence on the Kei Islands. Kopstein (1926) listed *Lygosoma* [=*Sphenomorphus*] *aruanus* Roux, 1910 as present on the Kei islands, though we believe this was in error, and likely refers to *S. undulatus*. Roux's description of the holotype of *L. aruanus* differs from *S. undulatus* by having fewer 4th toe lamellae and supralabials: 16 lamellae and seven supralabials (Roux, 1910) as opposed to 17–23 lamellae and 8 supralabials (Greer & Shea, 2004), respectively. All specimens sampled on Kei Besar are more similar to *S. undulatus* in this respect. We collected no specimens of *S. undulatus* on Kei Kecil and consider *S. aruanus* as described by Roux (1910) to be restricted to Aru.

***Tiliqua gigas keiensis* Oudemans, 1894**
(Fig. 28)

Type locality. Kei Islands.

Distribution in the Kei Islands. This subspecies is endemic to the Kei Islands. We collected specimens of *T. gigas* on both Kei Kecil and Kei Besar. We did not collect it on Tam and Kur, though it is possible it occurs there as well.

Natural history. A ground-dwelling active forager in grass and other open habitats though we collected one specimen that was attempting to cross a stream over a log in closed canopy forest at Gunung Daab.

Field identification. *Tiliqua gigas* is by far the largest skink in the Kei Islands (SVL to 297 mm), with a robust body shape, short legs, seven to nine dark brown crossbands that are black spotted, and a distinct blue tongue that it will display in defense. The subspecies *T. gigas keiensis* differs from other populations of *T. gigas* in having a greater number of mid-body scale rows (31–34 vs. 28–32); shorter forelimbs (forelimb length less than or equal to head length vs. forelimb length greater than head length; forelimb length 1/3–1/4 vs. 2/5 the axilla-groin distance), and more anterior temporal scales (usually four vs. three) (de Rooij, 1915, p. 157–158).

Fig. 28. Photo in life of *Tiliqua gigas* from Kei Kecil (ALS 465).

Family Varanidae

***Varanus* cf. *indicus* (Daudin, 1802)**
(Fig. 29)

Type locality. Ambon, Indonesia.

Distribution in the Kei Islands. We collected *Varanus* cf. *indicus* on Kei Kecil and additional specimens have been collected by the WAM expedition to Kei Besar. Though we did not collect *Varanus* on Tam, we did observe a large monitor lizard there, and therefore expect it to occur there. Interestingly, this lizard appears to be absent from Kur Island although local people claim it is abundant on nearby Kaimer island (just to the north or Kur).

Natural history. *Varanus* occupy a broad range of habitats from aquatic to arboreal. On Kei Kecil, we encountered *Varanus* primarily on small trees in disturbed forest.

Field identification. This is the only monitor lizard known from the Kei islands.

Remarks. Previously reported as *Varanus indicus* (Doria, 1875; Roux, 1910; de Rooij, 1915) or *V. finschi* (Ziegler et al., 2007) in the literature, this population is morphologically similar to other *Varanus* samples we collected on Aru, Seram, and Gorom though it differs in colour pattern, having much more pronounced yellow to gold ocelli.

Fig. 29. Photo in life of *Varanus* cf. in*dicus* from Kei Kecil (ALS 100).

Snakes
(10 species reported, 7 species surveyed)

Family Colubridae

***Boiga irregularis* (Bechstein, 1802)**

Type locality. Unknown.

Distribution in the Kei Islands. We collected a single specimen of *B. irregularis* on Kei Kecil. The AM, WAM and ZMUC expeditions have collected a total of seven specimens of *B. irregularis* from Kei Besar.

Natural history. A mildly venomous, rear-fanged snake. The single specimen we collected was found crossing the road during the day. In Australia, it is usually arboreal or rock inhabiting, but is also often found in the rafters of buildings (Wilson & Swan, 2013, p. 470).

Field identification. *Boiga irregularis* is a long and slender (average length 1.4 m), weakly venomous rear-fanged colubrid with large, catlike eyes with vertical pupils, a bulbous head that is distinct from a narrow neck, 19–23 mid-body scale rows, 225–265 ventrals, 85–130 divided subcaudals, and a single anal scale (Wilson & Swan, 2013, p. 470; Cogger, 2014, p. 835). Colouration in the Kei Islands matches the eastern Australian form; pale to rich brown above, with narrow, irregular, dark bands, and belly orange to pink (Wilson & Swan, 2013, p. 470)

***Dendrelaphis keiensis* (Mertens, 1926)**
(Fig. 30)

Type locality. Dulah, Kei Islands, Indonesia.

Distribution in the Kei Islands. This species is endemic to the Kei Islands. We collected three specimens of this species on Kei Kecil and a single specimen from Kur. The WAM expedition collected two specimens on Kei Besar.

Natural history. This fast-moving colubrid was found active during the day darting around the base of medium to large trees in plantation forest.

Field identification. An extremely slender, non-venomous, small to medium sized tree snake (mean SVL 75.5 cm). van Rooijen et al. (2015) elevated *D. keiensis* to full species from specimens from Babar and the Kei Islands, re-describing the species from the holotype and two additional specimens as follows: venter white; no temporal stripe; 8–10 supralabials; 211–213 ventrals; 142 subcaudals; relative tail length 0.29–0.30; total length to 135.5 cm (van Rooijen et al., 2015).

Remarks. *Dendrelaphis keiensis* definitively occurs on Babar, Tanimbar and the Kei Islands (van Rooijen et al., 2015). There also exists a morphologically similar population on Ambon that may also represent this species (How et al., 1996).

***Stegonotus cucullatus* (Duméril, Bibron & Duméril, 1854)**
(Fig. 31)

Type locality. Dore, Yapen Island, Indonesia.

Distribution in the Kei Islands. We collected single specimens of *Stegonotus cucullatus* from Kei Kecil and Kur. The AM expedition collected a single unidentified specimen of *Stegonotus* from Kei Besar that we presume is *S. cucullatus*. Given this distribution, it is likely to also occur on Tam and other small islands.

Fig. 30. Photo of dorsum and venter and head scales of specimen of *Dendrelaphis keiensis* from Kei Kecil (ALS 495).

Fig. 31. Photo in life of *Stegonotus keiensis* from Kei Kecil (ALS 525).

Fig. 32. Close-up in life of head of *Acanthophis laevis* from Kei Kecil (ALS 150).

Natural history. On Kei Kecil, the single specimen was found at night climbing a tree buttress about 1 m off the ground near Ohoililir beach. On Kur, the single specimen was collected in a garden area near the village. Known in Australia to be an able tree-climber, though also often found on the ground, around human habitations, or in freshwater areas feeding on lizards, frogs, or warm-blooded prey (Wilson & Swan, 2013, p. 472).

Field identification. A robust, medium-sized (total length to 1.3 m) non-venomous snake. Colour uniform brown to dark-grey or black above, belly white or cream, sometimes with black flecks and blotches. Scales smooth; 17 (sometimes 19) midbody scale rows; 170–225 ventrals; 65–105 divided subcaudals (Cogger, 2014, p. 840).

Remarks. Boulenger (1893, p. 365) synonymised *Stegonotus keyensis* Doria, 1875 as a junior synonym of *S. cucullatus*. This name is therefore available if the Kei Islands population is ever recovered as a distinct species.

Family Elapidae

Acanthophis laevis Macleay, 1877
(Fig. 32)

Type locality. New Guinea.

Distribution in the Kei Islands. We collected a single specimen on Kei Kecil and two specimens on Kei Besar. The WAM expedition collected six specimens from Kei Besar, and ZMUC holds five additional specimens from Kei Kecil. Local people are familiar with this lethal snake and report that it is not present on either Tam or Kur.

Natural history. Venomous and dangerous. On Kei Besar, we collected this species at two locations in the vicinity of Gunung Daab, one on the ground in a small forest window of bunchgrass within primary forest, and the other was found dead on the road near the trailhead. On Kei Kecil this species was found in disturbed forest habitat.

Field identification. A small to medium brown snake with a viper-like flat, broad, triangular head, distinctly raised horn-like supraoculars, and a relatively short and thin tail with a terminal spine (de Lang, 2013).

Aipysurus laevis Lacépède, 1804

Type locality. Locker Island, near Onslow, Western Australia.

Distribution in the Kei Islands. Reported by Boulenger (1896, p. 305), this marine species is likely widely distributed throughout the Banda Sea. We did not collect any specimens ourselves.

Natural history. Venomous. Viviparous marine snake.

Field identification. A uniformly brown sea snake with a distinctly compressed, paddle-like tail. Scales smooth; 21–25 mid-body scale rows; 137–162 ventrals; SVL to 1550 mm; tail to 170 mm (de Rooij, 1917, p. 220).

Laticauda colubrina (Schneider, 1799)
(Fig. 33)

Type locality. Unknown.

Distribution in the Kei Islands. Presumably found on all of the Kei Islands, as it is a marine snake. We collected four specimens from Ohoililir Beach on Kei Kecil. The WAM expedition collected a single specimen on Kei Besar.

Natural history. Venomous. This marine species is partly-terrestrial and may be seen on beaches or beachside rocks at night when it comes ashore to lay eggs, sleep, and drink water. They are usually seen foraging around reefs during the day within a few hundred metres of shore. We encountered multiple sea snakes out of the water along the rocks at the northern section of Ohoililir beach at night and ALS has observed this species foraging in the reefs off Kei Kecil and Kur.

Fig. 33. *Laticauda colubrina* was collected on the beach as it came to shore at night on Kei Kecil.

Field identification. This species has 20–65 distinctly striped black crossbands on a blue-grey (more dorsally) to white (laterally) body; a black head with yellow snout and lips; a compressed paddle-like tail; scales smooth; 21–25 mid-body scale rows; 210–250 ventrals; 25–35 (females) or 36–50 (males) divided subcaudals; SVL to 1.4 m (mean 1 m) (Cogger, 2014, p. 970)

Remarks. de Rooij (1917, p. 218) reported this species as the only known snake on Kur island (with no mention of the collector), however we obtained specimens representing several other snake species.

Family Pythonidae

***Simalia amethistina* (Schneider, 1801)**

Type locality. Unknown.

Distribution in the Kei Islands. This large python has been collected on all islands surveyed (Kei Kecil, Kei Besar, Tam, and Kur).

Natural history. We collected one road-killed specimen on Kei Kecil in the vicinity of Desa Lumadia (–5.743864, 132.689819). We collected two specimens on Kur, both of which were found during the day in narrow rocky limestone crevices.

Field identification. *Simalia amethistina* is the only python on the Kei Islands, and can be easily identified by a distinct series of labial pit organs. Colour olive-yellow to brown, iridescent, with brown or black, irregular and broken transverse bands, sometimes encircling the body. Scales smooth; 35–50 mid-body scale rows; 270–340 ventrals; 80–120 subcaudals, mostly divided; mean SVL 3.5 m (Cogger, 2014, p. 824).

Fig. 34. Photo in life of *Indotyphlops braminus*, collected on the surface of a sandy road at night on Tam (BRK 213).

Family Typhlopidae

***Indotyphlops braminus* (Daudin, 1803)**
(Fig. 34)

Type locality. Visakhapatnam, India.

Distribution in the Kei Islands. We collected single specimens on Tam and Kur. This parthenogenic species is commonly transported by humans, and may exist invasively in most tropical regions as it easily establishes populations where introduced.

Natural history. On Tam, we found this species at night in crawling in the middle of a dirt road through the town (Desa Tam Ngurhir). On Kur, we found a single specimen under a log in a nutmeg tree woodland. de Rooij (1917) reported this species present on the Kei Islands (presumably Kei Kecil or Kei Besar) though we did not observe it there.

Field identification. A small, threadlike, blackish to brown blind snake with indistinct eyes. Preocular in contact with the second and third labials; nasal cleft proceeding from the preocular; diameter of body 35–55 times the total length; 20 mid-body scale rows; SVL to 175 mm (Boulenger, 1893, p. 16).

Remarks. A common human commensal, it is likely that this is an invasive species in the Kei Islands.

***Malayotyphlops kraalii* (Doria, 1875)**

Type locality. Kei Islands, Indonesia.

Distribution in the Kei Islands. This species was described based on a single specimen from an unknown locality in the Kei Islands (Doria, 1875) and later collected by Captain Langen (again from an unknown locality) and reported by Boulenger (1893, p. 30). We did not find any specimens during our survey. It is also known from Seram (McDowell, 1974).

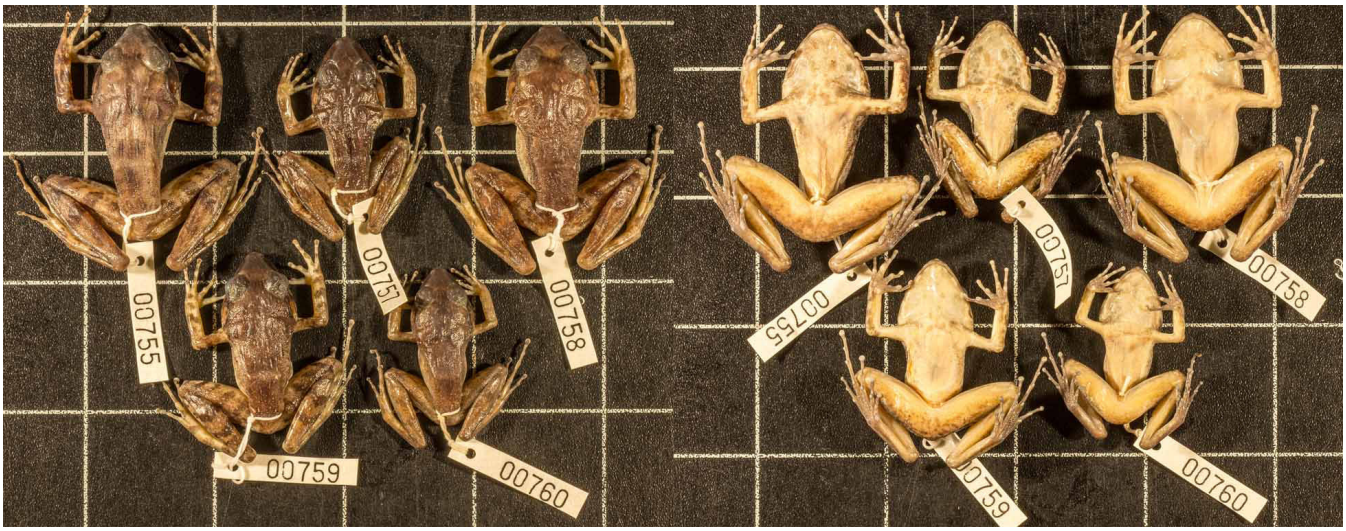

Fig. 35. Specimens of *Cornufer papuensis* from Kei Besar (ALS 755; ALS 757–60).

Natural history. A small, presumably fossorial blind snake.

Field identification. Differentiated from other blind snakes in the Kei Islands by possessing a preocular that is in contact with the third labial only. Boulenger (1893, p. 30) described specimens of this species as follows: "Snout rounded, projecting; nostrils lateral; rostral about one third the width of the head, not extending to the level of the eyes; nostril between two nasals, the anterior in contact with the first and second labials; preocular present, as broad as the ocular, in contact with the third labial only; eyes distinct; head-scales feebly enlarged; four upper labials; diameter of body [1/40 to 1/42] of the total length; tail as long as broad, ending in a spine; 24 to 26 scales round the body; blackish-brown; lower surface of head and middle of belly yellowish; total length 170 mm."

***Ramphotyphlops multilineatus* (Schlegel, 1839)**

Type locality. New Guinea.

Distribution in the Kei Islands. Originally described from New Guinea, three specimens were reported from Elat, Kei Besar by Roux (1910) and later reported by Boulenger (1893, p. 50). We did not collect any specimens during our survey.

Natural history. A larger, presumably fossorial blind snake.

Field identification. Another small blind snake from the Kei Islands, differentiated from *Malayotyphlops kraalii* by possessing a preocular in contact with the second and third labials. According to specimens examined by Boulenger (1893, p. 50), "snout very prominent, with sharp cutting edge and inferior nostrils; rostral very large, extending to between the eyes, the portion visible from below as broad as long; nasal nearly completely divided, the cleft proceeding from the first labial; preocular present, nearly as broad as the ocular, in contact with the second and third labials; eyes distinct; prefrontal, supraoculars, and parietals much broader than the scales on the body; four upper labials; diameter of body [1/50 to 1/60] of the total length; tail nearly twice as long as broad, ending in a spine; 20 scales round the body; greyish, with dark brown longitudinal lines corresponding with the series of scales; total length 370 mm."

Frogs
(3 species reported, 3 species surveyed)

Family Ceratobatrachidae

***Cornufer papuensis* (Meyer, 1874)**
(Fig. 35)

Type locality. "Mysore" [= Biak Island], Indonesia.

Distribution in the Kei Islands. Our expedition and the WAM expedition found this species only on Kei Besar.

Natural history. *Cornufer papuensis* was found largely associated with stream systems on Kei Besar near Gunung Daab. Like all Ceratobatrachids, it lays eggs in damp areas that develop directly into froglets, forgoing the larval life-stage entirely (Menzies, 1976). These frogs were abundant on the stream bank of the creek (Fig. 3) coming off the west side of Gunung Daab at night, much as *Limnonectes* fanged frogs are in Sulawesi and the rest of Indonesia.

Field identification. This is the only amphibian known from the Kei islands with long digits on the hindfoot with no more than a slight trace of webbing. First finger longer than second; SVL to 46 mm (males) and 64 mm (females) (Zweifel et al., 1969). Colour patchy grey-brown to black, with small skin folds.

Family Hylidae

***Litoria* cf. *bicolor* (Gray, 1842)** — New Record
(Fig. 36)

Type locality. Port Essington, Northern Territory, Australia.

Fig. 36. Dorsum and venter of three specimens of *Litoria* cf. *bicolor* collected from Kei Kecil (ALS 128–130). Photo of colouration of one specimen just after death (ALS 130).

Distribution in the Kei Islands. We collected three specimens of this species from Kei Kecil, representing a new record for the Kei Islands.

Natural history. Found around axils or on leaves of small vegetation.

Field identification. Best differentiated from *Litoria infrafrenata* by lacking a thick white lip. Colour uniform green above, with a brown stripe along the side of the snout that proceeds through the eye and the tympanum and dissipating posteriorly along the sides of the body; groin and ventral surface of thighs yellow; distinctly enlarged toe discs; fingers with slight webbing; toes three-quarter webbed; SVL 22–29 mm (n=3).

Remarks. The collection of *Litoria* cf. *bicolor* represent a new record for the island group, and raises the number of frog species from two to three. This may well represent a new species in the *L.* cf. *bicolor* group.

***Litoria infrafrenata* (Günther, 1867)**
(Fig. 37)

Type locality. Cape York Peninsula, Queensland, Australia.

Distribution in the Kei Islands. This species has only been found on Kei Kecil and Kei Besar.

Natural history. A common nocturnal inhabitant where observed, *Litoria infrafrenata* was often found on large leaves and small branches in trees in disturbed forest and plantations. It was especially common in banana plantations and on other large broad-leaf plants. Large numbers of *L. infrafrenata* would come down from the canopy and call on some nights we stayed on Kei Kecil yet on other nights frogs were largely inactive despite seemingly (to us) identical weather conditions. This activity pattern (or lack thereof) seems to be common for this species and other *Litoria* species we have observed in other areas of Maluku.

Field identification. Compared to *Litoria* cf. *bicolor*, *L. infrafrenata* is much larger in size and has a distinct white lip; colour uniform bright green, sometimes changing to brown; possesses a bright, white stripe along the lower lip that extends below the tympanum to near the base of the forelimb;

Fig. 37. Photo in life of *Litoria infrafrenata* from Kei Kecil.

another white stripe along the margin of the hindlimb from the fourth and fifth toes to the heel; second finger longer than first; finger and toe discs distinctly enlarged; fingers half webbed; toes nearly fully webbed; SVL to 45–90 on Kei Kecil (n=16).

QUESTIONABLE OR ERRONEOUS PRIOR RECORDS

Draco ochropterus Werner, 1910 and *D. lineatus* Daudin, 1802

We found no evidence for the occurrence of any *Draco* on the islands we surveyed. We asked many local people if flying lizards were present, but no one provided any indication that they were present. Indeed, many people responded by saying they knew of the species but only had seen them on Seram or Ambon. McGuire et al. (2007) also noted that, during a limited survey in 1998, he did not find flying lizards on the Kei Islands. The male specimens of *D. ochropterus* were destroyed during WWII (McGuire et al., 2007) and the remaining female specimens could not be distinguished from *D. lineatus* from Ambon, Seram, or Buru, so the species was considered a junior synonym of *D. lineatus* by McGuire et al. (2007). Roux (1910) also exhibited skepticism over the report of *Draco* by Werner (1910). Roux and Merton spent a total of 5 months surveying in the Kei Islands without finding *Draco*, and we spent a total of approximately 1.5 months without finding them as well. Given this evidence, we believe the record of *D. ochropterus* from the Kei Islands

is incorrect and that specimens from elsewhere in Maluku may have been erroneously attributed to the Kei Islands. We therefore concur with McGuire et al. (2007) that *D. ochropterus* is a junior synonym of *D. lineatus*.

Hypsilurus dilophus (Duméril & Bibron, 1837)

We did not collect specimens nor find any evidence of the presence of this large and conspicuous agamid on any of the islands surveyed. de Rooij (1915, p. 109) listed this species as present, though it is possible she incorrectly interpreted Roux's (1910) remark that the Aru Islands had three species of *Gonocephalus* [=*Hypsilurus*] including *Hypsilurus dilophus* while the Kei Islands had only the Agamid *Physignathus* [=*Lophognathus*] *temporalis*. Since we too found no presence of *Hypsilurus* on the Kei Islands, and no other record exists, we consider it unlikely that this species is present on the Kei Islands.

Chrysopelea rhodopleuron Boie, 1827

This snake was listed as present on Kei Kecil by de Lang (2013) based on a misidentification from our group along with an examination of a slide photo from an earlier expedition. We have since concluded that this species is not present on Kur and the photo represented an individual of *Dendrelaphis keiensis.*

Key to the Lizards of the Kei Islands

1. Small to large body size (adult SVL less than 300 mm); scales granular, smooth, or keeled; tongue short, unforked 2
– Very large body size, adult SVL to 530 mm or larger; scales beadlike; tongue long, deeply forked; dorsum with small yellow spots ..... *Varanus* cf. *indicus*
2. Forehead with granules or small scales; body scales matte and granular 3
– Forehead with large symmetrical shields; body scales glossy and overlapping 14
3. Teeth pleurodont; body depressed; dorsal crest absent 4
– Teeth acrodont; body compressed laterally; dorsal crest present; black head with thick white stripe below eye extending to dorsum ..... *Lophognathus temporalis*
4. Digits slender without widened scansors 5
– Digits with widened scansors 6
5. Dorsal tubercles not in rows ..... *Cyrtodactylus sp.*
– Dorsal tubercles arranged in rows ..... *Nactus pelagicus*
6. Terminal phalanges rising from within dilated portion of digit 7
– Terminal phalanges united with dilated portion of digit to its distal end and extending beyond 10
7. Digits broadly dilated distally; scansors narrow, on toe IV covering approximately distal half; terminal scansors distinctly wedge-shaped; inner digit clawless; skin often sloughs off when touched 8
– Digits uniformly dilated; scansors wide; on toe IV covering more than distal half; terminal scansors oval or squarish; inner digit clawed; skin does not usually slough off when touched 9
8. Digital lamellae divided by a median groove; SVL to 98 mm ..... *Gehyra mutilata*
– Digital lamellae undivided or partially divided; SVL to 100 mm ..... *Gehyra* cf. *barea*
9. Body with narrow lateral fringe; tail flattened with lateral serrations; digits with prominent webs ..... *Hemidactylus platyurus*
– Body without narrow lateral fringe; tail circular with tubercles arranged in transverse rings; digits without webs or only at base between toes III and IV ..... *Hemidactylus frenatus*
10. Scansor entire; distal ones with relatively straight, exposed margin or with shallow notch; adult SVL greater than 50 mm 11
– Exposed margin of scansor variably notched or divided; SVL less than 50 mm 12
11. No white dorsal stripe; granules on the throat equal in size; dorsum with pronounced, pointed tubercles; diameter of ear-opening one third that of the orbit; adult SVL to 95 mm ..... *Gekko monarchus*
– Prominent white dorsal stripe splits at neck towards eyes; granules on the throat heterogenous; dorsum without pronounced pointed tubercles; diameter of ear-opening half that of the orbit; small head; adult SVL to 130 mm ..... *Gekko vittatus*
12. Terminal scansors divided 13
– Terminal scansors undivided 14
13. Dorsum with paired spots; webbing between toe III and IV reaches one third to half of length of digit IV ..... *Lepidodactylus* cf. *novaeguineae*
– Dorsum with indistinct mottled colouration; webbing between toe III and IV reaches less than one quarter of length of digit IV ..... *Lepidodactylus* sp.
14. Depressed tail with lateral serrations *Lepidodactylus lugubris*
– Cylindrical tail without lateral serrations ..... *Lepidodactylus pantai*
15. Four digits on forelimbs 16
– Five digits on forelimbs 18
16. Keeled body scales; adult SVL greater than 40 mm; monomorphic 17
– Striate body scales; small gracile body, with SVL to 35 mm; dorsal colouration variable, often gold, red, or brown ..... *Lygisaurus novaeguineae*
17. Adult SVL from 60–80 mm; adult lateral colouration consisting of broad dark band from head to groin, intensely dark from ear through anterior trunk and brightly flecked with white above and below; juveniles lack dorsolateral or midlateral light stripes . *Carlia beccarii*
– Adult SVL from 44–55 mm; adult dorsal and lateral colouration unpatterned brown, sometimes retaining remnant of dorsolateral white stripe on side of head and neck; juveniles and some adults possess dorsolateral or midlateral light stripes..... *Carlia fusca*
18. Supranasals absent 19
– Supranasals present but may be reduced 23
19. Tongue large and blue; large head; large in body size, adult SVL to 312 mm ..... *Tiliqua gigas*
– Tongue not blue; small to medium body size head 20
20. Ear-opening depressed; striped or solid brown to black in colour; terrestrial 21
– Ear-opening superficial; anterior body emerald green in colour; arboreal ..... *Lamprolepis smaragdina*
21. Prefrontals not in contact 22
– Prefrontals in contact medially ..... *Sphenomorphus undulatus*
22. Limbs widely separated when adpressed; four supraoculars, two in contact with frontal; grooved subdigital lamellae; no distinct black throat ..... *Sphenomorphus capitolythos*
– Limbs in contact when adpressed; seven supraoculars, three or more in contact with frontal; smoothly rounded subdigital lamellae; black throat usually present, especially in males ..... *Sphenomorphus melanopogon*
23. Eyelids moveable 24
– Eyelid immovable, transparent, covering the eye ..... *Cryptoblepharus keiensis*

24. Bladelike subdigital lamellae, 66–94 in number; dorsum greyish to greyish-tan or brown, generally marked with scattered light and dark flecks: dark brown to blackish band on upper lateral surface absent or reduced to faint blotches ..... *Emoia longicauda*
– Rounded subdigital lamellae, 30–36 in number; dorsum blackish or dark brown with a pale vertebral stripe from tip of snout to base of tail; pale dorsolateral stripes; lateral surfaces usually with yellow spots; tail dusky white ..... *Emoia reimschisseli*
– Rounded subdigital lamellae, 32–42 in number; dorsum dark brown or gold with darkened or black lateral stripes; inhabits beachside rocks..... *Emoia atrocostata*

KEY TO THE SNAKES OF THE KEI ISLANDS

1. Tail more or less cylindrical, not flattened or paddle-shaped 2
– Tail strongly vertically compressed and paddle-shaped 8
2. No enlarged ventral scales, the scales on the belly more or less equal in size to those on the back; eyes vestigial, consisting of dark spots beneath scales of the head 3
– A single row of enlarged ventral scales which are at least three times as wide as those on the back and sides; eyes well-developed..... 4
3. Preocular in contact with the third labial only; 24 or 26 mid-body scale rows..... *Malayotyphlops kraalii*
– Preocular in contact with the second and third labials; nasal cleft proceeding from the preocular; 20 mid-body scale rows ..... *Indotyphlops braminus*
– Preocular in contact with the second and third labials; nasal cleft proceeding from the first labial; 26 or 28 midbody scale rows ..... *Rhamphotyphlops multilineatus*
4. Fewer than 30 midbody scale rows; no enlarged labial pit organs..... 5
– More than 30 midbody scale rows; a row of enlarged labial pit organs ..... *Simalia amethistina*
5. Head not triangular and distinctly widened from neck; end of tail without curved soft spine; suboculars absent; no enlarged supraocular projecting above eye 6
– Triangular head widening from a narrow neck; tail narrow and short, ending in a curved soft spine; suboculars present; enlarged supraocular projecting above eye *Acanthophis laevis*
6. Anal scale divided; robust build; colour not as below 7
– Anal scale single; gracile build; olive to rich brown above, the belly yellow and flecked with darkened areas ..... *Dendrelaphis keiensis*
7. Ventrals 170–225; scales in 19–23 rows around the mid-body; cream or brown to bright reddish-brown above with numerous narrow, irregular, crossbands ..... *Boiga irregularis*
– Ventrals 225–265; scales in 17 rows around the mid-body; uniform brown to dark grey or black above; belly cream, sometimes with black flecks ..... *Stegonotus cucullatus*
8. Nasals separated by internasals; body with distinct black and white bands..... *Laticuada colubrina*
– Nasals in contact medially; patternless brown in colouration ..... *Aipysurus laevis*

KEY TO THE FROGS OF THE KEI ISLANDS

1. Tips of digits with large, distinctly expanded pads 2
– Tips of digits with small, only slightly expanded pads ..... *Cornufer papuensis*
2. Vomerine teeth present; dorsal surface uniform green or brown, a distinctive white stripe along the edge of the lower jaw; SVL to 110 mm ..... *Litoria infrafrenata*
– Vomerine teeth absent; dorsal surface with broad vertebral band of bronze, bordered on either side by green; SVL to 30 mm ..... *Litoria* cf. *bicolor*

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