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The Lizards of Fiji: Natural History and Systematics

GEORGE R. ZUG

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THE LIZARDS OF FIJI:
NATURAL HISTORY AND SYSTEMATICS

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Contents

DEDICATED TO THE MEMORY of John and Lily Gibbons and their children, all of whom drowned in a boating accident while crossing the reef at Lakeba, Fiji, on 15 November 1986. John had an infectious enthusiasm for the biology of Fijian animals, particularly lizards, and stimulated everyone who knew him. He and Lily contributed to this project in many ways, especially through their friendship.

Abstract

The lizard fauna of the Fiji Islands consists of two iguanas (*Brachylophus fasciatus*, *B. vitiensis*), ten geckos (*Gehyra mutilata*, *G. oceanica*, *G. vorax*, *Hemidactylus frenatus*, *H. garnotii*, *Hemiphyllodactylus typus*, *Lepidodactylus gardineri*, *L. lugubris*, *L. manni*, *Nactus pelagicus*), and eleven skinks (*Cryptoblepharus eximius*, *Emoia caeruleocauda*, *E. campbelli*, *E. concolor*, *E. cyanura*, *E. impar*, *E. nigra*, *E. parkeri*, *E. trossula*, *Leiolopisma alazon*, *Lipinia noctua*). The systematics and biology of each species is reviewed and summarized by combining new and published observations on aspects of nomenclature (synonymies and commentaries), morphology (physical description, sexual and geographic variation), geographic distribution (map of actual occurrence), ecology, behavior, and reproduction. The preceding data allow preliminary analyses of population and community ecology of the Fijian lizard fauna and its biogeographic affinities. The sibling species *Emoia cyanura* and *E. impar* are the dominant lizard species on all islands with population densities to 4000 individuals hectare^{-1}. These two *Emoia*, *E. concolor*, *E. trossula*, *Lipinia noctua*, *Gehyra oceanica*, *Nactus pelagicus*, and *Brachylophus* form the core Fijian lizard fauna, i.e., the species found on most Fijian islands from several hectare to more than 100 km^2 in area. The sibling *Emoia*, *Lipinia*, *Gehyra oceanica*, and *Nactus pelagicus* are the core species for Oceania. Biogeographical affinities based on shared native species within Fiji show Ono-i-Lau as the least similar of the Fijian fauna and the Viti high island group as the most similar and oldest fauna. Externally, the Fijian fauna is most closely associated with the southern Tongan fauna.

Preface

I FIRST VISITED FIJI IN 1971 with the desire of seeing a banded iguana in the wild. Not surprisingly, in the few days spent in Fiji, I saw none. My search was confined to the vicinity of Nadi, Viti Levu. I searched the obvious places—gallery forest adjacent to streams and the scattered patches of secondary growth forests—but to no avail. I was struck and depressed by the scarcity of lizards of any kind, and by the catastrophic effect of sugarcane agriculture. Only later did I discover that Viti Levu had some relatively undisturbed habitats, but ground-living lizards were scarce throughout this island, owing to nearly a century of predation by the introduced mongoose.

At the time, my guides to the Fijian herpetofauna were Loveridge's *Reptiles of the Pacific World* (1945) and the Burts' *Herpetological Results of the Whitney South Sea Expedition VI* (1932). Both were helpful but sparse on the biology of lizards and, for that matter, on the biology of any amphibian or reptile. I was then and remain amazed that the Fijian herpetofauna has attracted so little attention. Since the early 1800s, Fiji has been a major crossroad of Pacific trade routes. Numerous biologists have visited, but few have published on Fijian amphibians and reptiles. Being a British commonwealth nation, one might expect the appearance of a talented amateur naturalist with a passion for reptiles. Such never occurred, so the biology of the herpetofauna has received only cursory and sporadic study.

Hurricanes and cyclones have altered several of my research trips. My plans to study in Tonga in 1982 were sidetracked due to Tonga's devastation by a powerful cyclone. Redirected to Fiji, I was well aware of the limited data on the Fijian herpetofauna. Upon arrival, I set out to document the micro- and macrodistributions of lizards on the Fijian islands and to gather as much biological data as possible on the individual species. Without these basic data on specific distributions and variations, and their natural history, evolutionary and ecological questions cannot be accurately defined or answered.

As I gathered field observations and assembled the meager and widely scattered literature, I decided that a compilation of the published and unpublished natural history data and an examination of the systematics of all Fijian lizard species would prove useful to anyone interested in the conservation and biology of Fijian animals. The success of this review in stimulating interest in the Fijian and other Pacific island lizard faunas will be measured by how quickly my observations and interpretations are superseded.

Acknowledgments

THE WINDS OF CYCLONE ISSAC blew the 1982 Smithsonian Pacific Ichthyological and Herpetological Expedition from Tonga to Fiji. On very short notice, we were most graciously and exceptionally well assisted by Dr. A. D. Lewis and his colleagues at the Lami Fisheries Laboratory of the Fijian Ministry of Primary Industries. They provided research space, logistics, people and equipment support, and encouragement. I also received most generous and cordial assistance from the Department of Biology, School of Natural Resources, the University of the South Pacific. The crew of the first *Blue Dolphin* survey (Vic Springer, Kurt Bruwelheide, Joe Libby, Gary Preston, Mike Gawel, Eru and Capt. Ron Welsh) encouraged my herpetological forays. John Gibbons provided pleasant and knowledgeable field companionship as opportunities arose amidst his busy teaching schedule. In 1986, the Marine Laboratory and the Department of Biology again aided my study with space and logistic support. Numerous Fijians assisted my field work no matter how peculiar it must have seemed to them for an adult to chase lizards. I especially wish to acknowledge Iliesa Takelo (Koro) and Ratu Lino-Rotuimaisala (Namosi, Viti Levu) and their families. Principal veterinary officers Dr. S. G. Revell and Dr. Niumaia Tabunakawai permitted me to export collections of Fijian lizards to the Smithsonian for study.

My examination of specimens and pursuit of biological data was most generously assisted by the staffs of numerous museums: American Museum of Natural History, Australian Museum, Bishop Museum, British Museum (Natural History), California Academy of Sciences, Field Museum of Natural History, Florida Museum of Natural History, Museum of Comparative Zoology/Harvard University, National Museum of New Zealand, University of Michigan Museum of Zoology, and University of Papua New Guinea. William Beckon and Dick Watling went out of their way to provide specimens and data. W. Bolger, T. Case, R. Fisher, J. Gibbons, and P. Ryan gave me access to their field observations on Fijian lizards. Steve Chavez, Rex Cocroft, and Rob Wilson shared in the data entry and analysis. Helen Wimer did all the gonad histology for determination of reproduction condition. Vic Springer's enthusiasm for Indopacific biogeography was a regular stimulant. The manuscript was improved by the suggestions of A. Bauer, W. Beckon, W. Brown, R. Crombie, T. Fritts, W. R. Heyer, I. Ineich, H. Ota, G. Pregill, G. Mayer, V. Springer, and D. Watling. This research project would not have been possible without the financial support of the Max and Victoria Dreyfus Foundation (1892 & 1986) and the Smithsonian's Scholarly Studies Program (1982) and Research Opportunities Fund (1984 & 1988).

I sincerely thank all the above people and institutions for their support. This study could not have been completed without them.

Introduction

THE AMPHIBIANS AND REPTILES OF FIJI are a mixture of endemic, southwest Pacific, and panPacific species. This mixture has several unexpected features with respect to the faunas of adjacent island groups and Fiji's past and present existence as a cluster of oceanic islands distant from a continental source. The endemic ground snake, *Ogmodon*, and frogs, *Platymantis*, would seem incapable of crossing the long gaps of water between Fiji and the Solomons-New Guinea area where their closest relatives live now. Although these gaps are sizeable, the distances that must have been crossed by the ancestors of some Fijian lizards are even greater. The closest relatives of the Fijian iguanas are in the Americas, more than 5000 km away. The relatives of the Lauan ground skink are in New Zealand, nearly 2000 km to the south. How and when did these lizards colonize? This question and many more require answers about the relationships, geography, and biology of the 23 species of Fijian lizards. This collation of natural history and systematic observations provides few answers. I hope, however, that it will serve as a foundation to address such questions.

Fiji: Land and Climate

Politically and geologically, Fiji encompasses 3 archipelagoes in the south-central Pacific (177°E–177°W, 12°S–24°S). These archipelagoes include more than 800 islands and islets that range in size from Viti Levu, which is over 10,000 km^2 and 1,320 m maximum elevation, to unnamed coral-head and sand islets of a few m^2 and less than 1–2 m high.

Rotuma is the smallest archipelago and includes 4 islands. This archipelago lies well north (177°E 12°S) of the 2 larger, southern archipelagoes, and on a separate submarine platform on the edge of the Pacific Plate. There are no submarine ridges linking it to the southern ones, hence Rotuma's geologic history is not as closely linked to core Fiji as is that of the Laus. The islands of Rotuma are tops of highly eroded volcanic seamounts. Rotuma is also the name of the largest island (≈ 40 km^2, 200 m max. elev.) in this group. It is a hilly island with only a narrow coastal plain and even narrower beaches, usually submerged at high tide. Its present vegetation is a mixture of secondary growth forests, coconut plantations, and gardens.

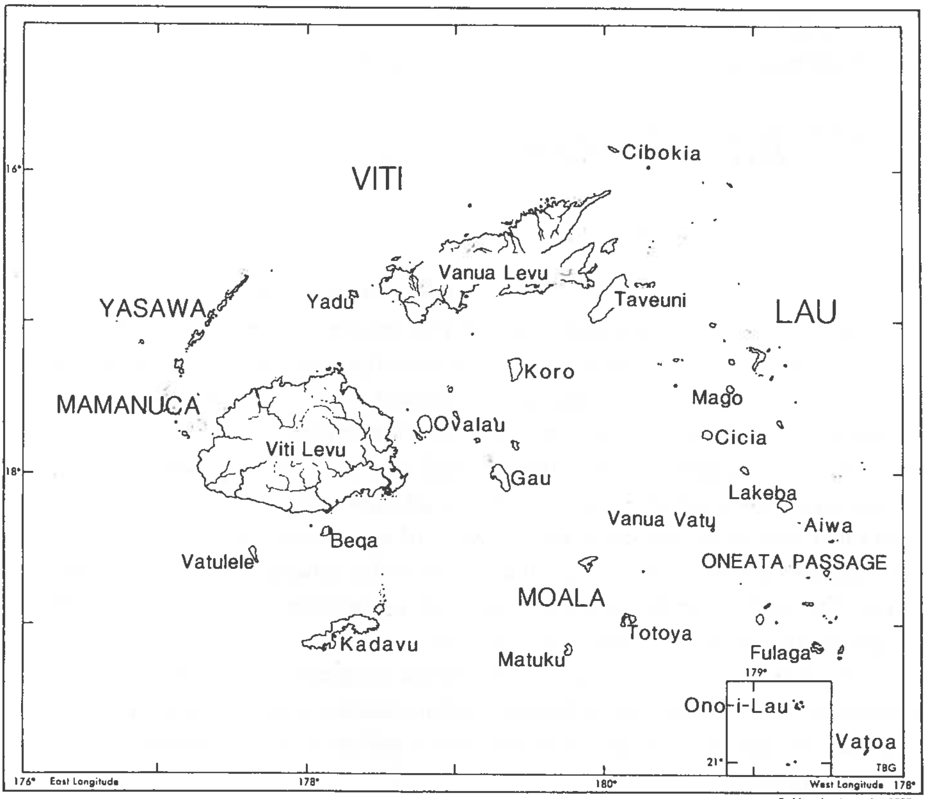


Figure 1. Major islands and island groups of Fiji. Island group names are in all capital letters, single island names are in upper and lower case letters.

The Lau and Viti archipelagoes (Fig. 1) form the Koro Sea, which is closed to the north where the Lau Ridge intersects the Fiji platform. The Lau archipelago is a string of low coral islands, islets, and reefs on the Lau Ridge. The string runs on a north-south axis. None of the islands are larger than 60 km^2 or higher than 300 m and the majority are much smaller and lower. The Lau archipelago includes over a dozen island clusters, each a coral-capped volcanic platform separated by deep-water channels or passages of various widths. The Nanuku Passage separates the northern Lau Islands from those of the Viti archipelago. The principal islands and island clusters within the Laus are (north to south): Exploring Isles, including Vanua Balavu and Mago; Tuvuca; Cicia; Lakeba cluster, including Vanua Vatu, Aiwa, and Oneata; Fulaga or Yagasa cluster, including Kabara, Navutu-i-Ra, Fulaga, and Ogea Levu; Vatoa; Ono-i-Lau; and Tuvana-i-Ra. Most of the Lauan islands are north of 19°30′S and separated by short gaps of water. At the southern end, Vatoa and Ono-i-Lau are broadly separated from one another and the other Lau island clusters by spans of water of 80–100 km.

The Lau islands are either low sand islands or raised coral reefs. Many have experienced long human occupancy, and their native forests have been replaced by coconut groves, small patches of scrub, gardens, and grassy areas. Those with low or no human occupancy retain low forest (canopy <15 m) with an understory of scattered seedlings and shrubs.

The Moala Group lies nearly in the middle of the Koro Sea, west of the main axis of the Lau Ridge. The 3 islands of this group, Matuku, Moala, and Totoya, are widely separated (>40 km), and each is the eroded top of a volcano. Thus they are geologically more closely related to the Viti Group, although geographically slightly closer to the islands of Lau Ridge. Their hillsides are densely wooded, usually with well-developed secondary growth forest formed from a mixture of native and wild cultivars. The flat coastal areas have some forest, but are mostly coconut groves, gardens, and open grassy areas.

The Viti archipelago comprises the high islands with either a central mountainous ridge (e.g., Taveuni) or an aggregation of irregularly trending mountain ranges (e.g., Viti Levu). This archipelago also contains all of the large islands, Vanua Levu (~5500 km^2) and its large satellite Taveuni (~435 km^2) in the north, Viti Levu and its major satellite Ovalau (~100 km^2) in the middle, and the much smaller Kadavu (~400 km^2) in the south. This archipelago has a northeast-southwest axis. Vanua Levu and Viti Levu are bordered along their northwest flank by the Great Sea Reef, which has a chain of small coral and sand islands (the Yasawa and Mamanuca groups) at its southwestern end. Lying in the northwestern corner of the Koro Sea and shadowed by the larger islands are several small, mountainous islands and their satellite islets (Lomaiviti group). Koro and Gau are the larger of these islands.

Viti's larger islands have a long history of human occupation. The coastal lowlands and mountain valleys have been heavily exploited and the remaining forests occur in small patches as a mix of native and cultivar species. On Vanua Levu and Viti Levu, much of the lowlands are covered by sugarcane, other commercial crops, and pastures. Many of the mountain sides have also been deforested and are grass covered, particularly in the drier areas. On the smaller islands, the lowlands and mountain sides are gardens or coconut plantations. Permanent water streams are found only on these high islands, and only on their shores are there mangrove forests.

Conway Reef (174°E 22°S) is the southern extremity of the Fijian political domain. It is an isolated reef shoal atop a seamount and distant from both the Viti and Lau groups. It is reported both as a reef submerged with each high tide and as a small, low, sandy island or cluster of islets.

The Fijian islands have a tropical climate. Temperatures are moderate, seldom below 20°C or above 32°C in the lowlands. Fiji lies within the southeast trade wind belt. These winds are fairly constant year around and are heavily laden with moisture, producing high humidity year around. The location, size, and elevation of each island affect the general climate of the island. The Lau group, the Yasawa chain, and the leeward sides of the Vanua Levu and Viti Levu are dry, but dry only in comparison to the wet areas, e.g., 150 compared to 300 cm yr^{-1}.

History of Herpetological Exploration

Fiji was bypassed during the early exploration of the Pacific, because it lay south of the path of the explorers, and later, south of the Peru-Philippine gold route. In 1643, the Dutchman Abel Janszoon Tasman was the first European to sight the Fijian islands. He made no landfalls but sailed rapidly through the northern Lau group, skirting Taveuni and the eastern tip of Vanua Levu, reaching the safety of deep water as a hurricane struck. Capt. Cook passed through the southern Lau group in 1774; he landed a few men briefly on Vatoa ("Turtle Island") and then sailed south-south-westward without seeing any other Fijian islands. Capt. Bligh was the first "explorer" to recognize Fiji as a major archipelago of large and small islands. Set adrift in 1789, he sailed northwestward through the middle of the archipelago from Yagasa to the Vatu-i-Ra channel between Viti Levu and Vanua Levu. Unarmed, he was fearful of hostile natives, so he passed through the archipelago without stopping. Bligh returned to Fiji in 1792 and extended his mapping of island positions, but apparently he landed no shore parties. In 1797, a missionary ship under Capt. Wilson sailed briefly among the Lau group. Capt. Bellingshausen, a Russian captain, came upon Ono-i-Lau in 1820, but like his European predecessors did not go ashore (see Garnier 1837, and Henderson 1933, for further details on European exploration in the Southwest Pacific). Early in the 19th century, Fiji was discovered to possess large stands of sandalwood. European traders (and scoundrels) immediately began to visit and live on the islands; however, there is no evidence that any of these traders made natural history collections.

The first zoological collections from Fiji were made nearly concurrently by French and U.S. naval survey expeditions. The French Astrolabe-Zélée expedition of 1837–1840 captured and returned to Paris with at least 3 species of amphibians and reptiles, *Platymantis vitianus*, *Emoia concolor*, and *Candoia bibroni*. The U.S. Exploring Expedition of 1838–1842 worked in the Fiji archipelago for 3 months (Staton 1975; Viola & Margolis 1985). They established a base in Ovalau (presumably the Levuka area) and sailed throughout the islands mapping and charting the land and water. The scientists accompanying the cartographers made extensive collections from a number of different islands. The herpetological collection contained *Platymantis*, *Candoia*, *Chelonia*, *Eretmochelys*, *Cryptoblepharus*, *Emoia cyanura*, *E. parkeri*, *E. trossula*, *Gehyra vorax*, *Nactus pelagicus* and *Brachylophus* *fasciatus* (Girard 1858). Unfortunately, the collectors did not designate the specific islands from which the specimens were collected. Having Fiji as the primary and only locality is common to many older collections and makes it impossible to document historical changes in distributions.

In 1909, the Hanseatische Südsee-Expedition visited Fiji for less than a week (Wolf 1915) and apparently obtained specimens only from Ovalau. The Whitney South Sea Expedition (Murphy 1924) of the American Museum of Natural History was the next major expedition to visit Fiji and make extensive herpetological collections. The Whitney expedition visited numerous islands (see list in Burt & Burt 1932:467), particularly those of the Lau group, in the 1920s. The Whitney collections from the 1920s form the core for our knowledge of Fijian lizard distributions. Many individual biologists have sampled the lizard fauna, but only a few (e.g., Brown & Gibbons 1986; Gibbons 1981a; Pernetta & Watling 1979) have published, even in part, the results of their field studies.

Materials and Methods

All Fijian specimens examined are listed in the Appendix: Table G. Mensural and meristic data were gathered using the standard methodology of saurian systematics. The only differences may be: 1) hindlimb length, measured from the posterior inguen to the tip of the longest toe with the limb held perpendicular to the body; 2) body length, measured from the posterior axilla to the anterior inguen; 3) supraciliaries, the number of scales forming the lateral edge of (and touching) the enlarged supraocular scales; 4) dorsal scale rows, the number of scale rows between the posterior edge of the hindlimb (equivalent to the position of the vent) and the parietal scales, including the enlarged nuchal scales; 5) ventral toe lamellae, in skinks the number of enlarged digital lamellae from and including the proximal-most lamella (that is, wider than long and touching a dorsal digital scale on at least 1 side) to the claw; in geckos with expanded digital pads, the number of enlarged digital lamellae on the pad from and including the proximal-most lamella or pair (wider than long) to the terminal lamella. Statistical analyses were performed with SYSTAT 4.0; Student's t tests at a 5% level of significance were used to discern dimorphism between adult females and males. Statistical summaries for all characters and for each species are presented in the Appendix: Tables A and B; Tables C and D provide statistics on sexual dimorphism and geographic variation, respectively.

Sex was determined by dissection and examination of the gonads. A female was considered sexually mature if she possessed ovarian follicles undergoing vitellogenesis (typically >1.2 mm diameter in the smaller species), oviducal eggs, or an enlarged flaccid oviduct (an indication that it held eggs previously). Virginal oviducts are oviducts unstretched by the presence of eggs (past or current), and gravid refers only to females with oviducal eggs. A male was considered sexually mature if he possessed enlarged testes and/or epididymides. Histological examination of testicular and epididymidal tissue in representatives of *Gehyra mutilata*, *G. oceanica*, *Hemidactylus frenatus*, *Hemiphyllodactylus typus*, *Lepidodactylus gardineri*, *Cryptoblepharus eximius*, *Emoia concolor*, *E. cyanura*, *E. nigra*, *E. trossula*, and *Lipinia noctua* provided information on minimum snout-vent length (SVL) for mature males. The minimum adult size (measured as SVL) for both females and males is that of the smallest sexually mature specimen examined. A sample may contain larger specimens that have not attained maturity; nonetheless, the size reported in the "Description" section of each species account represents the minimum size of known mature individuals. The reported sizes derive from Fijian specimens and are measurements of preserved specimens and are thus smaller than living specimens (preservative shrinkage is approximately 1.0 mm for every 10 mm of SVL above 30 mm SVL).

Hatchling size was determined from individuals observed hatching from eggs. In the absence of such data, specimens possessing yolk-sac scars were used to estimate size at hatching. Egg size and shape derive from examination of shelled oviducal eggs and eggs found in the field and hatched in the laboratory (to confirm specific identity of eggs).

The sections following present a key for species identification and then an account for each species. Each account attempts to outline the nomenclature, taxonomy, external morphology, distribution, and general biology of the Fijian species. Species occurence maps follow the same order of presentation as the species accounts in the text. Maps are presented only for those species with multiple localities. I include all localities for which I confirmed or was confident of the published or observer's species identification and locality information.

The following notes are a mixture of my observations and the published observations of other naturalists. Unless stated otherwise, the data derive from Fijian specimens, and statistical summaries are presented in the Appendix. The synonymies derive from Wermuth (1965) for geckos, and from Brown & Alcala (1980) and Boulenger (1885) for skinks; deviations from these synonymies are explained in the "Taxonomic comments" section of each account. Although I have used the synonymies of other workers, I have checked the original description of each name to ensure the accuracy of the type locality, pagination, and citation.

The extent of my observations on the lizards of different islands is quite variable: 0.5–1 day on Matuku, Yanuya, Davora, Estad, and Yagasa; 2–2.5 days on Totoya and Taveuni; 5 days on Koro; 6 days on Ovalau; 17 days on Rotuma; and 30+ days at various sites on Viti Levu. The majority of observations derive from April–May 1982 and May–June 1986, with a few earlier observations from September 1971.

Lizard Fauna: Known, Reported, and Possible

The known lizard fauna of Fiji consists of 2 iguanas, 10 geckos and 11 skinks (Table 1). Many more lizard species have been reported (Table 2), but these reports are misidentified species, specimens with incorrect locality data, or published reports lacking voucher specimens and subsequent verification.

Because these erroneous records confound an analysis of ecological and biogeographical data, I have attempted to verify all published records of species occurrence in Fiji. Those species represented by voucher specimens are described in the following "Species Accounts" and represent the known lizard fauna of Fiji. In this section, I examine the erroneous records of occurrence and offer suggestions about the occurrence of novel species and potential colonizers.

The reported occurrence of *Emoia atrocostata* in Fiji is based on Girard's report (1858:265) of a specimen collected during the U.S. Exploring Expedition to these islands. The specimen is extant (USNM 5643), and my examination reveals it to be an *Emoia parkeri*, a species not recognized until 1980. The specimen is a mature female (47.2 mm SVL) with 32 scale rows at midbody. *E. atrocostata* does not reach maturity until it has attained 70–80 mm SVL and has 36–40 midbody scale rows. This coastal species is often abundant in port areas elsewhere in the western Pacific and may someday reach Fiji.

Günther (1872a) described 4 new species of skinks (*Euprepes haplorhinus*, *Mocoa micropus*, *Hinulia tetragonurus*, and *Nannoscincus fuscus*) collected by Brenchley supposedly in the "Feejee Islands." Although Günther gave Fiji as the source of the specimens, Brenchley (1873) does not mention seeing or catching lizards in Fiji or in New Caledonia; however, in an appendix to Brenchley's book, Günther (1873) repeats Fiji as the origin for these 4 species of lizards. Later, Boulenger remarks in a footnote (1887:279) that the type localities for these 4 species is incorrect and should be New Caledonia. Since the lizards are New Caledonian endemics, the originally reported collecting locality is clearly erroneous.

Peters (1874) described *Euprepes (Mabuia) parvisquameus* from the Samoa and Fiji islands. However, Peters mistakenly considered Futuna to be a Fijian island; thus, this record is not a valid Fiji occurrence. This species is a synonym of *Emoia adspersa* (fide: Boulenger 1887; Schwaner & Brown 1984), and it may also be the basis for Sternfeld's report (1920) of *E. adspersa* from Fiji. This species is a potential colonist of Rotuma, being down current of Samoa and other source islands.

Boulenger (1885) listed a series of 3 juvenile *Gonocephalus godeffroyi* from Fiji. These specimens (BM[NH] 74.4.291240-1242) were reexamined and are *G. godeffroyi* (fide A. F. Stimson, in litt. February 1987). They derive from a collection purchased from Col. R. H. Beddome in 1874. Although the collection is predominantly comprised of Indian and Sri Lankan specimens, it does contain 14 specimens

TABLE 1

Lizards of the Fiji Islands

The species marked by an asterisk are assumed to be human-mediated colonists, i.e., introduced accidentally or intentionally by Melanesians and subsequent human groups. My reasons for identifying species as natural or human-assisted colonists are presented under the Zoogeographic comments section (p. 98).

Iguanidae	*Gekkonidae*	*Scincidae*
Brachylophus fasciatus	*Gehyra mutilata**	*Cryptoblepharus eximius*
Brachylophus vitiensis	*Gehyra oceanica*	*Emoia caeruleocauda**
	Gehyra vorax	*Emoia campbelli*
	*Hemidactylus frenatus**	*Emoia concolor*
	*Hemidactylus garnotii**	*Emoia cyanura*
	Hemiphyllodactylus typus	*Emoia impar*
	Lepidodactylus gardineri	*Emoia nigra*
	*Lepidodactylus lugubris**	*Emoia parkeri*
	Lepidodactylus manni	*Emoia trossula*
	Nactus pelagicus	*Leiolopisma alazon*
		Lipinia noctua

from Australia and Burma as well as the 3 *G. godeffroyi* from Fiji. Only the provenance of these latter 3 specimens is questionable, likely Australia or New Guinea; their Fijian locality datum appears to be incorrect.

In a published museum catalogue, Boettger (1893) listed several lizards: *Gehyra oceanica* and *Lygosoma cyanurum* from Viti Levu, and *Brachylophus fasciatus* and *L. cyanogaster* with no specific island identified. Only the latter species is an unlikely inhabitant; its identity has been confirmed as *Emoia cyanogaster* (fide W. Brown) known otherwise from Vanuatu and westward, thus indicating incorrect locality data.

Werner (1899) listed 4 lizards from Fiji: *Brachylophus fasciatus, Lepidodactylus lugubris, Lygosoma cyanogaster tongana*, and *Lygosoma samoense*. He noted that the Fijian *cyanogaster* is the same as his specimens from Tonga and differs from them by having only 26 scale rows at midbody. His description of *L. c. tongana* (1899:374) is brief. The description of the head scalation, coloration, and size match those features in *Emoia concolor*; the only difference is the low number of scale rows at midbody. My Fijian sample of *E. concolor* ranges from 27–33, mode 30, scale rows. The difference is slight and may result from a difference in counting technique, hence

TABLE 2

Species Reported from the Fiji Islands but Not Verified

The scientific names are as originally cited; the name as currently used or as reidentified is given below the original name in parentheses. The status of each taxon is discussed in the text.

Species	*Location*	*Author*
Agamidae		
Gonyocephalus godeffreyi	Fiji Islands	Boulenger 1885:296
(*Gonocephalus godeffreyi*)		
Gekkonidae		
Gecko vittatus	Matuka (Fidji-Inseln)	Vogt 1912:2
(*Gekko vittatus*)		
Scincidae		
Emoa atrocostata	Feejee	Girard 1858:264
(*Emoia parkeri*)		
Emoa samoensis	Feejee Groups of Islands	Girard 1858:268
(*Emoia trossula*)*		
Euprepes haplorhinus	Feejee Islands	Gunther 1872:420
(*Caledoniscincus austrocaledonicus*)		
Mocoa micropus	Feejee Islands	Gunther 1872:420
(*Nannoscincus gracilis*)		
Hinulia tetragonurus	Feejee Islands	Gunther 1872:421
(*Sigaloseps deplanchei*)		
Nannoscincus fuscus	Feejee Islands	Gunther 1872:421
(*Nannoscincus mariei*)		
Euprepes (Mabuia) parvisquameus	Fidji-Inseln (Futuna)	Peters 1874:160
(*Emoia adspersa*)		
Lygosoma (Emoa) cyanogaster	Fidji-Inseln	Boettger 1893:106
Lygosoma cyanogaster tongana	Fidji-Inseln	Werner 1899:375
(*Emoia concolor*)		
Lygosoma (Emoa) cyanogaster?	Fiji	Sternfeld 1920:380
(*Emoia concolor*)		
Lygosoma (Emoa) adspersum	Fiji-Inseln	Sternfeld 1920:381
(*Emoia adspersa*)		
Varanidae		
Varanus indicus	Matuka (Fidji-Inseln)	Vogt 1912:3
(*Varanus indicus*)		

* Girard and numerous subsequent authors did not recognize that the Fijian populations were a distinct species, *Emoia trossula*.

I believe *L. c. tongana* to be a junior synonym of *Emoia concolor*. Werner's description of the Fijian *L. samoense* matches the characteristics of the recently described *Emoia trossula*, particularly with the 84 mm SVL and the dark cross bands and white spots on the trunk.

In a summary of herpetological collections from the South Pacific, Vogt (1912) listed *Gekko vittatus* and *Varanus indicus* from Matuka. These 2 specimens (ZMB 21424, 21423, respectively) still exist in the Museum für Naturkunde der Humboldt-Universität zu Berlin and are correctly identified (R. Günther, in litt. May 1987). The locality written on the labels is, however, "Matupa, Südsee," not Matuka as published by Vogt. Although I have been unable to locate Matupa, I have found 3 similar names differing by a single letter: Matupi, 4°14′S 152°14′E; Mataupa, 9°57′S 150°54′E; Matupe River, 7°57′S 145°46′E. All these localities are within the natural range of *G. vittatus* and *V. indicus*, thus these 2 species should be removed from the herpetofauna of Fiji.

Sternfeld (1920) presented 2 lists of Pacific amphibians and reptiles. The first list (1920:380–381) was a summary of general distributions for Pacific reptiles. Fiji was mentioned specifically in association with *Gehyra vorax*, *Brachylophus fasciatus*, *Emoia adspersa*, *E. cyanogaster*, *E. nigra*, *E. samoense* (? = *trossula*), *Typhlops aluensis* (= *flaviventer*), and *Ogmodon vitianus*; the list has no references to specimens or published records. His 2nd list (1920:387–436) is a report on the specimens collected by the Hanseatische Südsee-Expedition. It contains no unexpected occurrence for Fiji, i.e., *Gehyra oceanica*, *Lepidodactylus lugubris*, *Brachylophus fasciatus*, *Emoia cyanura*, *Candoia bibroni*, and *Platymantis vitianus*, all from Levuka, Ovalau. The 1st list is confounding, because the occurrences of *E. adspersa*, *E. cyanogaster*, and *T. flaviventer* in Fiji remain unconfirmed. Likely the 2 *Emoia* records can be attributed to the publications of Peters (1874) and Werner (1899), respectively; however, without recourse to actual museum specimens or confirmed published records, the accuracy of Sternfield's 1st list is highly questionable. It is probably best ignored.

The USSR Moscow State University collections contain 1 specimen each of *Carlia fusca* (MMSU 42) and *Sphenomorphus solomonis* (MMSU 41), purportedly from Suva, Viti Levu (21 January 1977, collector Zlobin). Examination of these specimens confirms their specific identity; however, it is highly unlikely that these 2 species were collected in Fiji. Since other specimens collected by Zlobin derive from Papua New Guinea and the Solomon Islands, I suspect that these 2 specimens also derive from that area.

The herpetological collections of the Florida Museum of Natural History contain 2 specimens of *Caledoniscincus atropunctatus* (UF 64136–37; 23 April 1986, collector Krause), supposedly from Vanua Vatu. Comparison of these specimens with the descriptions (Sadlier 1986) of this species confirms their identification. It is likely that the specimens were collected in Vanuatu, and the data were incorrectly transcribed as Vanua Vatu, thus they incorrectly became Fijian lizards.

Further exploration of the mountains of Viti Levu and Vanua Levu may reveal a new *Emoia* or *Lepidodactylus*. While such discoveries are not predictable, they would not be surprising. More intriguing are the local reports of a giant gecko in the mountains of Viti Levu, and of a large limbless or reduced-limbed skink in the Mamanuca and Yasawa island groups (J.R.H. Gibbons, pers. comm. [May] 1986). On purely speculative grounds, the giant gecko might be nothing more than a larger than normal *Gehyra vorax* or, more exciting, an outlier *Rhacodactylus* relative. The skink may be a Fijian representative of *Tachygyia*, which has a species on Tonga and several potential relatives on New Caledonia.

Key to the Lizards of Fiji

THE FOLLOWING KEY includes all lizards whose presence in Fiji has been confirmed, as well as a few other Pacific species that are likely to arrive occasionally as stowaways. The latter species are identified with an asterisk.

1. Back covered by small non-overlapping scales 2
   Back covered by large overlapping scales .... 13 Scincidae
2. Skin on body tough, not easily torn; top of head covered by larger scales or plates; eye protected by movable lower eyelid; iris circular .... 3 Iguanidae
   Skin on body soft, easily torn; scales on top of head the same size as body scales or nearly so; eye protected by a clear immovable spectacle; iris elliptical .... 4 Gekkonidae
3. Body dark green with 2 or 3 broad, white vertical bands, not outlined; underside a uniform yellowish green; middorsal crest of short conical spines .... *Brachylophus fasciatus*
   Body light green with 2 or 3 narrow, white vertical bands outlined in black; underside whitish with green mottling towards the sides; middorsal crest of long conical spines, distinctly enlarged on neck .... *Brachylophus vitiensis*
4. Four or 5 digits with claws; digits with enlarged ventral pads 5
   All digits with large claws; digits straight sided, no enlarged pads .... *Nactus pelagicus*
5. Five distinct digits on each foot; size small to large (>36 mm, adult SVL); body stout, neck not elongated; postmental scales at least 4X larger than anterior throat scales 6
   First digit tiny and rudimentary; size small (<45 mm, adult SVL); thin and elongated neck and body; no enlarged

postmental scales, scales small and subequal within area
defined by infralabial scales . . . . *Hemiphyllodactylus typus*

6. Clawed portion of digit arising from within digital pad; 1st digit with small to large claw; postmental scales large, median pair rectangular, each more than half the size of 1st infralabial scale 7

   Clawed portion of digit arising from distal edge of digital pad; 1st digit with small or no claw; postmental scales small, median pair of postmentals round or oblong, each less than half the size of 1st infralabial scale 10

7. Digits strongly expanded into a round pad; 1st digit without a free tip 8

   Digit strongly expanded into an oblong pad; 1st digit with free tip 9

8. Lamellae of digital pads divided into 2 rows; 8–9 rows of lamellae on 4th toe; supranasal scales in contact on dorsal midline or narrowly separated by a small frontonasal scale; 5–7 supralabial scales anterior to eye . . . . *Gehyra mutilata*

   Lamellae of digital pads undivided; supranasal scales widely separated by large frontonasal scale 9

9. Between 12–16 lamellae on 4th toe; 6–8 supralabial scales anterior to eye . . . . *Gehyra oceanica*

   More than 19 lamellae on 4th toe; 7–9 supralabial scales anterior to eye . . . . *Gehyra vorax*

10. Eleven or fewer rows of lamellae beneath 4th toe; enlarged scales scattered among the small, granular body scales; regular whorls of spine-like scales on dorsal and lateral surface of tail . . . . *Hemidactylus frenatus*

    Twelve or more rows of lamellae beneath 4th toe; no enlarged scales on body; spine-like scales confined to ventrolateral edge on each side of tail . . . . *Hemidactylus garnotii*

11. Terminal and/or penultimate lamellae on digital pad (4th toe of hindfoot) divided 12

    Terminal and penultimate lamellae of digital pad undivided, although may be notched . . . . *Lepidodactylus manni*

12. Tail (unregenerated dorsoventrally compressed, ventrolateral edges serrated with numerous spine-like scales; terminal digital lamella divided . . . . *Lepidodactylus lugubris*

    Tail round, without spine-like scales; terminal digital lamella undivided . . . . *Lepidodactylus gardineri*

13. Each eye protected by movable lower eyelids; size moderate to large (>38 mm, adult SVL), body typically robust; shades of brown or black with or without stripes 14

No movable eyelids, each eye covered by clear scale (spectacle); size small (<42mm, adult SVL); body long and narrow; silvery gray back bordered on each side by alternating black and white stripes .... *Cryptoblepharus eximius*

14. Tail slender, limbs long; tips of toes of hindfoot extend to or beyond axilla; a supranasal scale above nasal scale on each side; background coloration in shades of green, olive, gray, or black, striped or unicolor 15

Tail thick, limbs short; tips of toes of hindfoot extend forward to midbody or slightly beyond; no supranasal scales; coloration in shades of brown 24

15. Size small to moderate (<55 mm adult SVL) with 3–5 narrow, longitudinal white stripes on back and sides, those on back may be obscured or faded in adults, but middorsal stripe on head to tip of snout always visible; tail often bluish or green 16

Size moderate to large (>45 mm adult SVL) with no narrow middorsal stripe; tail never blue or green 18

16. Usually a single middorsal and pair of dorsolateral white stripes present, often fusing on back into a broad dorsal stripe in adults; >55 lamellae under 4th toe of hindfoot 17

Commonly a single middorsal, 2 dorsolateral and 2 lateral white stripes present, all may remain distinct in adults; <55 lamellae under 4th toe of hindfoot .... *Emoia caeruleocauda*

17. An epiphyseal eye and spot on top of the head; anterior loreal height less than or equal to its length; middorsal scale rows on back always paired; belly and underside of thighs white .... *Emoia cyanura*

No epiphyseal eye or pigmented spot on top of the head; anterior loreal higher than long; 1 or more of middorsal scale row pairs fused; belly and underside of thighs dusky .... *Emoia impar*

18. Scales on body small and numerous, >50 scales around midbody and >90 from head to base of tail .... *Emoia adspersa**

Scales on body moderate size, <45 scales around midbody and <80 from head to base of tail 19

19. Adults large (>75mm adult SVL); broad silvery gray to olive dorsal stripe bordered on each side by broad, dark stripe, throat and chin area silvery; 34–40 midbody scales; 30–42 lamellae beneath 4th toe of hindfoot .... *Emoia atrocostata**
    Adults moderate to large; back and head never silvery in appearance 20
20. Adults moderate to large (>55 mm SVL) 21
    Adults robust and moderate size (43–52 mm SVL) with a golden bronze head and greenish bronze back bordered dorsolaterally by a dark-brown stripe; 28–33 midbody scale rows; 31–41 lamellae beneath 4th toe of hindfoot .... *Emoia parkeri*
21. Adults green, olive to gray dorsally 22
    Adults large (>80 mm SVL) and dark brown to black on head and at least anterior half of body; 32–40 midbody scales; 31–39 lamellae beneath 4th toe of hindfoot .... *Emoia nigra*
22. Adults slender 23
    Adults robust and large (>70 mm SVL); olive brown to gray, usually with dark bars or broken bands and white spots on back; 30–40 midbody scale rows, seldom <34; 42–56 lamellae beneath 4th toe of hindfoot .... *Emoia trossula*
23. Adults large (>65 mm SVL); grayish olive or brown with diffuse dark bands dorsally; 30–36 midbody scale rows, seldom <32; 48–54 lamellae beneath 4th toe ..... *Emoia campbelli*
    Adults moderate (>55 mm SVL); green to greenish tan head and body; 27–33 midbody scale rows; 43–65 lamellae beneath 4th toe of hindfoot .... *Emoia concolor*
24. Back unicolor or spotted; no light mark on nape .... *Leiolopisma alazon*
    Back often with broad, light longitudinal stripe; bright spot on nape .... *Lipina noctua*

Species Accounts

Brachylophus fasciatus Family Iguanidae
Fijian Banded Iguana

Ig. fasciata Brongniart 1800:90. Type locality, none given; restricted to Tonga, Tongatabu, by Gibbons (1981a:256).

Ctenosaurus Sieberi Fitzinger 1843:55. Type locality, none given.

Brachylophus brevicephalus Avery & Tanner 1970:167. Type locality, "Nukalofa, Tongatabu Island, Friendly Islands."

Remarks. The following text derives primarily from the studies of John R. H. Gibbons and Ivy Watkins (1981a, 1982, 1984a, 1984b) with additional observations by Arnett (1979), Carpenter & Murphy (1978), Cogger (1974), and Greenberg & Jenssen (1982). Illustrations, see Gibbons 1981: plate II and fig. 3.

Description. Adults 136–193 mm snout-vent length (SVL), hatchlings 65–83 mm SVL; males and females are equal size. Tail length 2–3X SVL and somewhat longer in females. Moderately robust and long-limbed lizards. Head large, neck of similar diameter to head. Digits of fore- and hindfeet long and strongly clawed. Low crest of enlarged middorsal scales from nape to tail base. Tail weakly compressed laterally and tapering gradually to a point.

Head and body covered by numerous irregular-shaped scales; scales largest on head, decreasing in size across neck to small, uniform and non-overlapping scales on body. Mouth bordered by distinct labial scales, 6–8 supra- and infralabial scales on each side. Snout with large medial rostral scale bordered on each side by small circular nasal scale, naris in center of scale. Throat with fleshy, folded skin—a dewlap.

In life, bright-green to dark-green background color, white to bluish spots on neck and broad transverse white bands on sides of body; females usually uniform green. Subequal-sized bands of alternating green and white encircle tail. Chin and throat whitish streaked with green; remainder of venter (underside) uniform yellowish green. Eyes reddish orange and nasal scales orange.

Variation. Clinal variation presumably exists in scalation with Tongan populations at one end of the cline (Gibbons 1981a), and presumably the cline is east to west, but Gibbons did not provide a detailed account of the variation. Gibbons & Watkins

(1982) list differences in female coloration and male crest structure in Kadavu, Viti Levu, and Ovalau specimens; they also state that Tongan lizards are slenderer than Fijian ones. Specimens from Malolo, Mamanuca group, are intermediate in size and appearance between *B. fasciatus* and *B. vitiensis* (Gibbons 1984b), and similar intermediate individuals have been reported from the Rakiraki area, Viti Levu (J.R.H. Gibbons, pers. comm. [May] 1986). Variation and potential natural hybridization in the 2 species remain largely undocumented. There is a distinct need to examine both morphological and biochemical characters in order to confirm the genetic distinctiveness (hence, specific status) of the 2 iguanas, particularly in respect to their likely decreasing numbers and the increasing fragmentation of their habitat.

Taxonomic comments. Confusion has existed on the date of publication of *B. fasciatus* and on the type locality. Gibbons' historical research identified 1800 as the date of Brongniart's description and demonstrated that the 1st specimen must have been derived from Tongatabu. Gibbons also noted that the genus *Brachylophus* must be credited to Wagler (1830).

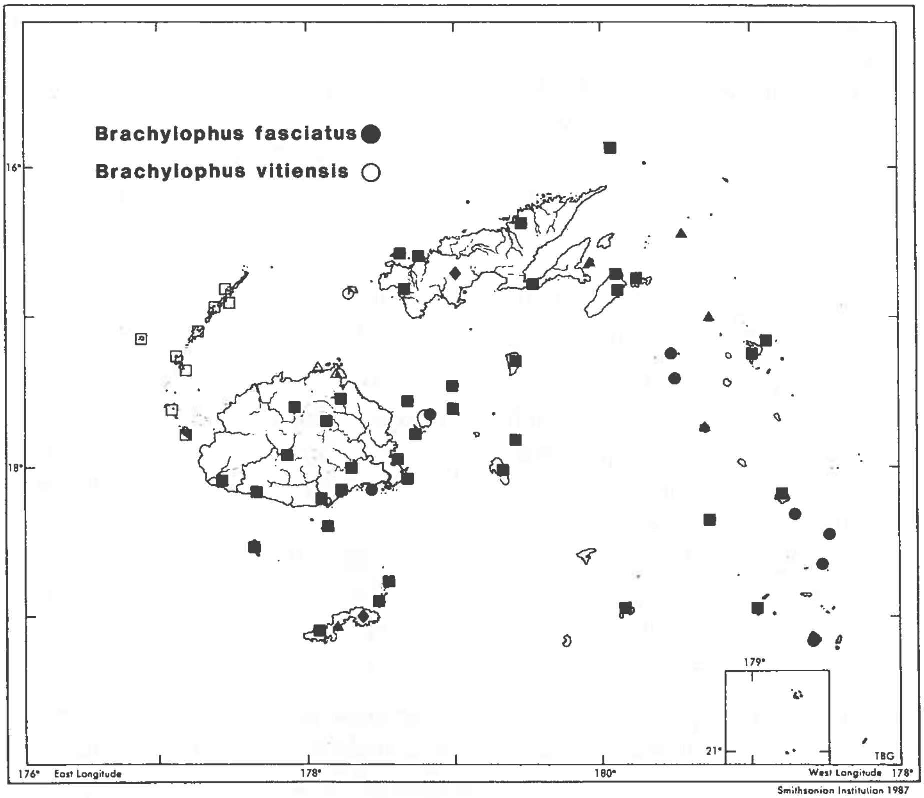
Ctenosaurus Sieberi was introduced by Fitzinger (1843) in a synonymy of *B. fasciatus*, with no explanation. Gibbons (1981a) examined the morphological criteria for *B. brevicephalus* from the Tonga island and concluded that it was a synonym of *B. fasciatus*.

Distribution. This species occurs from the large Fijian islands (Viti Levu and Vanua Levu) eastward through the Lau group (Map 1) to the Tongan islands of Tongatapu, Ha'apai, Vava'u and 'Eua (Gibbons & Watkins 1982) and is reported to have been introduced into Vanuatu (Bauer 1988). Inhabitants of Matuku and Totoya (Moala island group, Fiji) reported (May 1982) it to be absent on these islands.

Ecology. *Brachylophus fasciatus* is strongly arboreal and occurs in coastal and lowland forests, particularly those of swampy areas. Significantly, there are no confirmed occurrences in rain forest. It seems to be most commonly associated with the Tahitian chestnut (*Inocarpus fagifer*), although it also occurs on other native trees and introduced species, such as the mango (see Gibbons & Watkins 1982 for complete list). Diet appears to be mixed insectivory and herbivory. Dietary data are limited, so it is unclear whether age and/or individual preference affect food selection; however, fruits, flowers, and young leaves compose the herbivorous portion.

Behavior. Fijian banded iguanas appear to be entirely diurnal. They typically sleep on low, horizontal branches in sheltered locations: the head and body rest on the branch, forelimbs encircle the branch, and hindlimbs extend outward to touch another branch for additional balance. Similar postures are used for thermoregulation and are modified to reduce or enhance heat uptake.

Males appear to be territorial and aggressively defend their areas from intruding



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

males, at least in captivity (Cahill 1970; Carpenter & Murphy 1978; Cogger 1974; Gibbons & Watkins 1982). Aggressive interactions begin with bobs of the heads, and slowly the banded color pattern intensifies. They move toward one another until, when within 5–10 cm of each other, they turn their heads towards their adversary and open their mouths. Then they lunge at one another and attempt to bite; if successful, the bite is held only briefly. The dominant male slowly forces the other male to retreat (Carpenter & Murphy 1978). Head bobbing is variable in frequency and amplitude, hence is not stereotypic (Greenberg & Jenssen 1982). Social encounters typically evoke profile changes in males as well as color changes. Profile is modified by downward extension of throat, lateral compression of body, and a slight elevation of the dorsal crest.

Mating activity is preceded by a male display: the male moves in front of the female, becomes brightly colored, bobs his head, and often nudges the female along her flanks and neck with his snout (Cogger 1974). The male ends the display by biting and holding the female by the flesh of her neck; copulation lasts only a few minutes. Other behaviors, such as cloacal discharge, tongue flicking, and snorting, also occur as part of social interactions. Tongue flicking is also associated with the exploration of surroundings. Snorting expels salty fluid from the nostrils; the salt glands are well developed and appear to continually excrete salt (Cogger 1974).

Reproduction. Captive lizards living in seminatural enclosures in Fiji show a definite reproductive cycle (Gibbons & Watkins 1982). Courtship and mating begins in November and egg laying occurs from January to early March. Females participate in multiple copulations and may also produce multiple clutches. Eggs are laid in a burrow, approximately as long as the female's body. The eggs are deposited at the entrance, then they are pushed into the burrow with the forefeet. The soil is packed around the eggs by pushing and pressing with the head. Clutches consist of 3–6 eggs, usually 3–4, arranged in a compact cluster. Eggs are elliptical in outline and about 30 mm in maximum length (Cogger 1974, reported average length of 40 mm); the shell is white and parchment-like. The eggs require 125–210 days to hatch.

Under completely artificial conditions (Knoxville Zoo, Arnett 1979), courtship and copulation were most frequent in February and March. Egg laying occurred in June or early July. Clutch size varied from 2–8 eggs; hatching time varied from 163–184 days. A male hatchling reached sexual maturity in 1 year.

Brachylophus vitiensis Family Iguanidae
Fijian Crested Iguana

Brachylophus vitiensis Gibbons 1981a:257. Type locality, "Yaduataba Island (16° 15′S; 178° 20′E), Fiji."

Remarks. The following information derives entirely from the studies of John R. H. Gibbons and Ivy Watkins (1981a, 1982, 1984a, 1984b). Illustrations, see Gibbons 1981: plates I, II, and fig. 3.

Description. Adults 185–223 mm SVL, hatchlings 83–88 mm SVL. Males and females are equal size. Tail length 2–3X SVL. Heavy-bodied and long-limbed lizards. Head large, but dwarfed by nuchal enlargement producing high crest and broad-shouldered appearance. Digits of fore- and hindfeet long and strongly clawed. High crest of enlarged middorsal scales from nape to tail base. Tail weakly compressed laterally and tapering gradually to a point.

Head and body covered by numerous irregular-shaped, non-overlapping scales; scales largest on head, grading across neck to smaller body scales. Mouth bordered by distinct labial scales, 8–10 supra- and infralabial scales on each side. Snout with large medial rostral scale bordered on each side by large elliptical nasal scale, naris usually off center in this scale. Throat with fleshy, folded skin.

In life, green to nearly black background color; narrow, white, black-edged diagonal stripe on neck, and narrow, white, black-edged transverse bands on sides of body. Tail encircled by alternating bands of green and white, white bands usually narrower than green ones. Chin and throat pale green with white mottling; mottling extending ventrolaterally on each side of uniform pale-green chest and belly. Eye pinkish gold; nasal scale pale yellow.

Variation. Only individuals from the type locality have been thoroughly examined and measured.

Distribution. These lizards are presently known from Yadua Tabu and the northern islands of the Yasawa group (Map 1). The *Brachylophus* populations on the northern coast of Viti and Vanua Levu are often labeled as *B. fasciatus* but presumably some represent *B. vitiensis* as well.

Ecology. Brachylophus vitiensis is strongly arboreal and lives in dry beach–lowland forest. In forest lacking the Tahitian chestnut, this lizard is frequently found in Cevu (*Vavaea amicorum*). Captive and distributional data indicate that *B. vitiensis* is adapted to dry habitats and does poorly in cool, moist situations.

There appears to be habitat partitioning between the adult males and all other classes of iguanas (Cogger & Sadlier 1986). Adult males occupy the lower portion of the forest vegetation, and females, subadults and juveniles occur higher, in the canopy. Males also commonly descend and move about on the ground.

There is available only a single estimate of population size for either of the 2 species of Fijian iguanas. That estimate (Cogger & Sadlier 1986) suggests an extremely dense population of 2000–5000 *B. vitiensis* on small Yadua Tabu island. This density appears exceptional.

Behavior. Crested iguanas appear to be entirely diurnal and resemble the banded iguana in thermoregulatory and resting postures. When approached on a branch, crested iguanas swing to the opposite side of the branch to avoid detection. Individuals cantilever themselves off a branch to collect food: the forelimbs grasp the choice vegetation and bring it to the mouth, the hindlimbs grasp the branch, and the tail serves as a counterbalance. The food is eaten in a quick burst.

The aggressive interactions of crested iguanas are essentially identical to those of banded iguanas. The actual encounters may be more severe, because nearly 50% of the adult males show injuries to feet or tails. Cogger & Sadlier (1986) noted that males are strongly territorial and bear numerous scars and mutilations that presumably arise from interspecific encounters.

Adults appear to be strictly herbivorous and, in captivity, eat large quantities of bananas, papayas, and flowers; hatchlings and juveniles eat insects as well as fruits and flowers (Gibbons & Watkins 1982).

Active *B. vitiensis* had body temperatures averaging 32.3°C (27.8–35.9), significantly above ambient temperature (Cogger & Sadlier 1986).

Reproduction. Captive lizards living in seminatural enclosures in Fiji show a definite reproductive cycle (Gibbons & Watkins 1982). Courtship and mating begin in January and extend through March, although males establish territories by late October. There appears to be 1 female in each male's territory, and females migrate en masse to nesting areas in April and May (Gibbons 1981a).

Nesting is much more elaborate in the crested iguana than in the banded iguana. The nest is deeper and longer. The forefeet loosen the soil and fling it backward to the hindfeet which in turn push the soil out of the burrow. The eggs are laid in the burrow and arranged side by side, in a row. Presumably, the same forefeet-scraping and head-packing behaviors seen in *B. fasciatus* are used to fill the burrow. The 2 known clutches contained 4 eggs, each over 35 mm in maximum length. The eggs required 32–36 weeks to hatch.

Gehyra mutilata Family Gekkonidae
Stump-Toed Gecko

Hemidactylus (P.) mutilatus Wiegmann 1835:238. Type locality, "Manila."

Hemidactylus Peronii Duméril and Bibron 1836:352. Type locality, "'Île-de-France."

Hemidactylus platurus Bleeker 1858:31. Type locality, "Java, Sumatra, Nias en Banka"; restricted to "Java" by Smith (1935).

Dactyloperus insulensis Girard 1857:197. Type locality, "Sandwich Islands."

Gecko pardus Tytler 1865:547. Type locality, "Rangoon, Moulmenin and Port Blair"; restricted to "Moulmein" by Smith (1935:105).

Peropus packardii Cope 1869:319. Type locality, "Penang, Malacca."

Hemidactylus Navarri Dugés 1884:311. Type locality, "San Blas."

Gehyra beebei Annandale 1913:306. Type locality, "Kapit, Sarawak, Borneo."

Description. Adults 42–50+ mm SVL, hatchlings 18–23 mm SVL (Philippines, Brown & Alcala 1978). Males and females equal size. Tail length (unregenerated) equal to or slightly longer than SVL and equal in females and males. Stocky, somewhat flattened lizards. Head large and broad, distinct from neck. Digits of the fore- and hindfeet (Fig. 2) with large elliptical digital pads. Slender terminal portion of digit arising from within digital pad and bearing distinct claw on the 2nd through 5th digits; terminal portion greatly reduced to faint ridge of scales on 1st finger and 1st toe; tiny claw occasionally visible at tip of toe ridge; light to moderate webbing

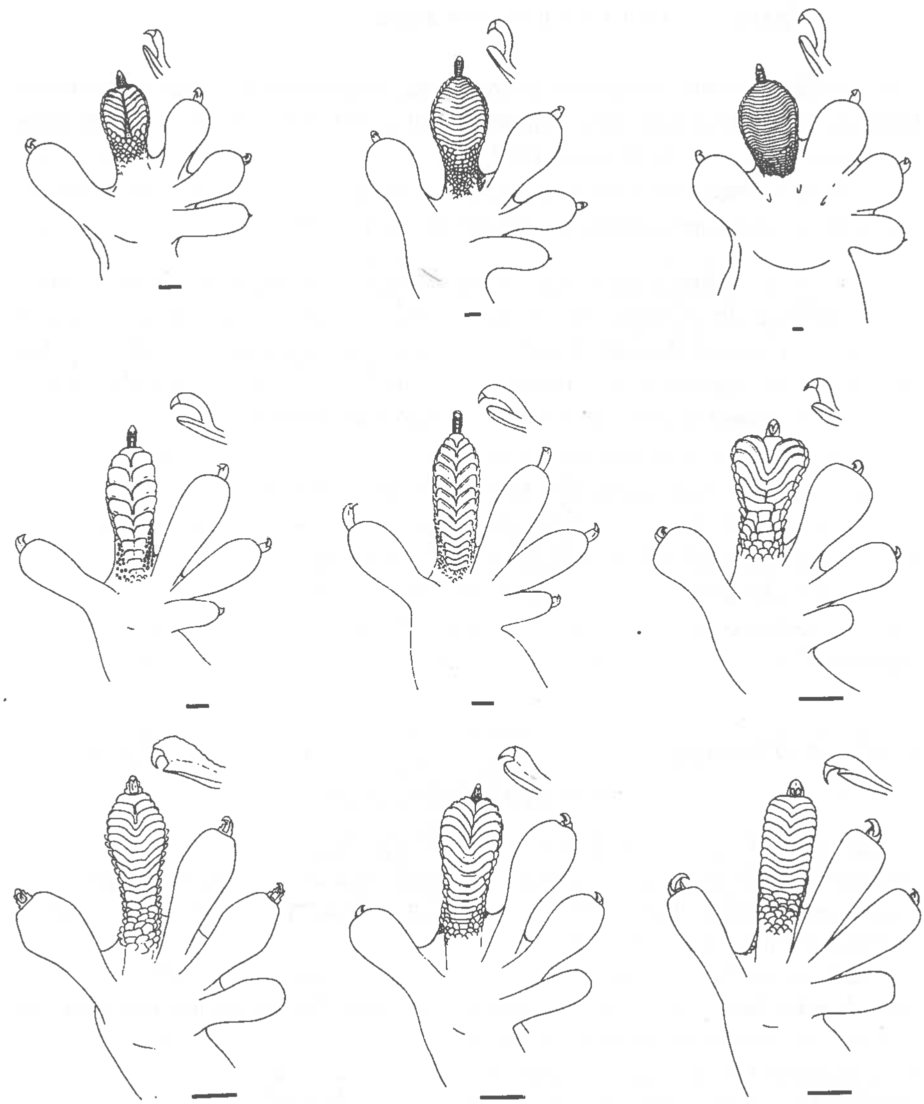
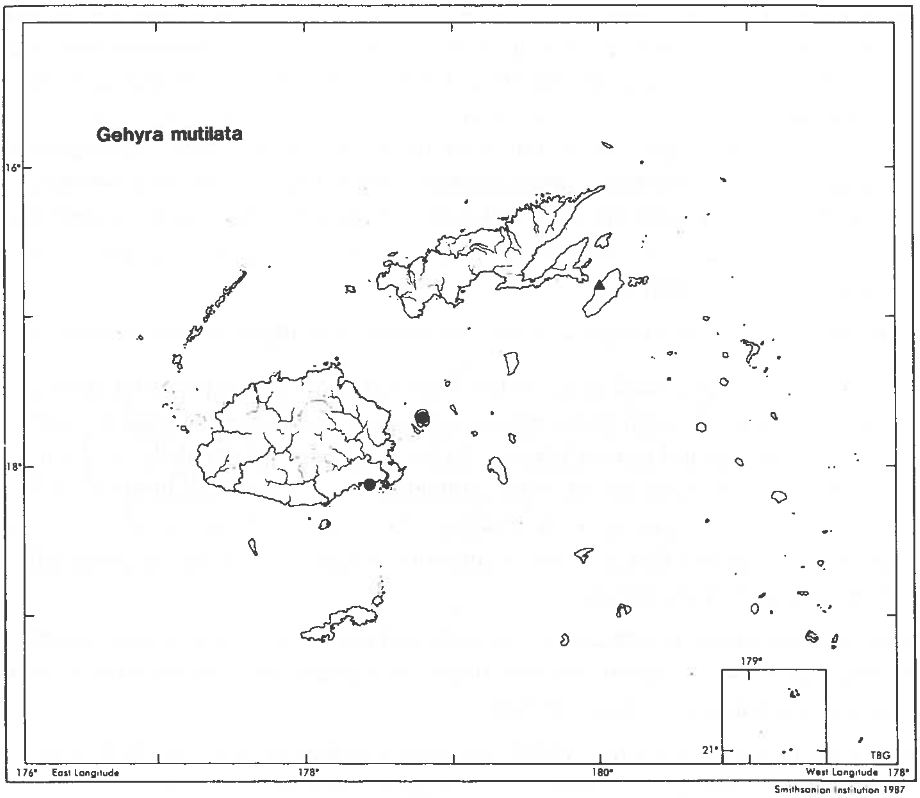


Figure 2. Hindfeet (right, plantar surface) of Fijian geckos with enlarged digital pads. The inset above each hindfoot illustrates the origin of the digit tip from the digital pad. Top row (left to right): *Gehyra mutilata*, composite of USNM 228653–71, Negros I., Philippines; *G. oceanica*, composite of USNM 230199–207, Matuku I., Fiji; *G. vorax*, composite of USNM 5699 (2), Fiji. Middle row: *Hemidactylus frenatus*, composite of USNM 43542,–44, Java; *H. garnotii*, composite of USNM 58935, 59549, 59686, Hawaii; *Hemiphyllodactylus typus*, USNM 230185, Viti Levu, Fiji. Bottom row: *Lepidodactylus gardineri*, composite of USNM 268843–47, Rotuma, Fiji; *L. lugubris*, composite of USNM 229902–08, Taveuni, Fiji; *L. manni*, composite of AMNH 81746–48, Viti Levu, Fiji. Scale = 1.0 mm.



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

between digits of fore- and hindfeet. Tail flattened, broader than high, and tapering gradually to a blunt point.

Body and head covered by numerous small, equal-sized scales in juxtaposition; ventral scales flat, slightly overlapping, and 3–4X larger than dorsal scales. No enlarged scales on top of head or on body. Enlarged scales present around the border of mouth, on snout, and on chin. Five supralabial scales anterior to eye. Rostral scale large, trapezoidal; depressed and cleft dorsomedially. Supranasal scales large and usually in contact medially. Mental (chin) scale nearly twice as large as 1st infralabial; row of postmental scales border anterior 2 pair of infralabials, median pair of postmentals largest and each as large as mental. Digital lamellae broad and divided medially, 8–9 on 4th toe of hindfoot. Tail (unregenerated) uniformly scaled above, no whorls of enlarged scales; ventrolaterally flattened into ridge bearing weakly denticulated scales; ventrally, row of enlarged, smooth scales extend from near vent to tip of tail. Continuous, chevron-shaped row of 32–34 femoral-precloacal pores in adult males.

In life, uniformly light olive to dark olive-brown background color with light and dark spots on head and body. Often, orange spots or bands on posterior surface of hindlimbs. Venter grayish olive to lemon yellow; base of tail may be orange ventrally. Hatchlings and juveniles with adult range of colors and patterns, spots usually brighter and more distinct.

Variation. The samples from Fiji are too small for meaningful statistical analysis.

Distribution. Gehyra mutilata is a widely distributed species, ranging from Madagascar and Sri Lanka through Indochina and the Indoaustralian archipelago to numerous Pacific islands and coastal Mexico. Its far-flung distribution likely results from accidental introductions owing to its commensal association with humans. In Fiji, its presence is confirmed only on Ovalau, Viti Levu, and Rotuma (Map 2). This distribution suggests that it is not a particularly aggressive colonizer when other commensal geckos are present.

Ecology. Elsewhere, this gecko occurs both as a human commensal and in forests. In Fiji, individuals have been captured only on man-made structures or on vegetation immediately adjacent to such structures.

Behavior. G. mutilata is arboreal and nocturnal. Foraging animals have body temperatures only slightly above ambient air temperatures (Cocos, Cogger et al. 1983). When handled, its skin is easily torn and tail easily lost, giving rise to its specific name *G. mutilata.*

Reproduction. Information on the Fijian populations is meager. A 43 mm SVL male showed active spermiogenesis, and a 44 mm female was immature with only previtellogenic follicles. The following data derive from non-Fijian populations (Java, Church 1962; Cocos, Cogger et al. 1983; Marianas, Sabath 1981; Samoa, Schwaner 1980). In Java, some sexually mature females (≥47 mm SVL) are gravid each month. Body size (SVL) of sexually mature individuals is: females 42–50 mm, males 39–50 mm, Marianas; females 40–48 mm, males 40–48 mm, Samoa. Females typically lay 2 eggs (Sabath 1981). Eggs are deposited in cracks and crevices in buildings, beneath tree bark and leaf axils of palms, and in flower bracts of coconut palms. The eggs are always found in cryptic locations and typically 1 meter or more above the ground (Philippines, Brown & Alcala 1978; Cogger et al. 1983). Eggs are 9.5–11.0 mm x 7.4–8.5 mm, 0.31–0.38 g (Cogger et al. 1983; Ota 1989a, Ryukyu islands), and adhesive; incubation appears to be about 60–65 days (Cocos, Gibson-Hill 1950). Hatchlings are 18.5–23.0 mm SVL (Brown & Alcala 1978).

Gehyra oceanica Family Gekkonidae

Oceanic Gecko

Gecko oceanicus Lesson 1828:pl. 2, fig. 3. Type locality, "O-Taïti et à Borabora," in Lesson (1830:42).
Gehyra pacifica Gray 1834:100. Type locality, "in Insulâ quâdam Oceani Pacifici."
Hemidactylus Oualensis Duméril & Bibron 1836:350. Type locality, "Oualan, Taïti, Vanicoro et Tongatabou."
Gehyra gularis Gray 1842:58. Nomen nudum, introduced in a synonymy.

Description. Adults 59–84 mm SVL, 4–17 g, hatchlings 33–34 mm SVL. Females (64–84 mm) and males (59–82 mm), are equal size. Tail length (unregenerated) subequal to SVL and equal in females and males. Stocky, somewhat flattened lizards. Head large and broad, distinct from neck. Digits of fore- and hindfeet (Fig. 2) with large elliptical digital pads. Slender terminal portion of digit with distinct claw and arising from within digital pad. Terminal portion greatly reduced to faint ridge of scales on 1st finger and 1st toe; claw visible only on toe ridge. Light to moderate webbing between digits of fore- and hindfeet. Tail flattened, broader than high, somewhat rectangular in cross-section, tapering gradually to a blunt point.

Body and head covered by numerous small, equal-sized scales in juxtaposition; ventral scales flat, slightly overlapping, and 3–4X larger than dorsal scales. Enlarged head scales (Fig. 3) present only around border of mouth, on snout, and on chin; 5–9 supralabial scales anterior to eye. Rostral scale large, trapezoidal; depressed and cleft dorsomedially. Supranasal scales large and separated by 1–2 moderate-sized scales. Mental (chin) scale subequal to 1st infralabial; row of postmental scales bordered anteriorly by 3 pairs of infralabials; median pair of postmentals largest and each nearly as large as mental. Digital lamellae narrow and undivided, 12–16 on 4th toe of hindfoot. Tail (unregenerated) uniformly scaled above, without whorls of enlarged scales; ventrally, row of enlarged, smooth scales extending from near vent to tip of tail. Usually continuous, chevron-shaped row of 17–41 (usually >30) femoral-precloacal pores in adult males; pores occasionally absent or partially absent on one side.

In life, uniformly light olive to dark olive-brown on head and body; often orange spots or bands on posterior surface of hindlimbs. Venter grayish olive to lemon yellow; base of tail may be orange ventrally. Hatchlings' and juveniles' range of background colors similar to adults; uniformly and faintly banded in light on dark background colors or with some small light spots; venter as in adults.

Variation. Aside from the presence or absence of femoral pores, adult females and males shared similar means and nearly congruent ranges for most morphometric and scale characters. Head width and length of females significantly smaller than males

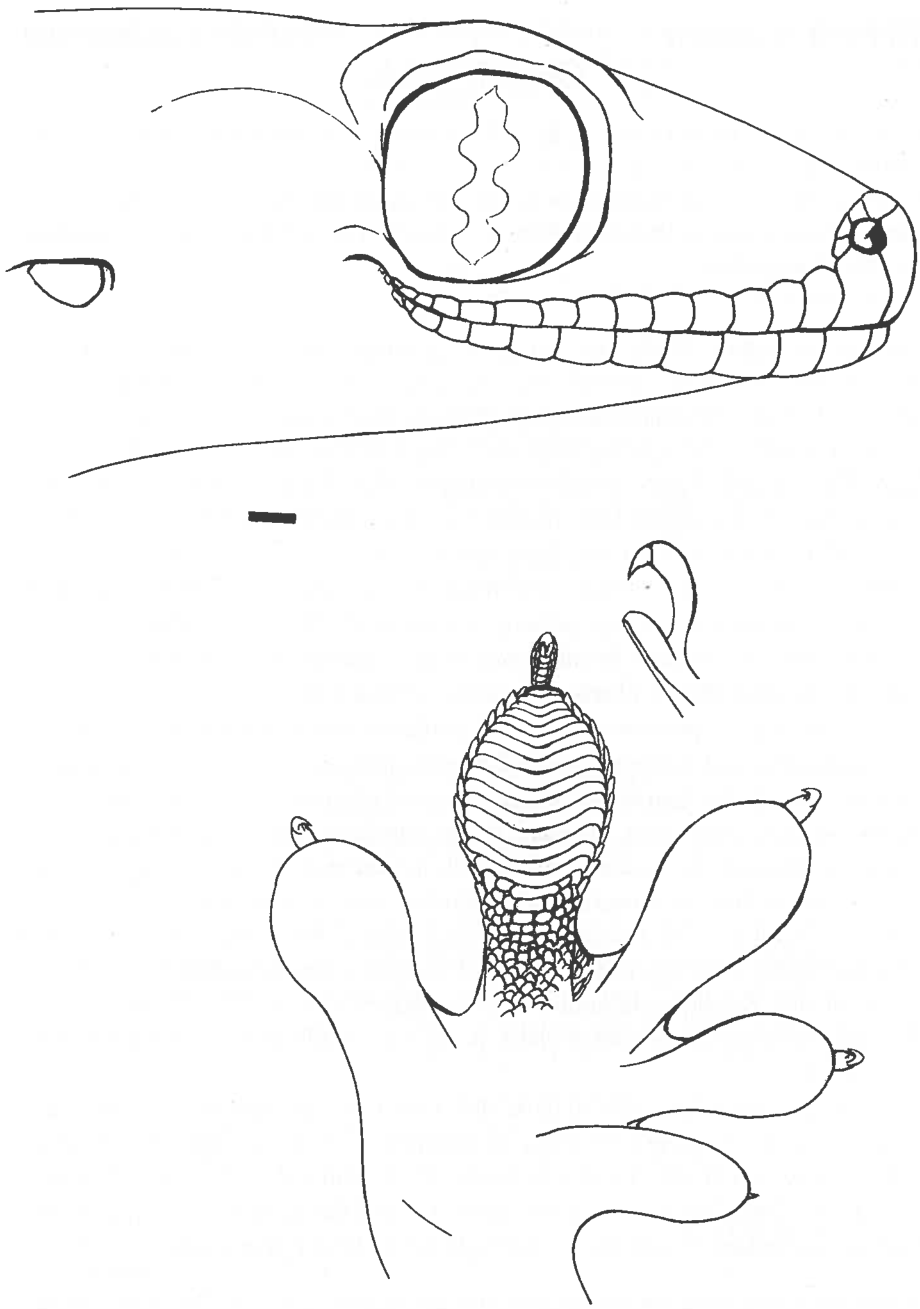
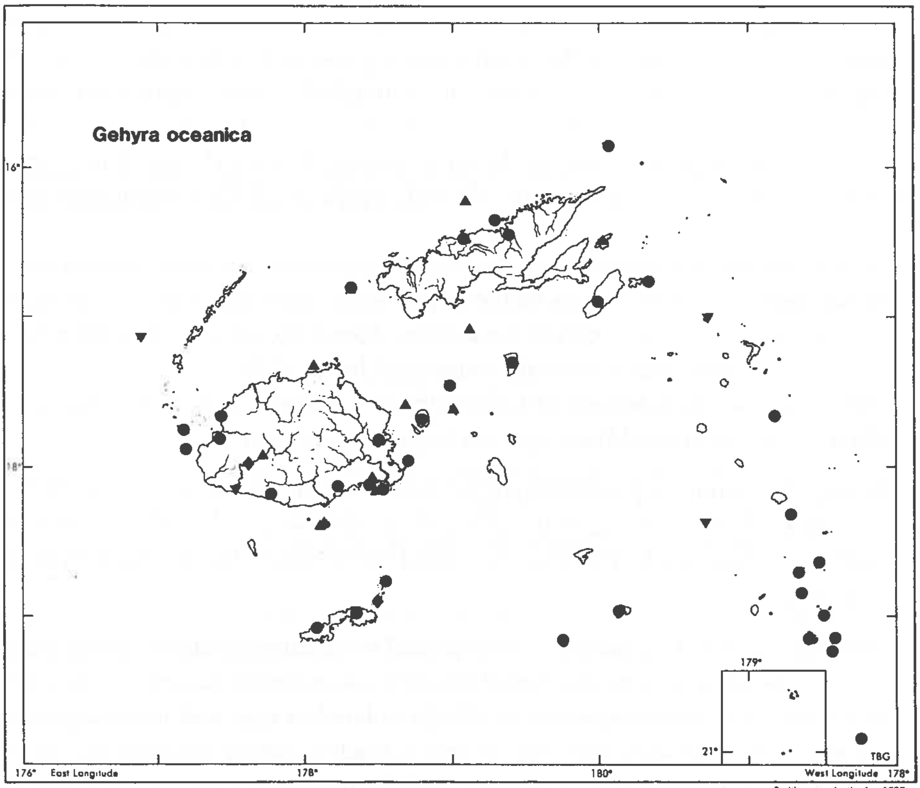


Figure 3. Head (lateral) and hindfoot (plantar) of *Gehyra oceanica*, composite of USNM 230199–207, Matuku I., Fiji. Scale = 1.0 mm.



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

(Appendix: Table C). A comparison of adults from different islands (Rotuma, Ovalau, Viti Levu, Kadavu, and Lau) showed no differences.

Distribution. Gehyra oceanica is wide-ranging throughout the tropical Pacific. It is found throughout the Fijian archipelago and Rotuma (Map 3).

Ecology. This gecko occurs both as a human commensal and in forests. Its occurrence on buildings tends to be associated with rural conditions where forests and gardens are nearby. In these situations, this species and *Lepidodactylus lugubris* may occur in nearly equal abundance. It is uncommon to absent in urban environments, where *L. lugubris* or the recently arrived *Hemidactylus frenatus* dominates. *G. oceanica* occurs regularly and abundantly in forests, from early successional to closed-canopied forests. Here it lives in holes and beneath the bark of erect trunks and branches; only occasionally is the oceanic gecko found on tree branches or logs on the ground. My impression is that it seeks dry resting/hiding sites. In gardens, it often occurs in the axils of taro.

Several individuals may occur on the same tree, but they do not aggregate. There may be some spacing mechanisms, and the high incidence (68%) of regenerated tails suggest intraspecific aggression.

Its diet appears to be exclusively insectivorous, including other arthropods as well, although other geckos may be a major dietary component (Marianas, T. Fritts in litt., November 1989). A wattled honeyeater, *Foulehaio carunculata* captured a gecko, presumably *G. oceanica* in the morning (Clunie 1973).

The linear regression for live SVL (X) to live body mass (Y) is $Y = -8.172 + 0.246X$ ($r^2 = 0.95$, $n = 23$).

Behavior. G. oceanica is predominantly nocturnal in activity, but not exclusively so. I have observed adults resting on trees (mid to late afternoon) adjacent to patches of sunlight or in deep shade. Pickering (in Girard 1858) also noted diurnal activity in this species.

Reproduction. Gehyra oceanica is a communal nester, depositing its eggs in palm axils, beneath bark, and in abandoned termite or woodbeetle tunnels. These communal nests may contain upwards of 20–30 unhatched eggs and numerous shell fragments of hatched eggs. Each female lays 2, rarely 1, nearly spherical eggs ($\bar{x}$ = 12.4 × 13.6 mm, range 11.8–13.1 × 12.6–15.0 mm; $\bar{x}$ = 1.2 g, 1.0–1.4 g; n = 14) with thin, calcareous shells (Schwaner 1980, reports clutches of 1–4 eggs, usually 2, with larger clutches in the larger females). The eggs are non-adherent to one another or the nest surface. Egg clutches have been found in May (Rotuma), and gravid females with oviducal eggs in May (Rotuma), August (Lau), and October (Viti Levu, and Kadavu). Incubation may require 100–115 days (Samoa, Schwaner 1980). Hatchlings range in SVL from 33.1–34.2 mm, tail length 29–34 mm, body mass 0.8–1.0 g (28.0–30.0 mm SVL, Samoa, Schwaner 1980).

A 70 mm SVL male showed active spermiogenesis. The smallest male with enlarged and numerous secreting precloacal pores was 60 mm. A 68 mm female was the smallest female with shelled oviducal eggs. A 64 mm female had midterm vitellogenic follicles; nonetheless, most females are probably not sexually mature at less than 70 mm, because many females of 67–71 mm size had virginal oviducts and only early vitellogenic follicles.

Gehyra vorax Family Gekkonidae
Giant Stump-Toed Gecko

Gehyra vorax Girard 1857:197. Type locality, "Fejee Islands."

Remarks. Knowledge of this gecko is limited. Gibbons & Clunie (1984) provide the only summary of this species' biology.

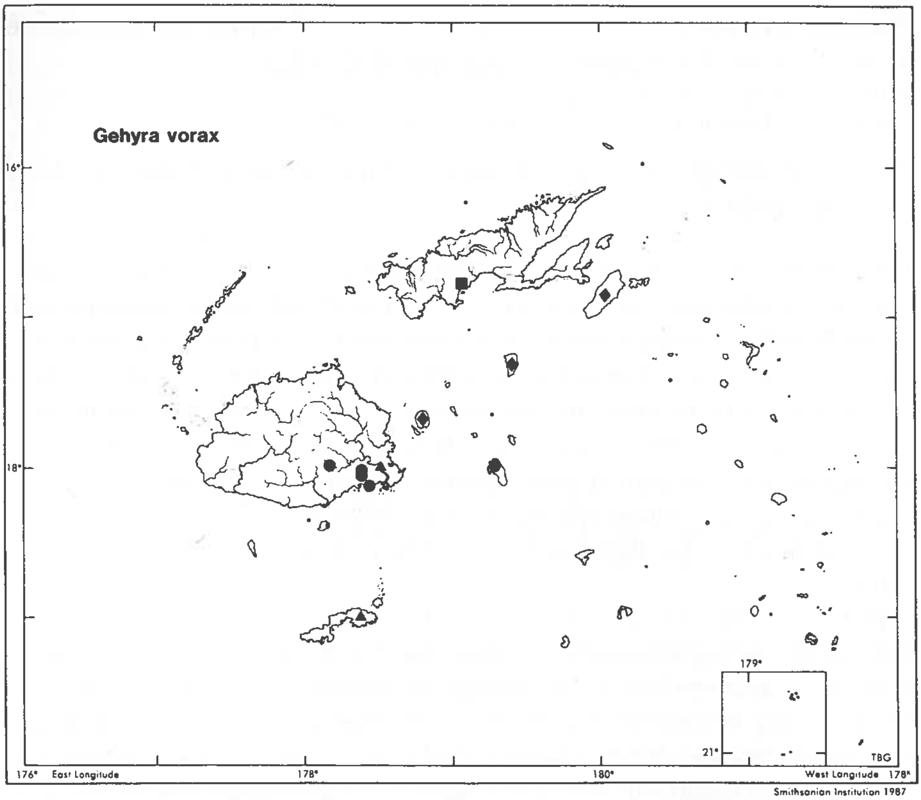
Description. Adults 122–156 mm SVL, hatchling size unknown. Males (122–156 mm SVL) usually larger than females (125–141 mm). Tail length (unregenerated) 0.5–0.7X SVL and equal in females and males. Stocky, somewhat flattened lizards. Head large and broad, distinct from neck. Digits of fore- and hindfeet (Fig. 2) short and broad. Digital pad obovate and broadest at the distal end; slender terminal portion of digit with distinct claw on 2nd through 5th digits and arising from within digital pad. Terminal portion greatly reduced to faint ridge of scales on 1st finger and 1st toe; tiny claw visible only on toe ridge. Moderate webbing between digits of fore- and hindfeet. Tail flattened, broader than high, and tapering gradually to a blunt point.

Body and head covered by numerous small, equal-sized tubercles; ventral scales flat, slightly overlapping, and 3–4X larger than dorsal scales. Scales or tubercles on head similar in size to body scales. Enlarged scales present around border of mouth, on snout, and on chin. Seven to 9 supralabial scales anterior to eye. Rostral scale large and trapezoidal. Nasal scales large and separated by 1–5 scales. Mental scale subequal to 1st infralabial; row of postmental scales bordered anteriorly by 3 pairs of infralabials, median pair largest and each about half the size of mental; remaining postmental scales small and grading rapidly into neck scales. Digital lamellae narrow and undivided, 19–23 on 4th toe of hindfoot. Tail encircled by alternating whorls of enlarged scales. Continuous, chevron-shaped row of 46–78 precloacal-femoral pores in adult males.

A variety of color patterns in life, ranging from uniformly dark brown to irregularly banded in brown and greenish gray, to mottled in a lichenous pattern of browns, grays, and greens.

Variation. As for *G. oceanica*, *G. vorax* shows no apparent sexual dimorphism in scalation (excluding precloacal-femoral pores) and morphometrics. The samples from the various islands are too small for meaningful statistical comparison.

Taxonomic comments. Until 1932, *G. vorax* was recognized as a distinct species and the largest *Gehyra*. Burt & Burt (1932) were unable to differentiate it from *G. oceanica* on the basis of total number of femoral pores and relegated the name to the synonymy of *G. oceanica*. Although there has been no formal taxonomic analysis,



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recent workers recognize this large gecko as a distinct species. The distinctiveness of the 2 species is reinforced by the recognition of a different mite species on each of these geckos (Bertrand & Ineich 1986) and the occurrence of *G. oceanica* throughout *G. vorax*'s range. Beckon (1992) summarizes the morphological differences between these 2 species and among the numerous insular populations of each species.

Distribution. Gehyra vorax occurs in southern Papua New Guinea, Vanuatu, Fiji, and Tonga (BMNH). In Fiji, it occurs on the large western islands (Map 4).

Ecology. Gibbons & Clunie (1984) state that "it [*G. vorax*] is certainly quite common in trees in the Fiji bush." However, my experience and its rarity in museum collections suggest low densities and/or occupancy of the upper levels of the forest.

Individuals have been taken in the crowns of wild pandanus, and in breadfruit, coconut, and banana trees.

Behavior. Like the oceanic gecko, it is reported to be active during the day as well as at night. It is presumably insectivorous, although fruit may be an important component of its diet, since it thrives on papaya in captivity. It has a distinct call that sounds like the bark of a dog.

Reproduction. There are few field observations on the reproductive behavior of *G. vorax*. Presumably, eggs are deposited in sites similar to those of *G. oceanica* although likely higher in the trees. Preserved females contain 2 nearly spherical eggs (approximate diameter 20 mm); 2 eggs laid in captivity were both 18 × 20 mm and 3.9 g (Gibbons & Zug 1987). A gravid female was collected in December (Viti Levu). The smallest female with oviducal eggs was 142 mm; a 133 mm female was the largest with maturing ovarian follicles (15.7 mm diam). The smallest male with actively secreting precloacal pores was 115 mm SVL; no *G. vorax* testes were examined for spermatogenic activity.

Hemidactylus frenatus Family Gekkonidae
House Gecko

Hemidactylus frenatus Duméril and Bibron 1836:366. Type locality, "l'Afrique australe, et... tout l'archipel des grandes Indes"; restricted to "Java" by Loveridge (1947:127).
Hemidactylus Bojeri Fitzinger 1843:106. Type locality, "Africa. Madagascar. Mauritus."
Hemidactylus javanicus (Cuv.) Fitzinger 1843:106. Type locality, "Asia. India. Bengala. Ceylon. Java. Timor. Amboina. Ins. Mariannae."; restricted to "Java" by Loveridge (1947:127).
Hemidactylus vittatus Gray 1845:155. Type locality, "Borneo."
Hemidactylus punctatus Jerdon 1853:467. Type locality, "Tellicherry."
Hemidactylus inornatus Hallowell 1861:469. Type locality, "Loo-Choo."
Hemidactylus pumilus Hallowell 1861:502. Type locality, "Hong Kong."
Gecko chaus Tytler 1865:547. Type locality, "Moulmein and Rangoon"; restricted to "Rangoon, Burma" by Loveridge (1947:128).
Gecko caracal Tytler 1865:547. Type locality, "Rangoon."
Hemidactylus longiceps Cope 1869:320. Type locality, "Manilla."
Hemidactylus hexaspis Cope 1869:320. Type locality, "Madagascar."
Peripia papuensis Macleay 1878b:97. Type locality, "Katow."
Hemidactylus tristis Sauvage 1879:49. Type locality, "le nord de la Nouvelle-Guinée."
Hemidactylus nigriventris Lidth de Jeude 1905:188. Type locality, "Sintang."
Hemidactylus fragilis Calabresi 1915:236. Type locality, "Bur Meldac."
Hemidactylus vandermeer-mohri Brongersma 1928:1. Type locality, "Pulu Berhala."
Hemidactylus okinawensis Okada 1936:271. Type locality, "Okinawa-jima."

Description. Adults 48–58 mm SVL and 2.0–4.5 g, hatchlings 19–21 mm SVL (Samoa, Schwaner 1980). Average female and male sizes are equal, although males often attain larger sizes. Tail length subequal to SVL and equal in females and males. Moderately built, somewhat flattened lizards. Head large and broad, distinct from neck. All digits of fore- and hindfeet (Fig. 2) have expanded digital pads. Digital pads oblong in shape with distal end only slightly wider than proximal end; slender terminal portion of digit arising from within digital pad of all digits. Claws on all digits; light webbing at base of digits. Tail flattened, broader than high, and tapering gradually to a blunt point.

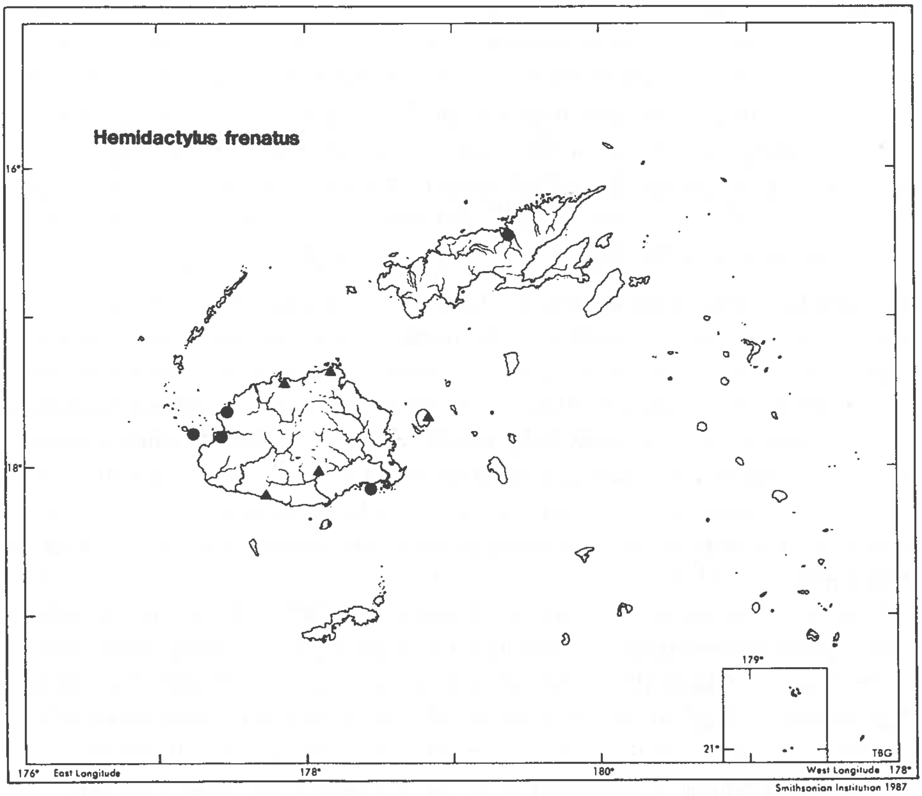
Body and head covered by numerous small, equal-sized scales and widely scattered enlarged tubercles on the back; ventral scales flat, slightly overlapping, and subequal to dorsal tubercles. Enlarged head scales only around border of mouth, on snout, and on chin. Four to 6 supralabial scales anterior to eye. Rostral scale large, trapezoidal, and cleft dorsomedially. Supranasal scales large and in contact above the rostral or separated by a single scale. Mental scale large; 2 pairs of enlarged postmental scales, 2nd pair touching infralabials. Digital lamellae large, paired except for undivided distal-most lamella on the pad, 8–11 on 4th toe of hindfoot; lamellae extending to base on all digits. Distinct whorls of scales around the tail; laterally and dorsally, each whorl edged with 5–6 enlarged denticulate scales; ventrally, median row of enlarged scales from vent to tip of tail. Continuous, chevron-shaped row of 15–32 (usually >28) precloacal-femoral pores in adult males.

In life, either a uniform beige to grayish beige color, or a series of olive-brown crossbars and stripes on a beige background. Venter pale yellow or beige; underside of tail and vent area often pale orange, always orangish in hatchlings and juveniles.

Variation. There is no apparent sexual dimorphism in scalation (except precloacal-femoral pores) and only head width is sexually dimorphic for the morphometric traits. Females have a significantly narrower head. The sample sizes for different islands are inadequate for meaningful statistical comparison.

Taxonomic comments. Bastinck (1984, 1985, respectively) showed *H. vandermeermohri* and *H. nigriventris* to be synonyms of *H. frenatus*. Ota (1989b) synonymized *H. okinawensis* with *H. frenatus*.

Distribution. This species is a commensal of humans and has obtained a worldwide subtropical-tropical distribution, although of spotty occurrence outside of Asia. Its arrival and successful colonization in Fiji occurred recently. *H. frenatus* was captured 1st from the Nadi-Latoka area in 1980. In 1986, the house gecko was well established in the Suva and Labasa areas and can be expected to continue its colonization of Fiji (Map 5).



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

Ecology. The house gecko occurs only on buildings and other man-made structures in Fiji. Although observations are limited, the house gecko seems to dominate the other commensal gecko, *Lepidodactylus lugubris*. The latter gecko appears to be excluded from buildings possessing large crevices that serve as diurnal retreats for the house gecko. Whether this exclusion results from competition, predation, or a combination of the 2 is unknown; however, many buildings on the campus of the University of the South Pacific had large populations of *L. lugubris* in 1982 and had no or few *L. lugubris* in 1986.

The linear regression for live SVL (X) to live body mass (Y) is $Y = -3.844 + 0.135X$ ($r^2 = 0.97$, $n = 8$).

Behavior. H. frenatus is nocturnal, emerging at full darkness. Activity in non-Fijian *H. frenatus* (Bustard 1970a; Marcellini 1971; Chou & Leong 1984) is concentrated in the early portion of the evening with most individuals being active for the 1st several hours after sunset and declining rapidly thereafter with a slight increase in activity immediately prior to sunrise. This activity exists in individuals when tested in constant darkness and at constant temperatures, so that the activity cycle is an endogenous rhythm; however, rainfall, changing temperature, and other environmental factors can modify the behavior of an individual or of an entire population.

Reproduction. The small sample available from Suva shows females and males greater than 47 mm SVL to be sexually mature. Studies of non-Fijian populations suggest maturity at a smaller size (males 36 mm SVL, Taiwan, Cheng & Lin 1977; females 44 mm, Java, Church 1962; females 37 mm, males 36 mm, Marianas, Sabath 1981; females 43 mm, males 40 mm, Samoa, Schwaner 1980). Histological examination of males from the Marianas (Zug unpubl. data) show spermiogenesis in a 44 mm SVL male but not in a 47 mm one, thereby indicating variable rates of maturity within the same population and possibly different minimum.mature sizes for different populations.

Data from non-Fijian populations (Cheng & Lin 1977; Church 1962; Fukada 1965; Sabath 1981; Schwaner 1980) give the following reproductive characteristics for *H. frenatus*. Clutch size is typically 2 nearly spherical (8 x 9 mm), hard-shelled eggs (rarely 1). Eggs are laid in a variety of crevice situations, between boards or shingles of houses, beneath bark, and in plant axils (Philippines, Brown & Alcala 1978). Incubation is 77–88 days, and the hatchlings are 19.0–21.0 mm SVL (Marianas), 18.5–22.0 mm SVL (Philippines); 2 hatchlings averaged 18.7 mm SVL (Cocos, Cogger et al. 1983). Two presumed hatchlings (i.e., possessing yolk-sac scars) were 20–21 mm SVL and were collected in May (Viti Levu). Gravid females occur in all months in tropical areas; in temperate areas, males show a distinct spermatogenetic cycle with maximum spermiogenesis occurring in late spring.

Hemidactylus garnotii — Family Gekkonidae

Fox Gecko

Hemidactylus peruvianus Wiegmann 1835:240. Type locality, "Peru, bei Tacna"; probably in error, see taxonomic comments below.

Hemidactylus Garnotii Duméril & Bibron 1836:368. Type locality, "l'île de Taïti."

Doryura vulpecula Girard 1857:197. Type locality, "Sandwich Islands."

Hemidactylus Ludekingii Bleeker 1859a:27. Type locality, "Agam, Padangsche bovenlande."

Doryura gaudama Theobald 1868:30. Type locality, "Tonghu (valle Sittangensi)."

Hemidactylus Mortoni Theobald 1868:32. Type locality, "Teikgyie, north of Rangoon."

Hemidactylus (Doryura) mandellianus Stoliczka 1872:101. Type locality, "Pankabari, just above the Sikkim Terai, and . . . the Rungnu and Tístá valleys."
Hemidactylus blanfordii Boulenger 1885:141. Type locality, "Himalayas."

Description. Adults 51–58 mm SVL, hatchlings about 25 mm SVL. Tail length (unregenerated) 1.25–1.5X SVL. Moderately robust and somewhat flattened lizards. Head width equals body width; neck commonly swollen on each side by enlarged endolymphatic sacs. All digits of fore- and hindfeet (Fig. 2) have expanded digital pads. Digital pads oblong with distal end only slightly wider than proximal end; slender terminal portion of digit arising from within digital pad of all digits. Each digit has distinct claw and light webbing at base of digits. Tail compressed, broader than high, and tapering gradually to a blunt point.

Body and head covered by numerous small, equal-sized scales. No enlarged scales on back or sides; ventral scales flat, slightly overlapping, and 5–6X larger than dorsal scales. Enlarged head scales only around border of mouth, on snout, and on chin and anterior portion of the throat. Six to 8 supralabial scales anterior to eye. Rostral scale large, trapezoidal, and cleft dorsomedially. Supranasal scales large and separated by 1–2 scales above rostral. Mental scale large; 2 pairs of enlarged postmental scales, 2nd pair rounded, behind 1st pair and separated from infralabials by a row of small scales. Digital lamellae broad and distal, 4 or 5 lamellae strongly cleft, 12–14 on 4th toe of hindfoot; lamellae of all digits reach base of digit. Row of enlarged denticulated scales along each ventrolateral edge of tail; no whorls of scales around tail.

In life, brownish gray or gray with a row of small, light spots parasagittally and laterally. Venter white to lemon yellow and underside of tail often orangish.

Variation. Samples from Fiji are too small for meaningful statistical analysis.

Kluge & Eckardt (1969) showed the Hawaiian and Floridian populations to be triploid (N = 23; 3N = 70). The Vietnamese population of *H. garnotii* was found to have a different karyotype (N = 20; 3N = 60) and was recognized as a distinct species *Hemidactylus vietnamensis* Darevsky et al. (1984). The populations of Taiwan, Hainan, and Yunnan, formerly assigned to *H. garnotii* were recognized as being morphologically distinct from one another and from the Hawaiian population, thereby suggesting additional karyotypic races (Ota, Hikida, & Zao 1986). The Taiwan population has a distinct triploid karyotype (3N = 56) and is now recognized as *H. stejnegeri* (Ota & Hikida 1989). They also suggest that other karyotypic races exist in Oceania. If such do exist, identification of the different karyotypic populations may provide an opportunity to trace the dispersal of *H. garnotii* group populations (clones) throughout the Pacific.

Taxonomic comments. The synonymy derives from Kluge & Eckhardt (1969). They also examined the type of *H. peruvianus* and discovered that the specimen closely matches typical *H. garnotii*. Since they believe the type locality to be in error and the name to have been used rarely, they recommended the use of *garnotii* for the sake of nomenclatural stability.

Distribution. This species has a peculiar distribution in Fiji (Map 6). Pernetta & Watling (1979) reported that it was confined to buildings on Viti Levu and Taveuni. Those museum specimens with field notes also indicate a commensal association with humans; however, these specimens derive mainly from highland localities rather than from coastal areas and ports. *H. garnotii* occurs on mainland southeast Asia from eastern India southward through the Indoaustralian archipelago into northern Australia, and eastward through Oceania, including the Philippines, New Caledonia, and Polynesia. Its reported occurrence in Brazil and Peru is probably due to specimens with incorrect locality data (Kluge & Eckhardt 1969).

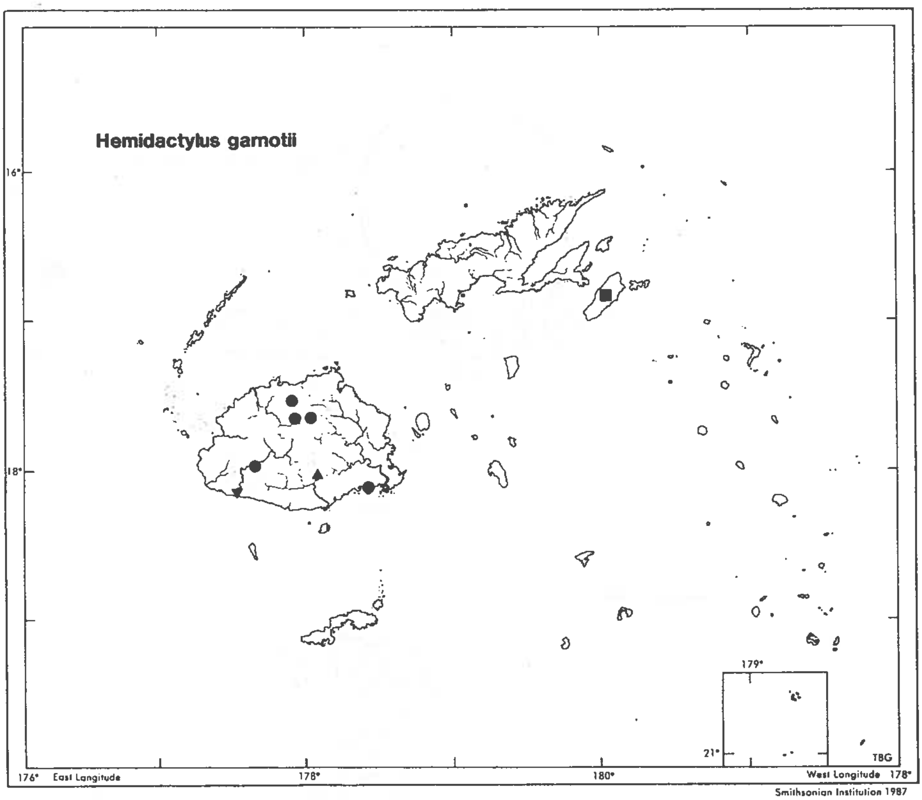
Ecology. Kluge & Eckardt (1969) and Dryden & Taylor (1969) concluded that Cagle's (1946) ecological observations of *H. garnotii* on Tinian Island should be attributed to *H. frenatus*.

Behavior. The fox gecko is arboreal and predominantly nocturnal, although it is occasionally seen during the day (McKeown 1978).

Reproduction. All populations of *H. garnotii* appear to be parthenogenetic (Kluge & Eckardt 1969). This all-female species lays 2 nearly spherical to ellipsoidal, non-adherent eggs, ranging in size from 8.7–8.9 x 9.4–17.0 mm (Hawai'i, Hunsaker & Breese 1967) to 9 x 10 mm (Tonga, Gibbons & Zug 1987) to 9–10 mm (maximum diameter of oviducal eggs, Viti Levu). Incubation may be as long as 64 days (Hawai'i, Hunsaker & Breese 1967). Hatchlings are 22.5–26.0 mm SVL (Hawai'i, Oliver & Shaw 1953), 27–28 mm SVL, 19–21 mm tail length, 0.3–0.4 g body mass (Tonga, Gibbons & Zug 1987), 25 mm SVL (Viti Levu). The smallest Fijian female with oviducal eggs was 54 mm SVL, with enlarged vitellogenic follicles 51 mm SVL.

Hemiphyllodactylus typus — Family Gekkonidae
Indopacific Tree Gecko

Hemiphyllodactylus typus Bleeker 1860:327. Type locality, "Goenong Parong (Java)."
Spathodactylus mutilatus Günther 1872b:594. Type locality, "East-Indian archipelago."
Lepidodactylus ceylonensis Boulenger 1885:164. Type locality, "Ceylon."
Hemiphyllodactylus leucostictus Stejneger 1899:800. Type locality, "Kauai, Hawaiian Islands."
Hemiphyllodactylus insularis Taylor 1918:237. Type locality, "Sumagui, Mindoro."



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Hemiphyllodactylus margarethae Brongersma 1931:11. Type locality, "Fort de Kock, Sumatra."

Description. Adults >40 mm SVL, hatchlings 15–17 mm SVL. Tail length usually less than body length. Slender, elongate lizards. Moderate-sized head distinct from neck. Second to 5th digits of fore- and hindfeet (Fig. 2) long with distinct digital pads and distinct claws; 1st digit rudimentary and without claw. Digital pad obovate with broadest end distally; slender terminal portion of digit arises from within digital pad; very slight webbing between bases of digits. Tail slender, cylindrical, tapering gradually to a blunt point.

Body and head covered by numerous small, equal-sized scales; ventral scales flattened, non- to barely overlapping, and 2–3X larger than dorsal scales. Enlarged

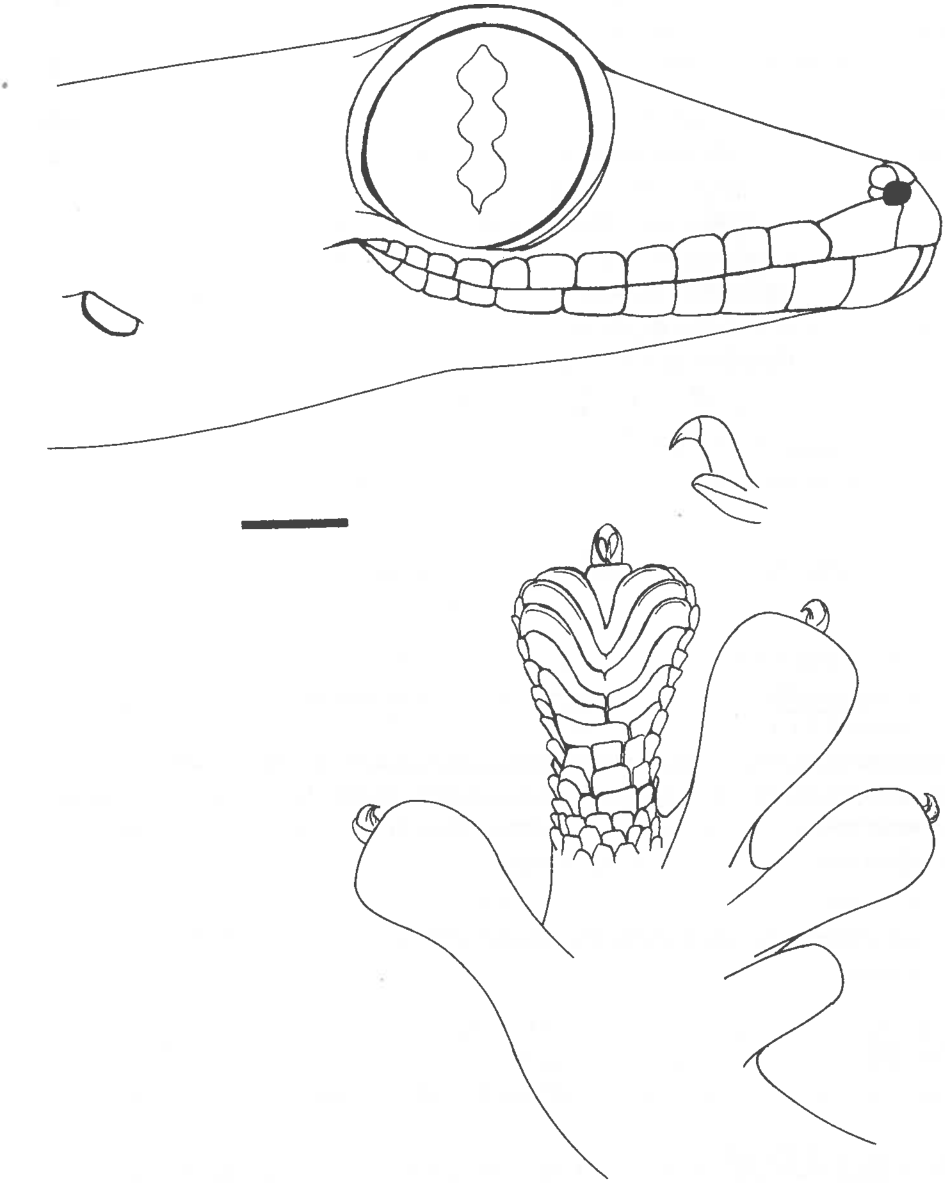
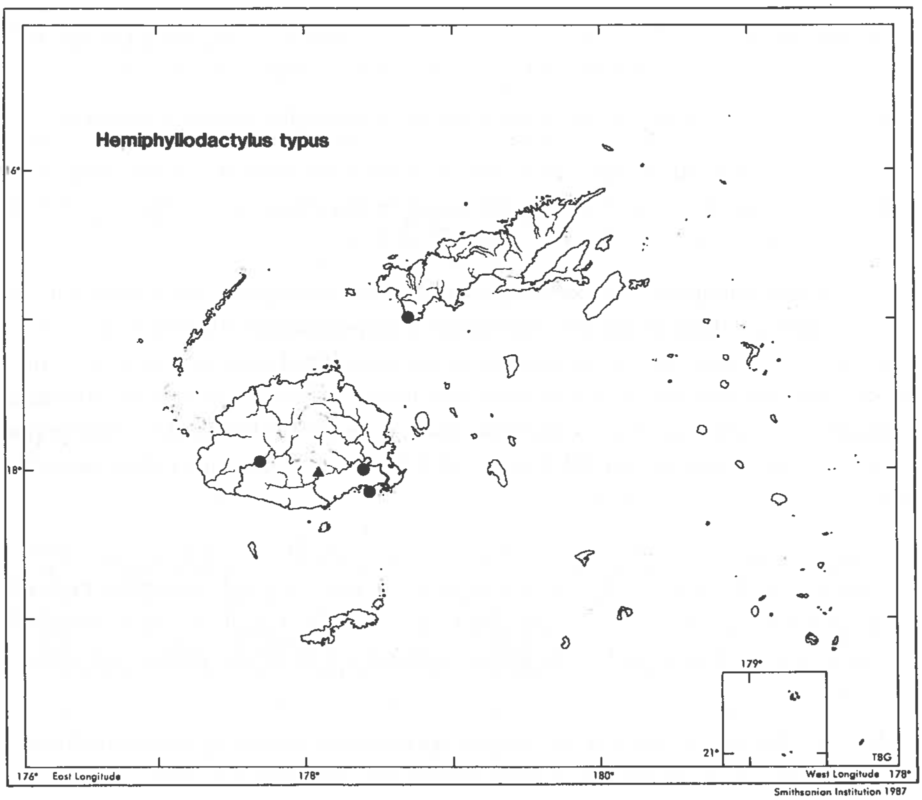


Figure 4. Head (lateral) and hindfoot (plantar) of *Hemiphyllodactylus typus*, USNM 230185, Viti Levu, Fiji.



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

head scales only around border of mouth (Fig. 4). Four to 6 supralabial scales anterior to eye. Rostral scale large and trapezoidal. Supranasal scales small, only slightly larger than adjacent head scales. Mental scale slightly smaller than adjacent infralabials; postmental scales small, barely larger than adjacent throat scales. Digital lamellae moderately wide, lyre-shaped, divided on pad, straight and undivided on base of pad, and 6–7 on 4th toe of hindfoot. Tail covered by subequal-sized scales, approximately 2–3X larger than dorsal body scales. Chevron-shaped row of 7–12 weakly developed precloacal pores separated from 0–7 tiny femoral pores on each side.

In life, dusky brown on back and sides, head lighter dusky tan with a narrow, dark postocular stripe extending along neck to axilla; postocular stripe bordered dorsally by 4 small, white spots. Back with distinct to indistinct narrow, dark-brown chevrons and occasionally a series of small, light spots dorsolaterally. Venter dusky beige. Tail lighter than back with indistinct chevrons and dusky orange color below.

Variation. Samples from Fiji are inadequate for meaningful statistical analysis.

Taxonomic comments. Kluge (1968) reviewed the relationships of *Hemiphyllodactylus* (*Lepidodactylus* and *Pseudogecko* are its closest relatives) and the accuracy of Wermuth's synonymy (1965), with which he concurred.

Distribution. This species, as currently recognized, is widespread from India and Sri Lanka eastward through the Indoaustralian archipelago into the Pacific islands to Hawai'i. It is commonly considered to be an introduced species, but presumably some of its distribution in Oceania is natural. Its present distribution in Fiji has been confirmed only for Vanua Levu and Viti Levu, although it is likely more widespread (Map 7). The earliest record (BMNH 1938.8.2.7) is from the mid-1930s along the Rewa River.

Ecology. Because of its retiring behavior and presumably low abundance, little is known about this species. It is predominantly a forest animal, occurring beneath bark and within leaf axils on trees (McCoy 1980). In Fiji, it has been found in overgrown garden plots within the axils of pandanus and similar plants, and also on buildings.

Behavior. The tree gecko is a very cryptic species even during its nocturnal forays. On buildings, it occurs in the darkest areas and uncommonly there. I have not observed it on vegetation at night, but during the day, it hides in the bases of leaf axils and moves quickly as soon as exposed.

Reproduction. The reproductive biology of *Hemiphyllodactylus* is poorly known. The Oceanic populations appear to be unisexual, and some Indomalayan populations are bisexual (Zug pers. observ.). The Fijian sample is small and contained no gravid (with oviducal eggs) females; a 42 mm SVL female had enlarged vitellogenic follicles. Eggs are small (5.7–6.6 mm diameter, Hawai'i, Snyder 1917), adherent, hard-shelled spheres laid beneath bark or in clusters of bamboo stalks (5.6–6.6 mm diameter, Java, Brongersma 1932), in rotting logs on forest floor, and in axils of aerial ferns (Philippines, Brown & Alcala 1978). Dissection of 3 gravid females (35.5, 37.8 mm SVL, Hawai'i; 36.0 mm, Tonga) revealed oviducal eggs of 6.4, 4.4, and 6.4 mm diameter, respectively, and clutches of 1–2 eggs. Two presumed hatchlings (visible yolk-sac scars) from Hawai'i were 15.4 and 16.9 mm SVL (14.3–16.1 mm, Brown & Alcala 1978).

Lepidodactylus gardineri Family Gekkonidae
Rotuman Forest Gecko

Lepidodactylus Gardineri Boulenger 1897:306. Type locality, "Rotuma, north of the Fiji Islands."

Description. Adults 48–53 mm SVL and 2.0–2.8 g, hatchling size unknown. Males and females are equal size. Tail length slightly less than SVL and equal in females and males. Moderately stocky lizards. Head moderate size and broad, distinct from neck. Digits of fore- and hindfeet (Fig. 2) long with digital pads and distinctly clawed except for 1st digit. Digital pad elongate and obovate with broadest end distally; slender terminal portion of digit arises from edge of digital pad of 2nd through 5th digits; light webbing at bases of digits. Tail short and cylindrical, tapering gradually to a blunt point.

Body and head covered by numerous small, non-overlapping scales, smallest on back and gradually enlarging and flattening ventrally (belly scales 2–3X dorsal ones). Scales on head similar in size to body scales. Enlarged head scales present around border of mouth, on snout, and on chin. Five to 7 supralabial scales anterior to eye. Rostral scale large and trapezoidal. Supranasal scales moderate size and separated by 1–4 scales above rostral. Two to 3 rows of moderately enlarged postmental scales, grading rapidly into small throat scales. Digital lamellae of moderate width and mostly undivided; penultimate 2 or 3 lamellae of 2nd to 5th toes divided; 11–17 lamellae on 4th toe of hindfoot. Tail encircled by scales similar in size to those of body. Adult males have continuous, chevron-shaped row of 37–43 precloacal-femoral pores.

In life upon first capture, uniformly dark brown dorsally and laterally, bright yellow ventrally; rapidly lightening to a mottled black on grayish olive background or to a uniform gray; head typically darker than body. Venter somewhat lighter, with vent area remaining bright yellow. Black tongue and buccal cavity.

Variation. Females and males are dimorphic in the number of scales between the nares, in the occurrence of precloacal pores, and in head size (Appendix: Table C). Females lack precloacal pores, have fewer internarial scales, and have significantly narrower and shorter heads than males.

Distribution. Lepidodactylus gardineri is a Rotuman endemic, currently known only from the secondary growth forest of Rotuma.

Ecology. Lepidodactylus gardineri is highly arboreal, living beneath bark or within termite galleries of dead tree branches. Vacant termite galleries in the tree *Acalypha grandis* were the preferred microhabitat; approximately 75% of my captures derived from this species of tree. Other trees included coconut palms, breadfruit, and orange, all rotten with termite galleries. *A. grandis* is a bushy tree with numerous trunks or vertical branches; these trunks seldom grow beyond 10 cm diameter at the base before dying. Thus, most trees have several dead trunks, and each trunk is galleried by termites. These galleries in upright trunks are dry, even after several days of heavy rain. Dryness seems to be preferred by *L. gardineri* (only 4 of 29 specimens were found in damp situations). The termite galleries often had small colonies (2–5 individuals) of *gardineri* as well as occasionally a *Lipinia* or *Gehyra oceanica.*

The total sample included 6 males, 7 females, and 16 juveniles; no hatchlings or eggs were found. The linear regression of live SVL (X) to live body mass (Y) is $Y = -2.112 + 0.087X$ ($r^2 = 0.86, n = 29$). Body temperatures were obtained for only 2 individuals, 26.8°C and 30.0°C, only slightly above substrate temperature.

Behavior. This gecko was never observed on the surface, but was always found beneath bark or in vacant termite galleries. Perhaps it feeds on the surface at night; my nocturnal observations were too limited to confirm such foraging. Individuals would occasionally emerge from the termite galleries as the tree trunk was being broken off. They appeared to attempt to leap to adjacent trunks or branches. If they fell to the ground, they remained motionless or moved stealthily.

Multiple individuals in a single termite gallery were found 7 times in 17 captures. Five of the captures contained 2 individuals, an adult female and an adult male, with the female always the larger of the pair. Two captures contained 5 individuals each, with at least 1 each adult male and female. Regenerated tails occurred in 78% of the individuals captured and as frequently in juveniles as in adults.

Reproduction. No eggs were discovered in any of the termite galleries examined or in any adjacent rotten trees or leaf axils. The smallest and only female with oviducal eggs was 51.5 mm SVL; she bore 2 spherical eggs (8 mm diameter). A 50.5 mm male possessed testes in spermiogenesis but had smaller testes than a 49.8 mm male. A 46.7 mm male had not begun spermatogenesis, suggesting that males mature at 48–49 mm SVL.

Lepidodactylus lugubris — Family Gekkonidae
Mourning Gecko

Platydactylus Lugubris Duméril & Bibron 1836:304. Type locality, "l'île d'Otaïti."
Peropus neglectus Girard 1857:197. Type locality, "Rio de Janeiro, Brazil."
Hemidactylus Meijeri Bleeker 1859b:47. Type locality, "Bitang."
Dactyloperus Pomareae Fitzinger 1861:400. Type locality, "Taiti."
Peripia cantoris Günther 1864:110. Type locality, "Pinang."
Gecko Harrieti Tytler 1865:548. Type locality, "Andamans; . . . Port Blair and its neighbourhood."

Peropus roseus Cope 1869:319. Type locality, none given.
Platydactylus crepuscularis Bavay 1869:8. Type locality, not stated, but New Caledonia by restricted coverage of publication.
Gymnodactylus caudeloti Bavay 1869:13. Type locality, "Nouvelle-Calédonie, surtout dans le Nord."
Peripia mysorensis Meyer 1874:129. Type locality, "Mysore."
Peripia ornata Macleay 1878b:98. Type locality, "Port Moresby."
Lepidodactylus woodfordi Boulenger 1887:334. Type locality, "Faro Island."
Lepidodactylus divergens Taylor 1918:242. Type locality, "Great Govenen Island."
Lepidodactylus lombocensis Mertens 1929:239. Type locality, "Ekas, Südost-Lombok."
Gehyra variegata ogasawarasimae Okada 1930:188. Type locality, "Chichi-jima, Bonin Islands."
Lepidodactylus intermedius Darevsky 1964:567. Type locality, "Komodo, . . . Rintja . . . Padar."

Description. Adults 34–44 mm SVL and 1.1–2.1 g, hatchlings approximately 15 mm SVL. Tail length 1.0–1.25X SVL. Moderately stocky, somewhat flattened lizards. Head distinct from neck, often swollen in adult females by enlargement of endolymphatic sacs. Digits of fore- and hindfeet (Fig. 2) have expanded digital pads; only the last 4 digits of each foot distinctly clawed. Digital pad obovate with broadest end distally; slender terminal portion of digit arising from edge of digital pad on 2nd through 5th digits, and 1st digit without free digital tip; light webbing at bases of digits. Tail flattened, broader than high (somewhat rectangular in cross-section), and tapering gradually to a blunt point.

Body and head covered by numerous small, equal-sized tubercles; ventral scales larger (3–4X), somewhat more plate-like, but non-overlapping. Head scales or tubercles similar in size to body scales. Enlarged head scales only around border of mouth, on snout, and on chin. Five to 8 supralabial scales anterior to eye. Rostral scale large and rectangular. Supranasals separated by 1–3 scales. Mental scale small, equal in size, or slightly smaller than 1st infralabials; postmental scales one-third size of infralabials and quickly grading into neck scales. Distal 2–3 digital lamellae divided, remainder undivided and extending proximally onto slender portion of digit, and 9–15 lamellae on 4th toe of hindfoot. Tail (unregenerated) uniformly scaled dorsally and ventrally; low ridge of lightly denticulate scales on each ventrolateral edge.

In life, light, grayish beige background with a series of widely spaced pairs of dark-brown spots extending from neck to tail; alternatively, brown background with diffuse dark-brown W-shaped crossbands on back. Dark-brown orbital stripe usually present from naris through eye to axilla. Venter yellowish white to light beige. Same range of coloration in juveniles as in adults. Tongue and buccal cavity lining pinkish white.

Variation. A comparison of adults from different islands (Rotuma, Taveuni, Vanua

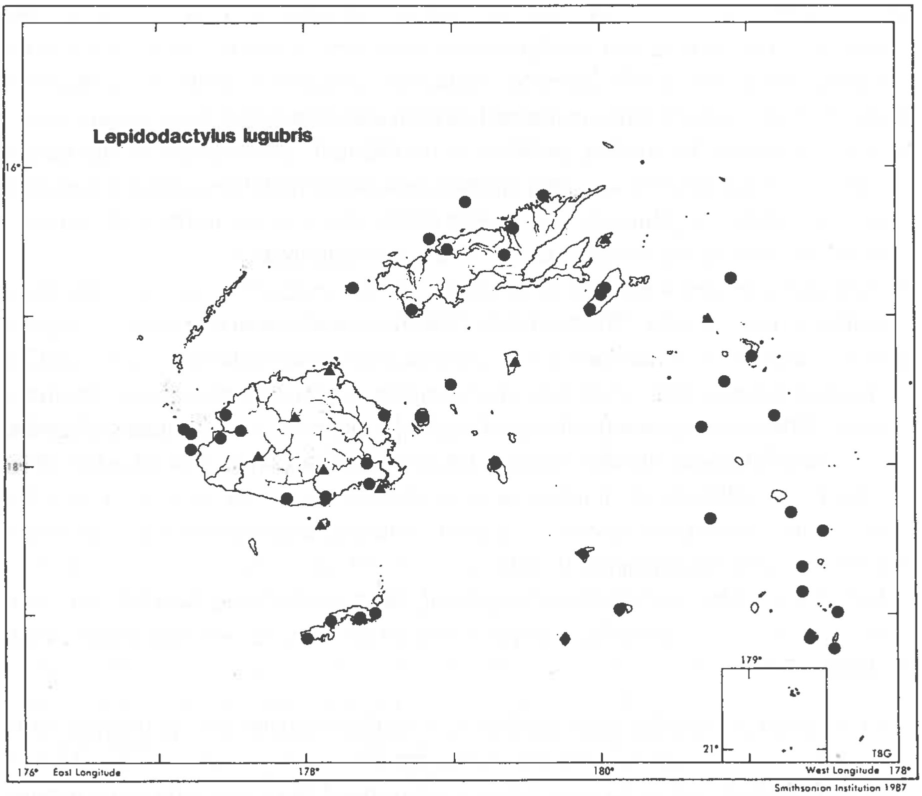
Levu, Ovalau, Viti Levu, and Kadavu) show no differences in scalation or morphometrics.

Ineich (1988) examined nearly 1500 *L. lugubris* from French Polynesia and discovered the presence of 1 bisexual group, 5 unisexual clones, and hybrids within this area. The clones and bisexual group are individually recognizable by differences in dorsal color pattern. Within French Polynesia, the most common clone (A) is diploid (clones B and C are triploid) and comprised 65% of Ineich's sample. In recently collected Fijian specimens (e.g., ones with clearly legible patterns; $n = 35, 10$ for Fiji proper and Rotuma, respectively), clone A is also the most abundant morphotype, 77% and 100%, respectively. Clones B, C, and E are represented by single specimens in the Fiji sample, clone D by 3 individuals, although half of the clone A specimens show a reduction in the intensity of the posterior spots, thus tending towards the D pattern. Both clone A and bisexual patterns occur in the Ovalau subsample. Further, diploid and triploid populations of the clones are sympatric on Vanua Levu and Ovalau (Pasteur et al. 1987).

Taxonomic comments. The synonymy derives from Kluge (1968). Brown & Parker (1977) presented a shorter one but offered no explanation for excluding *cantoris*, *labialis*, *roseus*, *lombocensis*, and *intermedius*; they also provided a key to the Pacific and Indoaustralian species. The following year, Brown & Alcala (1978) demonstrated that *Gecko labialis* (Peters, 1867) was a *Pseudogekko*. Kluge (1982) drew attention to Shigei's (1971) recognition of *Gehyra v. ogasawarasimae* as a synonym of *lugubris*. Pasteur et al. (1987) considered *Lepidodactylus woodfordi* to be identical to *lugubris*. Bauer (pers. comm., March 1990) suggested that *Gecko Harrieti* refers to *L. lugubris* rather than to *Gehyra mutilata*, its usually attributed senior synonym. Kluge (1991) includes Fitzinger's *D. pomareae* with other synonyms of *L. lugubris*. I have examined the type (MNHN 5304) of *Platydactylus crepuscularis*, and it is a *lugubris* and not a *Hemiphyllodactylus typus*.

Distribution. Lepidodactylus lugubris has an extensive tropical distribution from India and Sri Lanka eastward through southeast Asia and the Indoaustralian archipelago to northern Australia, the Philippines, and the Oceanic Pacific islands, occurring also in western Mexico and Central America. It is a common commensal of humans, and likely obtained its wide Pacific basin distribution with human assistance. It is widespread on buildings in Fiji, including Rotuma, and is occasionally found in agricultural areas and secondary growth forests (Map 8).

Ecology. This gecko occurs commonly in close association with humans. Although occasionally found in disturbed forests, rock outcrops, and gardens, it reaches its greatest densities on buildings, where it rests in crevices and cracks during the day and emerges at dusk to feed. It typically concentrates in artificially lighted areas.



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

Density was estimated 0.23 individuals/m^2 (approximately 2300 ha^{-1}) on the walls and ceiling of a cottage (Hawai'i, Jarecki & Lazell 1987). Home range was estimated to be 2.5–4.5 m^2 (Hawai'i; Hunsaker & Breese 1967) based on observations along a transect of several buildings.

L. lugubris occurs alone or in association with *Gehyra mutilata* and G. *oceanica*; in these associations, it is usually the most abundant gecko. Where *Hemidactylus frenatus* has appeared, *L. lugubris* is either displaced or uncommon (see comments in *H. frenatus* account).

The linear regression for live SVL (X) to live body mass (Y) is Y = −1.628 + 0.076X ($r^2 = 0.72$, $n = 19$).

Behavior. The mourning gecko is nocturnal and arboreal. It appears to be strongly gregarious owing to high densities on buildings and shared occupancy of diurnal resting sites in both wild and urban habitats. However, during the evening, individuals appear to defend feeding areas by aggressive encounters and vocal displays of chirping. Tail waving is also a common behavior associated with these social interactions. Dominance hierarchies seem to be established whereby larger individuals occupy the better feeding sites and smaller geckos the periphery. Mass migrations have been observed (Hunsaker & Bresse 1967) where many individuals simultaneously left their home ranges and moved to new buildings.

Individuals of the unisexual populations of this species occasionally display a copulatory-like behavior (Werner 1980). This behavior closely resembles the typical gekkonid copulatory behavior with 1 individual bite-grasping the neck and mounting the back of another individual; tails may even be tilted into an intromission position. Werner (1980) noted that reproductive females do not share hiding places and appear to be regularly spaced. He also suggested that this pseudocopulatory act might serve to assert 1 female's social dominance or territorial superiority over other females. Crews (1987) has shown experimentally that ovulation is initiated by this copulatory behavior in unisexual whiptail lizards.

Mourning geckos are insectivorous, eating small moths, ants, beetles, and other insects. They commonly stalk their prey and, when within a few centimeters, dash forward to capture it.

Reproduction. Lepidodactylus lugubris is a parthenogenetic species (but see comments above in "Variation" section). In Fiji, females mature at 35 mm SVL (34 mm, Marianas, Sabath 1981; 35 mm, Samoa, Schwaner 1980), although most females with shelled oviducal eggs were ≥40 mm SVL. Eggs are laid communally in a variety of locations: beneath rock slabs, in rock and bark crevices, beneath bark on dead trees, and in leaf axils. Females typically lay 2, rarely 1, nearly spherical, hard-shelled, adherent eggs, ranging in size 8.5–8.7 x 9.5–9.9 mm, 0.4 g (Gibbons & Zug 1987). Hatchlings are approximately 16 mm SVL and 0.2 g body mass (15.5–17.6 mm SVL, Philippines, Brown & Alcala 1978). Incubation is approximately 2 months (Samoa, Schwaner 1980). Females bore shelled oviducal eggs in April (Taveuni and Vanua Levu), September (Lau and Viti Levu), November (Vanua Levu), and December (Viti Levu).

Lepidodactylus manni Family Gekkonidae
Mann's Forest Gecko

Lepidodactylus manni Schmidt 1923:51. Type locality, "Suene, Viti Levu, Fiji Islands."

Description. Adults 35–48 mm SVL, hatchlings 16–17 mm SVL. Females (39–48 mm) average larger than males (35–45 mm). Tail length subequal to body length and equal in females and males. Moderately robust lizards. Head moderate size and distinct from neck. Digits of fore- and hindfeet (Fig. 2) long with expanded digital pads; claws on 2nd through 5th digits. Digital pad oblong, distal end only slightly wider than proximal end; slender terminal portion of digit projecting from edge of digital pad of 2nd through 5th digit; light webbing at bases of digits. Tail slender and cylindrical, tapering gradually to a blunt point.

Body and head covered by numerous small, equal-sized, non-overlapping scales; ventral scales non-overlapping, flattened, and enlarged, 3–4X larger than middorsal ones. Head scales similar in size to body scales. Enlarged head scales (Fig. 5) only around border of mouth and on snout. Five to 6 (rarely 7) supralabial scales anterior to eye. Rostral scale large and trapezoidal. Supranasal scales moderate size and separated by 2–3 (rarely 1) scales above rostral. First postmental scales elliptical and moderate size (one-third the size of infralabials), bordered posteriorly by smaller scales, grading into neck scales. Digital lamellae wide and undivided, 9–14 on 4th toe of hindfoot; lamellae extending to base of digits. Tail has uniform whorls of moderate-sized scales, slightly larger ventrally than dorsally; scales smooth, rounded, and slightly overlapping. Large, blunt cloacal spurs in adults, typically 1 on each side (rarely 2–3). Chevron-shaped row of 9–14 precloacal pores in adult males; 1 individual had 9 femoral pores on the right side and 7 on the left.

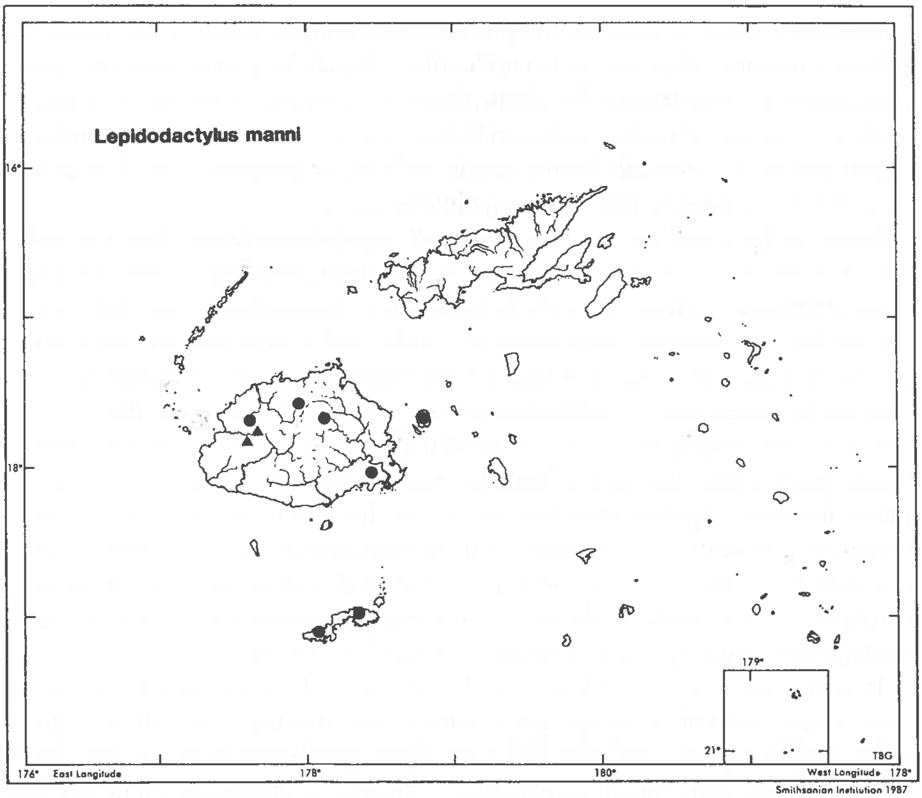
In preservative, tan upper body with brown chevrons, sometimes ill-defined, on neck, trunk, and tail. Most specimens have a pair of small, dark-brown scapular spots; infrequently, 4–5 pairs of dark spots running from neck to base of tail. Venter beige to cream; light coloration confined to midline by encroachment of tan from the sides. In life, dorsum dark brown with black, buff, and chestnut markings; venter yellow. Tongue and buccal cavity lining pinkish white.

Variation. Aside from the presence of precloacal pores in males, females and males share nearly identical means and ranges for scalation and morphometrics. Samples are inadequate for meaningful inter-island comparison.

Distribution. Lepidodactylus manni is a Fijian endemic, currently known from Viti Levu, Ovalau, and Kadavu (Map 9).

Ecology. This gecko occurs in a variety of situations from saxicolous terrestrial to arboreal. In the Nausori Highlands, it occurred both beneath the bark of dead trees (upright and fallen) and beneath rock chips on outcrops. In the Nadarivatu area, it occurred in crevices in rock faces; these crevices also contained eggs. It was found in treetop epiphytes at Monasavu when the reservoir was flooding the forest. A Kadavu specimen was found in a crevice of a liana, 2.5 m above the ground.

Behavior. This gecko is presumably nocturnal; it is found under cover during the day. Little else is known about its habits and behavior.



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

Reproduction. Lepidodactylus manni is a bisexual species. Males were considered sexually mature if they possessed moderate to large testes, enlarged cloacal spurs, and secreting precloacal pores; the smallest male with these traits was 35.0 mm SVL. The smallest female with oviducal eggs was 45.3 mm, and the smallest female with enlarged, convoluted oviducts was 38.7 mm SVL. Females with oviducal eggs (2) were captured in July and December. Eggs are ellipsoidal (10.1–10.6 x 6.6–6.9 mm) and hard shelled and have been found in dry rock crevices in March and July.

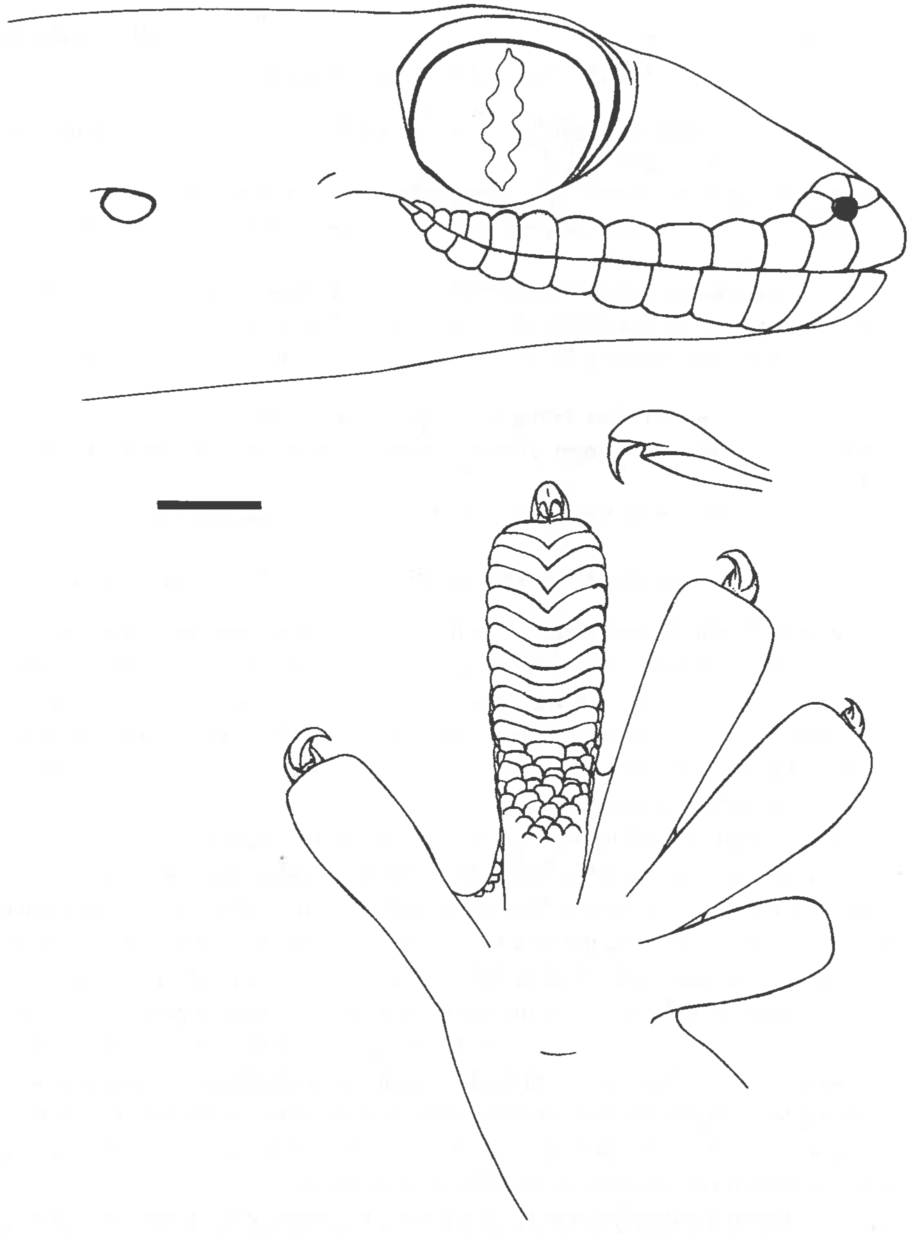


Figure 5. Head (lateral) and hindfoot (plantar) of *Lepidodactylus manni*, composite of AMNH 81746–48, Viti Levu, Fiji. Scale = 1.0 mm.

Nactus pelagicus Family Gekkonidae
Pacific Slender-Toed Gecko

Gymnodactylus Arnouxii A. Duméril in Duméril & Duméril 1851:44. Nomen dubium. Type locality, "Nouvelle-Zelande."
Heteronota pelagica Girard 1857:197. Type locality, "Feejee and Navigator Islands."
Gymnodactylus multicarinatus Günther 1872a:421. Type locality, "New Hebrides (Aneiteum) and Tongatabu."
Gymnodactylus (Heteronota) arfakianus Meyer 1874:129. Type locality, "Neu-Guinea."
Heteronota fasciata Macleay 1878b:100. Type locality, "Hall Sound."
Heteronota marmorata Macleay 1878b:100. Type locality, "Fitzroy Island and Endeavour River."
Heteronota eboracensis Macleay 1878b:101. Type locality, "Cape York."
Gymnodactylus cheverti Boulenger 1885:41. Nomen novum for *Heteronota marmorata* Macleay.
Gymnodactylus heteronotus Boulenger 1885:41. Nomen novum for *Heteronota fasciata* Macleay.
Gymnodactylus pelagicus undulatus Kopstein 1926:74. Type locality, "Elat, Gross-Kei."

Description. Adults 48–65 mm SVL and 2.2–3.9 g; hatchling size unknown. Tail length 0.75–1.25X SVL, and often regenerated. Slender and long-limbed lizards. Head large, somewhat flattened, large jowled, and sharply delineated from slender neck. Digits of fore- and hindfeet (Fig. 6) long, slender, and distinctly clawed, without enlarged digital pads; no webbing at bases of digits. Tail slender and cylindrical, tapering gradually to a blunt point.

Body and head covered by numerous small, equal-sized scales; ventral scales only slightly larger than dorsal ones. Fourteen to 20 longitudinal rows of widely spaced, large-keeled scales from neck to base of tail on back and sides. Head scales similar in size to body scales. Enlarged head scales (Fig. 6) only around border of mouth, on snout, and on anterior portion of chin. Three (rarely 4) supralabial scales anterior to eye. Rostral scale large and trapezoidal. Supranasal scales large and in contact above rostral, occasionally separated by 1 small scale. Mental scale greatly enlarged, separating a pair of small postmentals. Proximal 1 or 2 phalanges of each digit with broad digital lamellae, smaller and narrower ones on distal phalanges; 19–26 total lamellae on 4th toe of hindfoot. Tail covered by moderate-sized, keeled scales. Chevron-shaped row of precloacal scales without pores.

In life, uniform brown background color with a series of dark-brown chevrons from nape to tail. Snout dark brown with narrow, tan bars on dark lips. Venter from chin to vent light dusky brown.

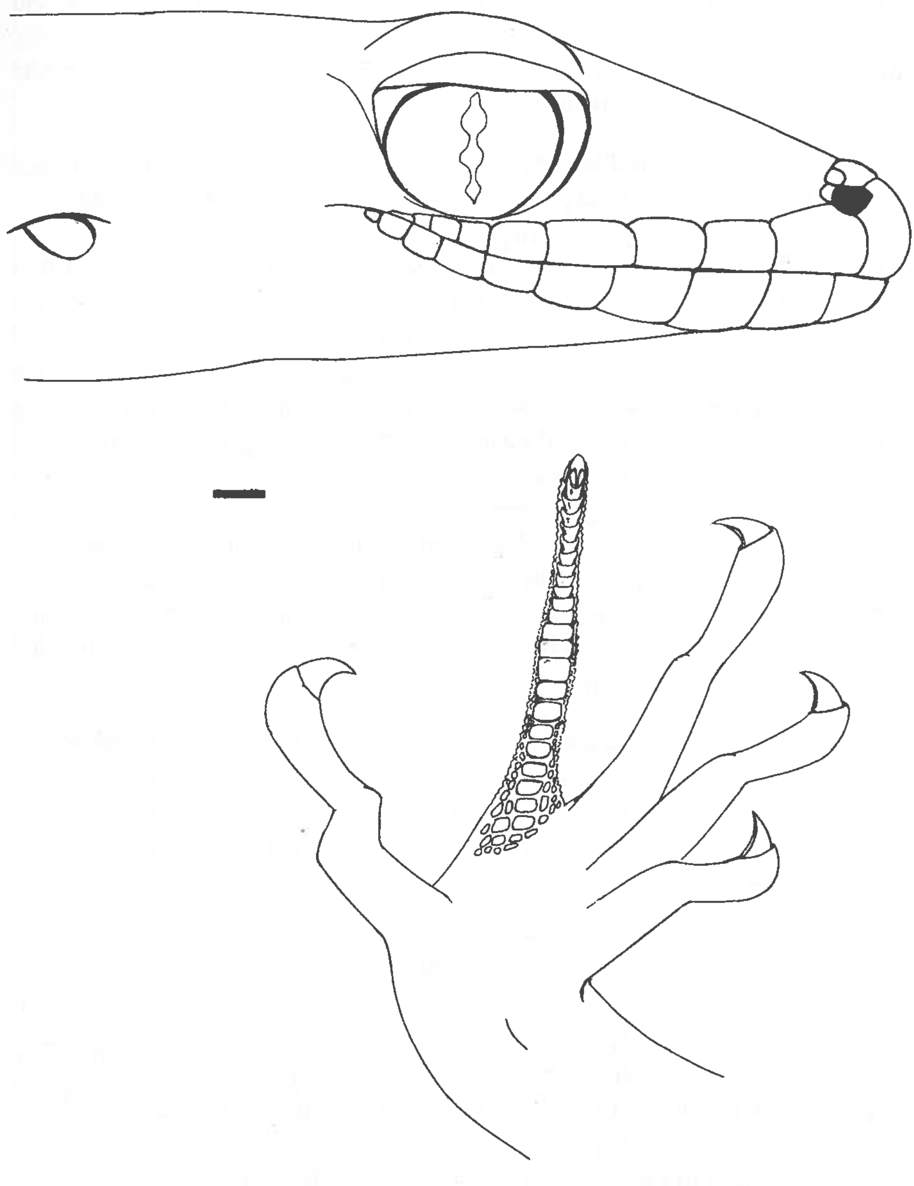


Figure 6. Head (lateral) and hindfoot (plantar) of *Nactus pelagicus*, composite of USNM 229585–97, Taveuni, Fiji. Scale = 1.0 mm.

Variation. A comparison of adults from different islands (Rotuma, Ovalau, Viti Levu, and Kadavu) shows similar means and ranges in morphometrics and scalation. The Rotuman geckos have slightly higher scale counts; however, the present samples from all the islands are too small to statistically validate the differences.

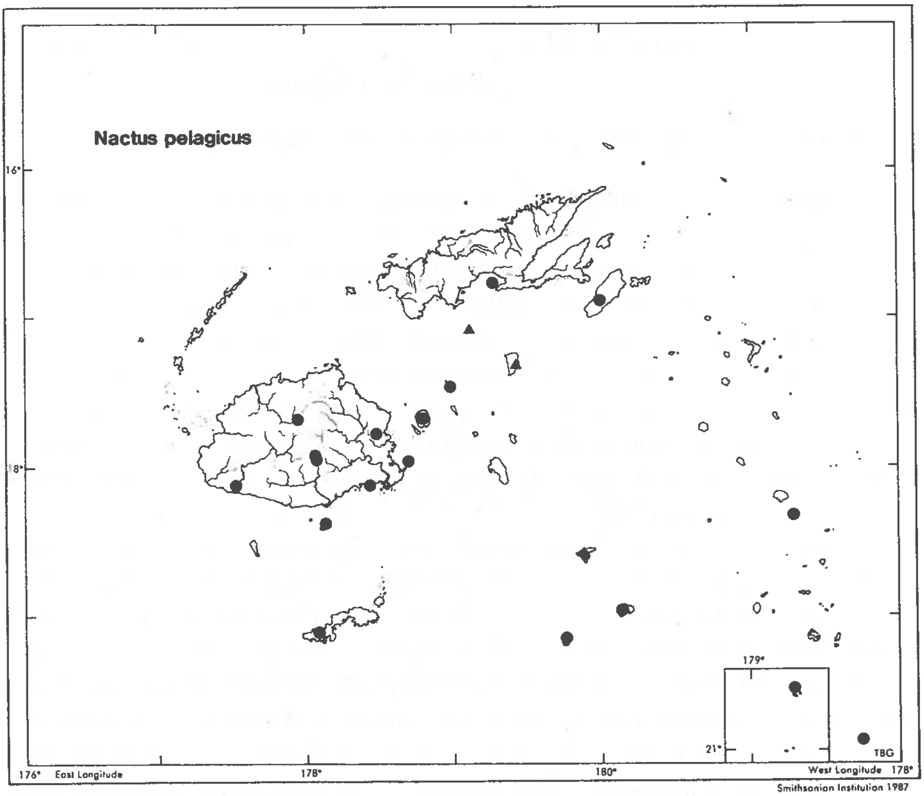
Taxonomic comments. Until recently, this gecko was included in the genus *Cyrtodactylus*. Kluge (1983) found that *pelagicus* and 4 other species differ from all other *Cyrtodactylus* by the presence of a 2nd ceratobranchial, as well as fused nasal bones, so he proposed the new genus, *Nactus* for these 5 species. In addition, Kluge (1983) proposed the substitution of *arnouxii* for the commonly used *pelagicus*. Such a substitution is invalid, however, because it contravenes Article 23b of the 1963 and 1985 International Codes of Zoological Nomenclature. This article encourages the use of long-accepted names and discourages replacement of such names by long unused senior synonyms. To avoid confusion, I petitioned the commission in 1989 to suppress *arnouxii* and to declare *pelagicus* the valid epithet. Further, Moritz (1987) showed that *pelagicus* as currently recognized consists of at least 3 species, each with a different karyotype and biochemical signature. The Oceanic species is unisexual, and since the type locality of *pelagicus* is Fiji and Samoa, *pelagicus* is the correct name for the Fijian *Nactus*. Morphological differentiation of *pelagicus* populations is largely concordant with the karyotypic groups (Moon & Zug, unpubl. data); the different karyo-morphotypes probably represent distinct species.

Distribution. The *Nactus pelagicus* complex is widespread in the southwest Pacific, ranging eastward from Kei Island and Cape York Peninsula of Australia through New Guinea to Akiaki, Tuamotu Archipelago (Kluge 1983; see comment in preceding paragraph). It is equally widespread in the Fiji archipelago, occurring on all large islands and many small ones, and in Rotuma (Map 10).

Ecology. Nactus was nowhere abundant, although if 1 individual was found in a detritus accumulation, others were likely (50% of the time) to be present as well. Typically, the multiple occurrences included an adult and 1 or more juveniles. This is possibly a social aggregration of siblings and a parent. This gecko was also found regularly with *Emoia cyanura*; both are predominantly terrestrial, and *cyanura* escapes by hiding beneath detritus. It was also found with *Lipinia* on those islands where the latter was terrestrial.

The linear regression for live SVL (X) to live body mass (Y) is $Y = -2.725 + 0.105X$ ($r^2 = 0.88$, $n = 9$).

Behavior. Nactus is nocturnal and somewhat arboreal, low on trunks of trees. Schwaner (1980) always found them 1 m or less from the ground, and they escaped downward. During the day, they are found on the ground beneath litter. When



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uncovered beneath detritus, this gecko scurries forward a short distance and then freezes.

Reproduction. The Fijian populations of *Nactus pelagicus* are unisexual. Females reach sexual maturity at approximately 50 mm SVL. Some 49–56 mm individuals appeared immature (small follicles, virginal oviducts), whereas two 48–49 mm specimens possessed early vitellogenic follicles. Eggs are laid on or near the ground beneath rotting logs, coconut husks, and similar detritus. Females typically lay 2 ellipsoidal, leathery-shelled eggs, ranging in size from 6.5–8.0 x 12.0–14.0 mm, 0.4–0.5 g (Gibbons & Zug 1987). Gravid females were found in February (Viti Levu), June (Ovalau), August (Toberua), and October (Kadavu). Hatchling size and incubation period are unknown.

Cryptoblepharus eximius Family Scincidae
Pygmy Snake-Eyed Skink

Cryptoblepharus eximius Girard 1857:195. Type locality, "Feejee islands."

Description. Adults 33–40 mm SVL, hatchlings about 20 mm SVL. Females and males are equal size. Tail length 1.25–1.5X SVL and equal in females and males. Slender lizards with moderately short limbs; tip of 4th toe extending beyond midbody but not to axilla when hindlimb is adpressed to side of body. Head conical, slightly flattened, and grading imperceptibly into neck. Digits of fore- and hindfeet (Fig. 7) long and strongly clawed. Hindtoe length pattern 4>3>5>2>1. Unregenerated tail long and slender, oblong in cross-section, and tapering gradually to a point.

Body covered by smooth, shiny, imbricated scales. Middorsal scales distinctly larger (about 1.5X) than those on sides, in 46–61 (usually <50) rows between parietal scales and base of tail; 21–27 (rarely <24) scale rows at midbody. Subdigital lamellae smooth with 13–20 beneath 4th finger and 16–26 beneath 4th toe. Head scales (Fig. 7) smooth. Rostral broad, touching frontonasal across broad suture. Supranasals absent; nasals commonly divided into large anterior part and small posteroventral part. Prefrontals usually in broad contact medially but may be narrowly separated; frontal small and diamond shaped. Frontoparietal large, single, and fused with interparietal. Pair of nuchal scales enlarged. Anterior loreal higher than long and subequal with longer than high posterior loreal. Lower eyelid fused to upper and covering eye as large transparent spectacle, bordered above by 3 enlarged eyelid scales. Seven (rarely 8) supralabial scales, enlarged 5th (rarely 6th) supralabial beneath eye, and 6 (rarely 5 or 7) infralabials.

In life, grayish bronze to dark brown or black with silvery beige stripes on sides. Broad dorsal stripe from snout to tail: copper-colored stripe at the head, becoming dark gray on neck and its coppery tint disappearing posteriorly. Dorsal stripe bordered laterally by very narrow black stripe, then narrow silvery beige stripe, broader black lateral stripe and narrow silvery beige stripe demarcated from grayish olive venter by irregular speckling of black. Dorsolateral silvery stripe from eye to midbody; ventrolateral silvery stripe from beneath eye to inguen, although faded and irregular on posterior half of body. Tail mottled gray when unregenerated and tan when regenerated.

Variation. Females and males are similar in scalation and morphometrics with the exception of body length. Females have significantly longer bodies than males (Appendix: Table C).

Interisland comparison is possible for 10 island groups (Yadua, Ovalau, Viti Levu, Kadavu, Matuku, Cicia, Late-i-Viti, Yagasa, Naibo [? = Nayabo], and Ono-i-Lau).

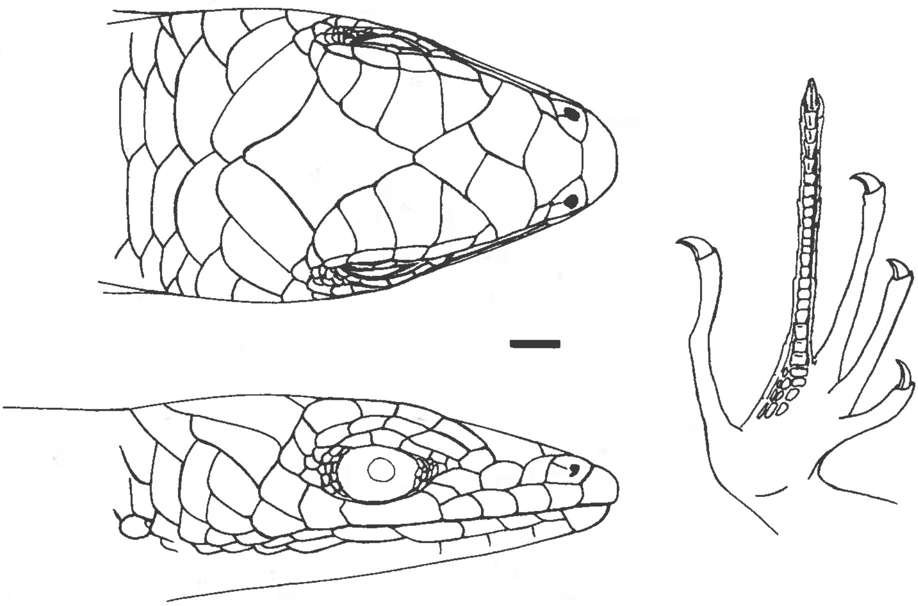
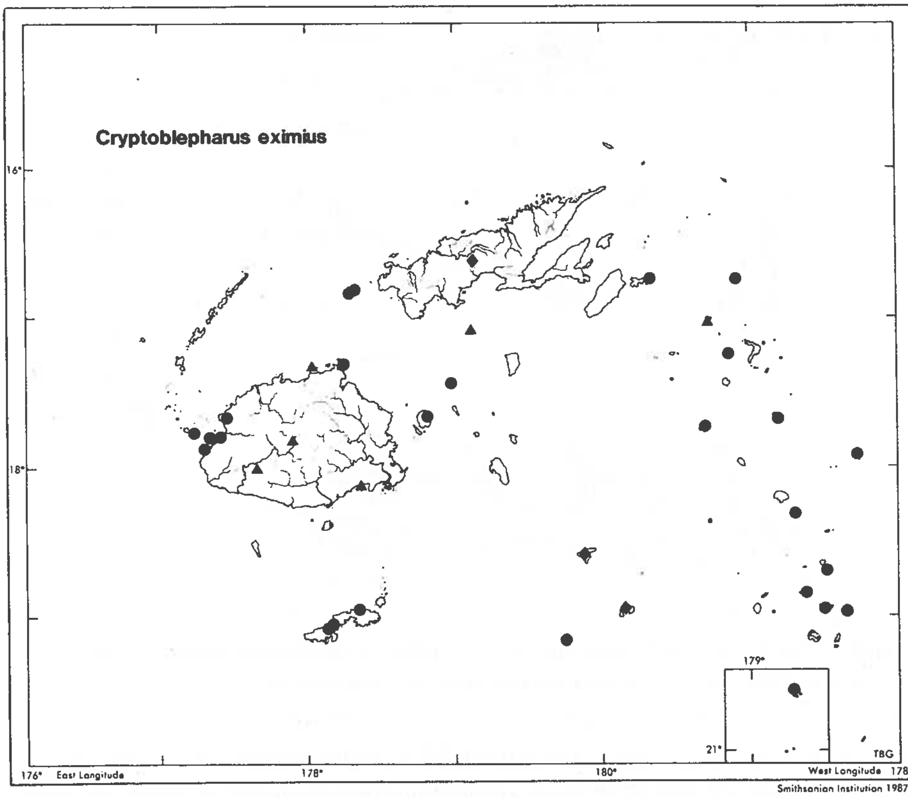


Figure 7. Head (dorsal & lateral) and hindfoot (plantar) of *Cryptoblepharus eximius*, composite of USNM 230090–94, Ovalau, Fiji. Scale = 1.0 mm.

The range of variation is slight for most traits; the most variable ones are dorsal scale rows (range of $\bar{x}$ 51.0–55.2), scale rows around midbody (24.3–26.0), 4th finger lamellae (16.2–18.2), and 4th toe lamellae (19.2–22.2). None of the samples appear significantly different (i.e., $\bar{x} \pm 1$ SD overlap); nonetheless, there are some trends. First, the Ovalau sample has the highest mean in dorsal scale rows and toe lamellae; high dorsal counts are shared with the Yadua and Viti Levu samples. The Naibo and Late-i-Viti samples have the lowest means in dorsal rows and toe lamellae. The Ono-i-Lau sample also has low means for these traits. There is no similar pattern of concordance in midbody rows and finger lamellae. For midbody rows, the highest mean occurs in the Late-i-Viti sample, lowest in Viti Levu sample, but adjacent samples show the opposite condition. A similar situation occurs for finger lamellae with maximum mean in the Cicia sample and minimum mean in the Yadua sample.

Taxonomic comments. The snake-eyed skinks of the Pacific basin were long included in a widespread genus *Ablepharus*. Fuhn (1969) demonstrated that this ablepharus assemblage was polyphyletic and transferred the Indopacific populations to the genus *Cryptoblepharus*. Aside from a few distinct Australian populations, the numerous populations of the Pacific islands have been considered members of the polytypic *Cryptoblepharus boutonii* whose range extended from the eastern Pacific



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

westward through the East Indies to the eastern coast of Africa, or as *C. poecilopleurus* for the Oceanic populations. A number of distinct subspecies have been recognized (Mertens 1931, and others), one of which is the Fijian *eximius*. Although *eximius* shares a similar scalation with other Pacific *Cryptoblepharus*, its unique color pattern, smaller adult size, and the absence of intermediate populations indicate that it is a distinct species and is so recognized here. Its relationships to other Pacific populations of the *poecilopleurus* complex are under study (Zug unpub. data).

Distribution. Cryptoblepharus eximius occurs along the coast of many Fijian islands, but not in Rotuma (Map 11).

Ecology. C. eximius is predominantly a coastal species. Most populations are supralittoral in occurrence, living on rock faces, beach rubble, and in the shrubs immediately beyond the high-tide line; individuals forage in the detritus in the upper littoral zone. A few have been seen on vegetation in tidal pandanus swamps. Occasionally, they occur on rocky cliff faces and stone-mortared buildings in open habitats distant from the shoreline (e.g., Nausori Highlands, Viti Levu).

They are locally abundant, commonly reaching densities of 4–5 for every 10 m of shoreline, occasionally double that; however, their occurrence is spotty and they are often absent from long stretches of seemingly suitable coastal habitat. High abundance is regularly associated with heavy vegetation or detritus bordering one edge of a rock face or wall.

The linear regression for live SVL (X) and live body mass (Y) is $Y = -1.278 + 0.06X$ ($r^2 = 0.83$, $n = 16$).

Behavior. C. eximius is a diurnal skink, and my impression is that it is strongly heliotropic, being most abundant and active under sunny conditions. It will bask and move about at midday on well-lit and presumably very hot surfaces. Even when many were present, there was no evidence of antagonistic interactions.

Reproduction. These skinks are oviparous. Gravid females typically (92%) bore a single oviducal egg in the right oviduct (90%) and occasionally (8%) an egg in each oviduct. Oviducal eggs were ellipsoidal, 8–10.5 mm in maximum length. Egg deposition sites are unknown, as is the nature of the nest (i.e., solitary or communal). Several communal clutches of hatched and unhatched eggs were discovered beneath rock slabs in the Nausori Highlands. These clutches had 2 sizes of eggs. *L. lugubris* hatched from the larger ones; a sample of the smaller ones (5.5–5.7 × 7.0–7.6 mm) revealed no embryos. These smaller eggs were probably *Cryptoblepharus* eggs. Both the larger and smaller eggs were glued to the rock surfaces and to one another. Three individuals with yolk-sac scars, presumably recently hatched, were 20.0–23.6 mm SVL; however, this hatchling size seems large relative to the maximum size of oviducal eggs.

Males are mature at 33 mm SVL (sperm in epididymides). The smallest gravid female was also 33 mm SVL. Gravid females occurred in May (Ono-i-Lau and Ovalau), August (Naibo and Viti Levu), and September (Viti Levu).

Emoia caeruleocauda Family Scincidae
Pacific Blue-Tailed Skink

Mocoa caeruleocauda de Vis 1892:12. Type locality, "Sudest [British New Guinea]."
Lygosoma cyanurum werneri Vogt 1912:5. Type locality, "Marianen."

Remarks. I have examined only 1 Fijian specimen of this species. The following description derives largely from Brown (1991).

Description. Adults 40–65 mm SVL, hatchlings unknown. Males (40–65 mm) average larger than females (41–55 mm). Tail length approximately 1.5X SVL. Moderately robust lizards with well-developed limbs; tip of 4th toe extending to or near axilla when hindlimb is adpressed to side of body. Head conical, slightly flattened, and grading into neck. Digits of fore- and hindfeet (Fig. 8) long and strongly clawed. Hindtoe length pattern 4>3=5>2>1. Tail long and slender, round in cross-section, and tapering gradually to a point.

Body covered by smooth, shiny, imbricated scales. Middorsal scales subequal to those on sides, in 50–64 rows between parietal scales and base of tail; 27–36 (rarely >34) midbody scale rows. Subdigital lamellae smooth with 33–54 beneath 4th toe. Head scales smooth. Rostral broad and touching frontonasal across moderately broad suture. Supranasals small and somewhat triangular; prefrontals range from widely separated to narrowly in contact medially; frontoparietal single and fused with interparietal. Nuchals distinctly enlarged and usually 1 pair. Anterior loreal higher than long and smaller than posterior loreal. Lower eyelid movable with large transparent disc surrounded by small opaque scales. Six to 7 supralabial scales, enlarged 5th supralabial beneath eye, and 6–7 infralabials.

In life, brightly striped with 3 or 5 whitish stripes on a dark-brown or black background; middorsal stripe from tip of snout to base of tail; dorsolateral stripe from top of orbit along body to tail; lateral light stripe from posterior edge of orbit through ear opening to inguen. Tail commonly blue or gray. Venter usually ivory, occasionally suffused with blue or gray.

Taxonomic comments. The synonymy derives from Brown (1991).

Distribution. E. caeruleocauda is reported from Viti Levu and Taveuni in the Fiji archipelago (Pernetta & Watling 1979; Walter Brown and I have confirmed the identity of specimens from these 2 islands). This limited distribution suggests that it is a recently introduced species; the earliest Fijian record is 1911 (USNM 58317). Elsewhere, it is widespread, extending from southern Indonesia through New Guinea and the Solomons northward into the Marianas, Carolines, and Marshall islands (Brown 1991).

Behavior. This skink is diurnal and largely terrestrial, although it does climb low vegetation. It is commonly found in garden areas to open woodland.

Reproduction. E. caeruleocauda is oviparous and individuals usually produce 2 eggs. Gravid females occur in all months; May and June have the lowest frequency of gravid females, September through February the greatest frequency. The spermatogenetic cycle of males (based on testicular weights) peaks in March and April, but does not decline sharply until September and stays low through February; how-

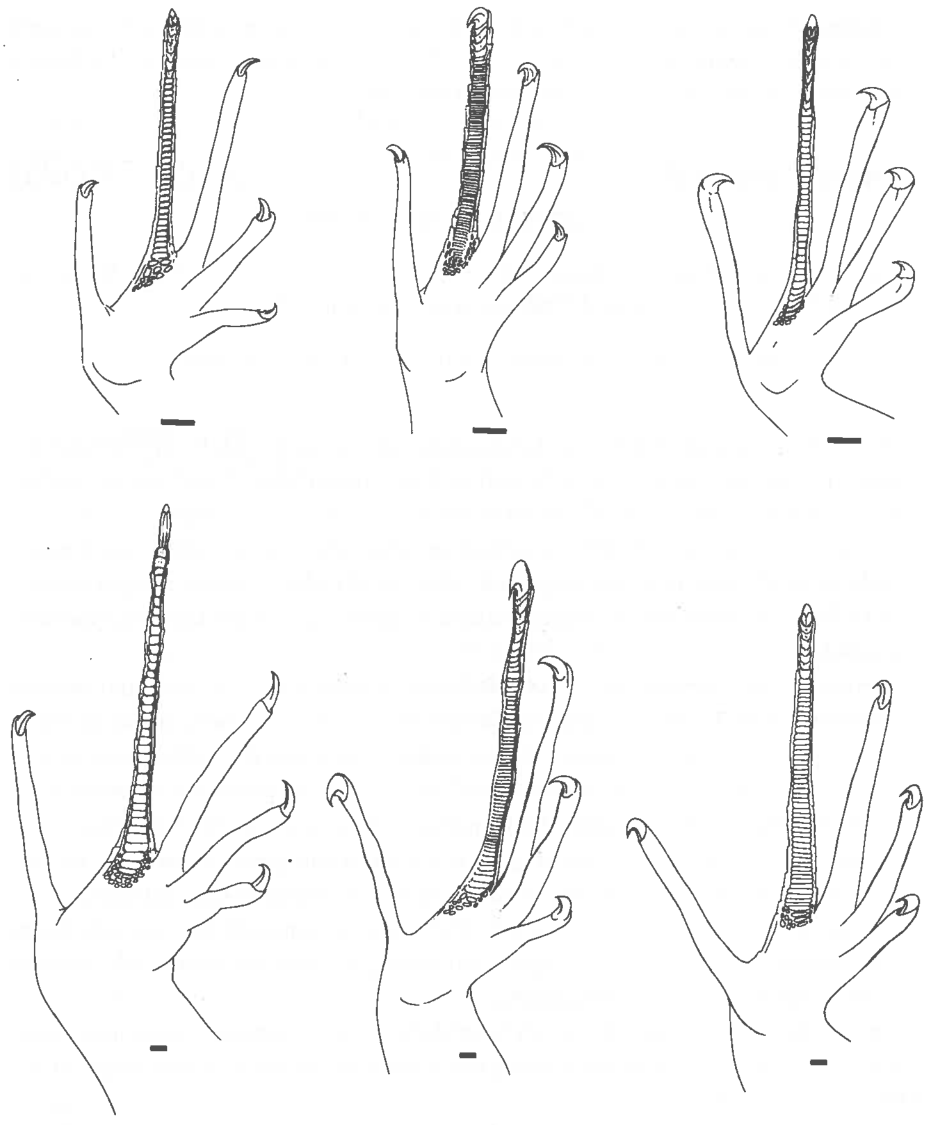


Figure 8. Hindfeet (right, plantar surface) of Fijian *Emoia*. Top row (left to right): *Emoia caeruleocauda*, composite of USNM 192864–68, Guam, Mariana Is. *E. cyanura*, composite of USNM 230124–26,–32,–32, Ovalau, Fiji; *E. parkeri*, composite of CAS 146961–64, Viti Levu, Fiji. Bottom row: *Emoia nigra*, USNM 230073, Koro, Fiji. *Emoia concolor*, USNM 230224, Matuku, Fiji; *E. trossula*, USNM 230201, Yadua Tabu, Fiji. Scale = 1.0 mm.

ever, spermatozoa were present in the epididymides in all months. Females and males are sexually mature at body masses ≥1.25 g. The preceding data derive from a population in Espiritu Santo, Vanuatu (Baker 1947).

Emoia campbelli Family Scincidae

Montane Tree Skink

Emoia campbelli Brown and Gibbons 1986:49. Type locality, "Monsasavu [*sic* Monasavu] on the Rairaimatuka Plateau . . . 750 meters on Viti Levu . . ."

Remarks. The following data derive from the original description by Brown & Gibbons (1986).

Description. Adult 68–98 mm SVL, hatchling size unknown. Males and females are equal size. Moderately stout lizards with well-developed limbs; tip of 4th toe extending anterior to region of axilla when hindlimb is adpressed to side of body. Head elongate, conical, slightly flattened, and grading imperceptibly into neck/trunk. Digits of fore- and hindfeet long and strongly clawed. Hindtoe length pattern 4>3>5≥2>1. Tail long and slender, round in cross-section, and tapering gradually to a point.

Smooth, shiny, imbricated scales on body; middorsal scales subequal or only slightly larger than those on sides, in 56–64 rows between parietal scales and base of tail; 30–36 (rarely <32) scale rows at midbody. Subdigital lamellae smooth with 48–54 beneath 4th toe. Head scales smooth. Rostral broad and touching frontonasal across broad suture. Supranasals small and narrowly triangular; prefrontals in broad contact medially; frontoparietal single. Parietals and interparietal distinct. One pair of enlarged nuchal scales present. Anterior loreal broader than high and subequal to posterior loreal. Lower eyelid movable, with large transparent disc surrounded by small opaque scales. Seven to 8 supralabial scales, enlarged 6th (rarely 7th) supralabial beneath eye, and 6–7 infralabials.

In life, light gray to grayish green with dark, broken transverse bars alternating with yellowish blotches on back. Head often darker than body. Venter bright sulfur yellow to greenish yellow.

Taxonomic comments. In body form, scalation, and behavior, this species is likely an upland derivative of *Emoia concolor.*

Distribution. E. campbelli is known only from the vicinity of the type locality on the Rairaimatuku Plateau, Viti Levu.

Ecology. The type series were collected in montane forest.

Behavior. This skink is arboreal, foraging on tree branches and shelters primarily, if not exclusively, in ant plants.

Reproduction. One female contained a pair of oviducal eggs. Several egg clutches were found in the chambers of ant plants (*Hydnophytum*).

Emoia concolor — Family Scincidae

Fijian Green Tree Skink

Euprepes concolor A. Duméril in Duméril & Duméril 1851:162. Type locality, "origine inconnue."

Euprepes (Euprepes) resplendens Peters 1877:416. Type locality, "Fidji-Insel Ovalau."

Lygosoma cyanogaster tongana Werner 1899:374. Type locality, "Tonga-Inseln."

Description. Adults 57–86 mm SVL, hatchlings 26–28 mm SVL. Males (57–86 mm SVL) average larger than females (59–77 mm). Tail length 1.5–2.0X SVL and equal in females and males. Moderately slender lizards with well-developed limbs; tip of 4th toe extending anterior to axilla or slightly beyond when hindlimb is adpressed to side of body. Head conical, slightly flattened, with a long pointed snout, and grading into neck. Digits of fore- and hindfeet (Fig. 8) long and strongly clawed. Hindtoe length pattern 4>3>5>2>1. Tail long and slender, round to oblong in cross-section, and tapering gradually to a point.

Smooth, shiny, imbricated scales on body; dorsal scales shallowly striated longitudinally. Middorsal scales subequal or only slightly larger than those on sides, in 54–62 rows between parietal scales and base of tail; 27–33 (usually ≤32) scale rows at midbody. Subdigital lamellae smooth, 30–48 beneath 4th finger and 43–65 beneath 4th toe. Head scales smooth (Fig. 9). Rostral broad, touching frontonasal across broad suture. Supranasals small and narrowly rectangular; prefrontals usually broadly in contact medially; frontoparietal single. Interparietal distinct. Enlarged nuchal scales usually present in single row (occasionally 2 or 3 rows). Anterior loreal longer than high and slightly smaller than or equal to the posterior loreal, which is longer than high. Lower eyelid movable, with large transparent disc surrounded by small opaque scales. Seven to 8 supralabial scales, enlarged 6th (occasionally 5th) supralabial beneath eye, and 6–8 infralabials.

In life, dorsum is uniform green to greenish coppery tan, occasionally with scattered brown or black spots or, less commonly, light spots; spots usually 1-scale large. Head usually darker green than body, with tan appearing at midbody or at base of tail and becoming distinctly tan or copper colored on tail; sides greenish yellow, and venter yellowish white to lime green.

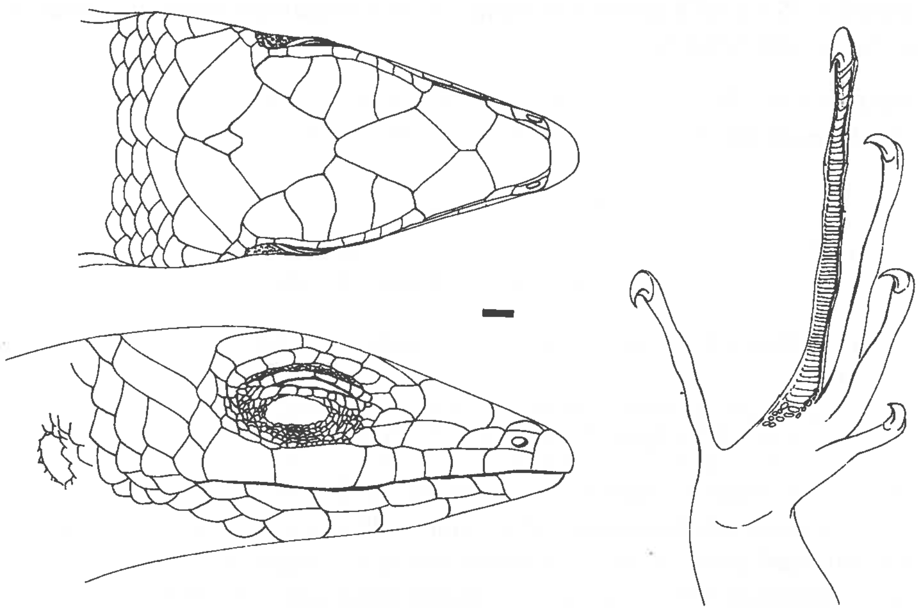
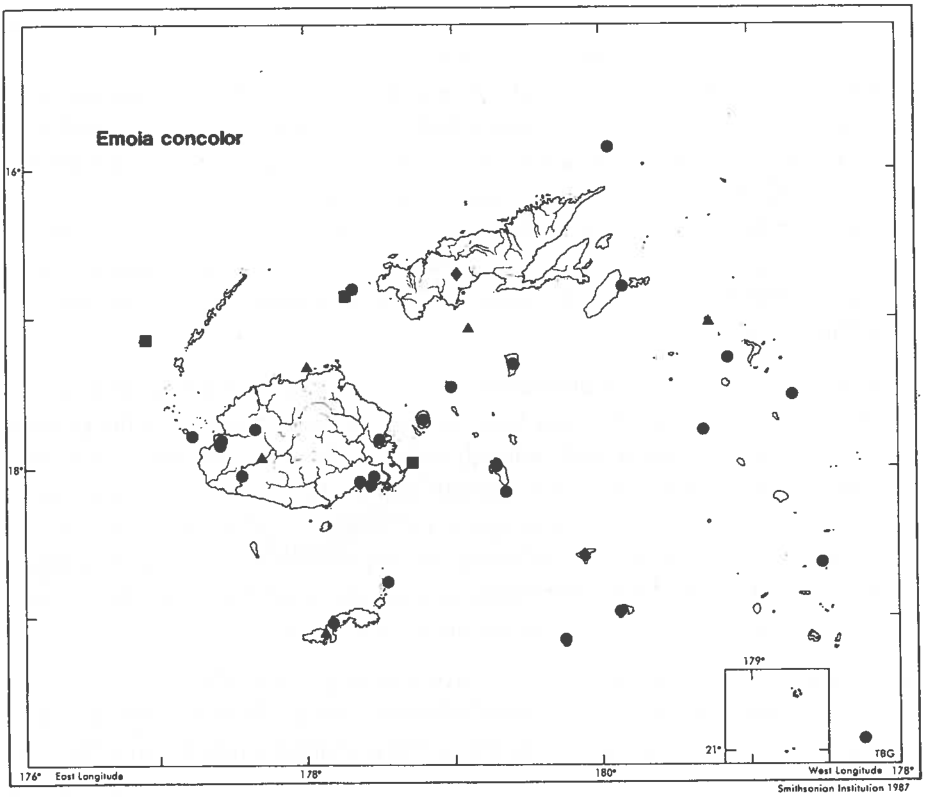


Figure 9. Head (dorsal & lateral) and hindfoot (plantar) of *Emoia concolor*, USNM 230224, Matuku, Fiji. Scale = 1.0 mm.

Variation. Females and males are similar in scalation, but females have significantly smaller head widths, head lengths, and hindlimb lengths (Appendix: Table C).

Interisland comparison is possible for 5 islands (Yadua/Yadua Tabu, Viti Levu, Gau, Kadavu, and Matuku; Appendix: Table D), although the samples are small (*n*, 7–19). The range of variation for most scale traits is slight, and the means are similar or identical; the greatest variation shows in midbody scale rows ($\bar{x}$, 28.7–31.4), 4th finger lamellae (35.1–44.6) and 4th toe lamellae (47.5–62.1); only the toe and finger lamellae have sample means that are significantly different. Interestingly, these 3 traits are concordant for 2 groups: Yadua-Viti Levu and Gau-Kadavu-Matuku. The Matuku sample also possesses the lowest number of supra- and infralabial scales; the samples from the other localities are the same or very similar.

Taxonomic comments. Boulenger (1887) synonymized *Emoia concolor* with *Emoia samoensis* and subsequent authors followed this decision. Brown (1953) recognized the distinctiveness of *concolor* populations and considered them to represent a distinct species, although he incorrectly placed *concolor* within the *physicae* group of the New Guinea region. Several naturalists (W. Beckon, J. C. Pernetta, and D. Watling) working with the Fijian fauna in the 1970s also recognized the distinctiveness of *concolor* and *samoensis* and the latter 2 workers (1979) included *concolor*



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as a separate species in their list of introduced and native Fijian vertebrates. Brown & Gibbons (1986) summarized *concolor*'s taxonomic history and discussed its affinities with *samoensis* group members.

Distribution. Emoia concolor occurs throughout the Fijian Archipelago with an outlying population on Rotuma Island (Map 12). Although its presence on all Fijian islands has not been confirmed, sight records combined with museum vouchers indicate its presence in all island groups. In our recent Rotuman survey, *E. concolor* was not seen or captured. An 1895 voucher specimen (BM[NH] 97.7.29.8) is *E. concolor* so if *E. concolor* persists on Rotuma, it must have very low population densities.

Ecology. This skink occupies a variety of open woodland situations from lowland

and mountain forests to agricultural-suburban areas. It may also occur in heavily canopied forests, but its presence is unconfirmed.

Although present on many islands, it appears to exist at low densities on most. Only in the secondary forest of Matuku and in the Nausori Highlands (Viti Levu) were several specimens seen for each hour of observation. Elsewhere, 1 specimen for several hours of observation was the typical experience.

Native predators likely include the Pacific boa, *Candoia bibroni* and a variety of birds. A wattled honeyeater, *Foulehaio carunculata* was seen unsuccessfully attacking an adult (Clunie 1973); hatchlings and juveniles would be less successful in avoiding capture.

Behavior. Emoia concolor is diurnal and strongly arboreal. Adults are seldom seen on the ground, although they may bask on a tree trunk within 1 m of the ground; basking posture is typically body vertical, facing the ground, head raised. To avoid predators, these skinks run to the opposite side of the trunk and upward, rarely stopping until they are 3–5 m above ground; if closely pursued, they move directly into dense foliage in the crown of the tree. Small juveniles are occasionally seen on rocks or low shrubs with no trees nearby. Since adults are often seen on solitary trees, they must regularly move across the ground to other trees.

Reproduction. Gravid females bore 1–4 oviducal eggs (ellipsoidal, 7.1–7.7 x 13.7–14.6 mm). None of the gravid females had dates of collection. A single specimen with a yolk-sac scar indicates that hatchling size is approximately 26 mm SVL. The smallest female with oviducal eggs was 57.5 mm, and the smallest male undergoing spermiogenesis was 57.9 mm SVL; however, some 60–65 mm males and females appeared immature.

Emoia cyanura Family Scincidae
Brown-Tailed Copper-Striped Skink

Scincus cyanurus Lesson 1826:Plate IV, fig. 2. Type locality, "d'O-Taïti."
Tiliqua Lessonii Cocteau 1836:7. Type locality, " unknown.
Tiliqua Kienerii Cocteau 1836:7. Type locality, " unknown.
Eumeces Lessonii Duméril & Bibron 1839:654. Type locality, "îles oceaniennes [Pacific]."
Lygosoma arundelii Garman 1899:61. Type locality, "Clipperton Island."

Description. Adults 39–56 mm SVL, hatchlings about 22–23 mm SVL. Males average larger (39–56 mm SVL) than females (39–53 mm). Unregenerated tail length 1.5–1.75X SVL and proportionately equal in females and males. Moderately stout lizards with well-developed limbs; tip of 4th toe extending to or near axilla when hindlimb is adpressed to side of body. Head conical, slightly flattened, and

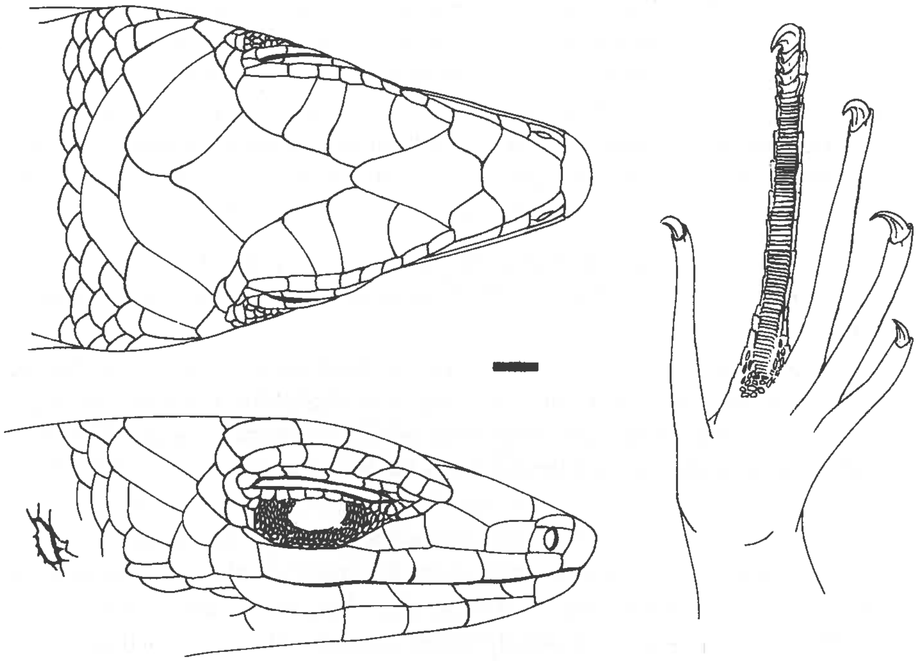


Figure 10. Head (dorsal & lateral) and hindfoot (plantar) of *Emoia cyanura*, composite of USNM 230124–26,–32, Ovalau, Fiji. Scale = 1.0 mm.

distinct from neck by moderately enlarged jowls (temporal area). Digits of fore- and hindfeet (Fig. 8) long and strongly clawed. Hindtoe length pattern 4>3>5>2>1. Tail long and moderately robust, round in cross-section, and tapering gradually to a point.

Smooth, shiny, imbricated scales on body. Middorsal scales subequal or only slightly larger than those on sides, and middorsal pairs never fused, 53–63 rows between parietal scales and base of tail; 28–34 (mode 29–30) scale rows at midbody. Subdigital lamellae (Fig. 10) smooth, narrow and numerous with 36–51 (seldom <40) beneath the 4th finger and 57–82 (rarely <60) beneath 4th toe. Head scales smooth (Fig. 10). Rostral broad, abutting frontonasal across moderate suture. Supranasals medium size and narrowly rectangular; prefrontals widely separated by frontonasal-frontal contact. Frontoparietal single and fused with interparietal; epiphyseal eye posteromedially in frontoparietal. One pair of greatly enlarged nuchal scales. Anterior loreal longer than or equal to its height, subequal to or smaller than posterior loreal. Lower eyelid movable, with large transparent disc surrounded by small opaque scales. Seven (rarely 6 or 8) supralabial scales, enlarged 5th (rarely 4th or 6th) supralabial beneath eye, and 5–8 (mode 6) infralabials.

Brightly striped with black and copper longitudinal stripes on head and back, often with brownish tail. Middorsal coppery beige stripe from tip of snout to base of tail. Similarly colored pair of dorsolateral stripes from above eye to inguen, occasionally fading posteriorly. These 3 stripes typically narrowly edged in black; sides and space between stripes black or more commonly dark copper, produced by each scale with copper center and black border. Tail turquoise in juveniles, becoming brownish to coppery in adults. Venter shiny ivory white to copper-tinted white.

Variation. Females and males share a similar scalation. Females are significantly smaller than males in SVL, head width, head length, body length, and hindlimb length (Appendix: Table C).

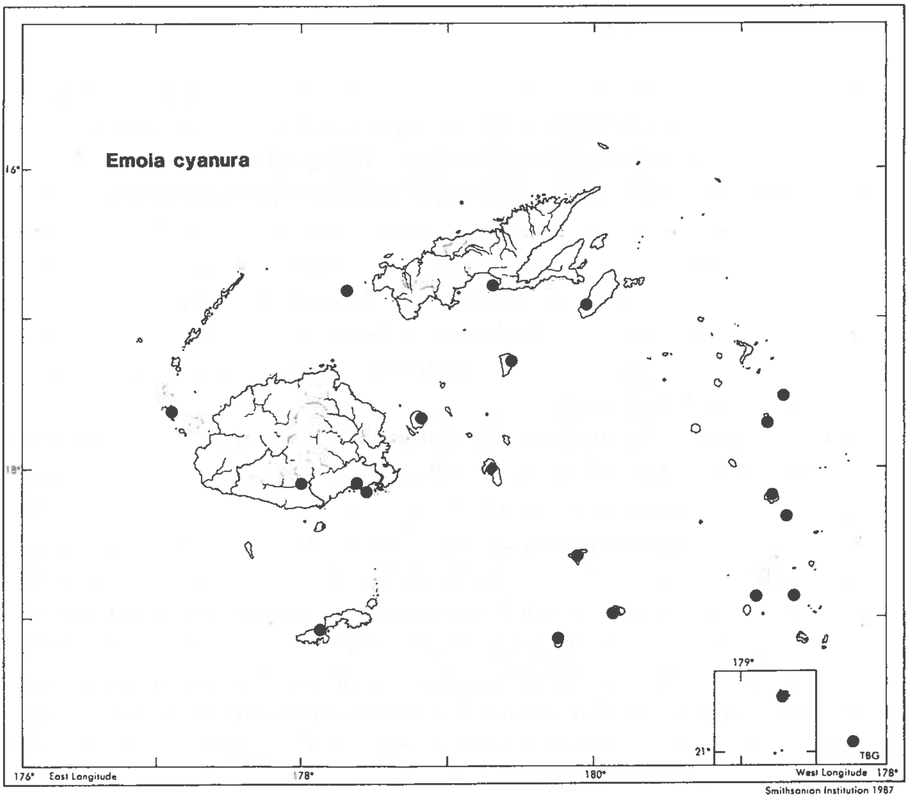
Interisland comparison is possible for 8 islands (Rotuma, Taveuni, Koro, Ovalau, Kadavu, Matuku, Totoya, and Ono-i-Lau; *n*, 12–54; Appendix: Table D). The range of variation is slight for all scale traits with similar or identical means. The most variable (but not significantly different) traits are dorsal scale rows ($\bar{x}$, 55.5–58.8), midbody scale rows (28.9–30.3), 4th finger lamellae (43.3–48.3) and 4th toe lamellae (66.1–75.3). There is no discernible geographic pattern in the variation of these traits. The Rotuma and Kadavu samples share the lowest number of finger and toe lamellae; Rotuma, Kadavu, and Ono-i-Lau share low dorsal and midbody scale rows; the other 4 samples show slightly higher counts for these latter 2 traits.

Taxonomic comments. Ineich (1987) recognized that *E. cyanura* actually consisted of 2 sibling species that are sympatric throughout much of Oceania. Ineich & Zug (1991) examined the taxonomic history of the sibling species and provided synonymies for both species.

Distribution. Emoia cyanura is abundant and widespread in Fiji, occurring on all islands of a hectare or more (Map 13). It is also a common and broadly distributed Pacific species, occurring from the Bismarcks (but not mainland New Guinea) through the Solomons and Vanuatu eastward to and including Polynesia (Ineich & Zug 1991).

Ecology. My field observations were made prior to my recognition that "*E. cyanura*" was a pair of sibling species. In many respects, they are similar in ecology, behavior, and physiology, but verification of the similarities and differences will require careful field observations and experiments. The following observations are an attempt to extract a posteriori *E. cyanura* from *E. impar* observations, but some mixing of the 2 may remain. Statistics are based on only those voucher specimens for which I could confirm the species involved.

E. cyanura is the most commonly seen, hence the most abundant, skink on all islands visited, except on Ono-i-Lau and Viti Levu. On 3 islands of the former group, *E. impar* was the dominant lizard. In Viti Levu, the mongoose has nearly eliminated



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

terrestrial skinks, and individuals survive only in areas of dense vegetation, particularly high, thick grass, or in semiarboreal situations (e.g., axils of pandanus, taro, and similar retreats) in scrub habitats. Elsewhere, this skink is seen regularly on the ground in open to dense vegetation, as well as low on tree trunks and bushes.

Population estimates were made on 2 islands, Koro and Ovalau, using the Zippin removal technique (Zippin 1958) for 4 consecutive days. On Koro, the site was a 359 m^2 polygon located by a small stream in an overgrown pasture. The density estimate was 50 (SE = 1.83) for this site, approximately 1390 *E. cyanura* ha^{-1}. On Ovalau, the site was a 404 m^2 polygon in a recently cleared taro garden on a gently sloping hillside. The density estimate was 165 (SE = 5.66), approximately 4090 lizards ha^{-1}. The estimates reflect my impression of the actual abundance at the 2 sites and surrounding areas. Also the estimates provide a range of population densities that are probably representative for Fijian *E. cyanura* populations where the mongoose is absent.

The population structures at these 2 sites were also quite different (Fig. 11). Juveniles ($n = 17$) dominated the Koro pasture site with a few adult females (2) and more numerous large males (8). In contrast, on Ovalau, adults were the most abundant class with males (22) again outnumbering females (10); nonetheless, juveniles (13) were a common and a conspicuous component of the Ovalau population. Single-site collections from other islands also show adults as numerically dominant, but with juveniles as conspicuous components. The adult sex ratios (females:males) of the larger samples were: 4:3 Kadavu; 2:9 Koro; 3:1 Matuku; 10:22 Ovalau; 14:16 Rotuma; 5:3 Totoya. Only the Koro and Ovalau samples are significantly different ($\chi^2 > 2.7$, 1 df) from 1:1.

Since *E. cyanura* is the ubiquitous lowland lizard, it occurs in association with most of the other lowland Fijian lizards. I found it syntopically (in the same microhabitat) with *Gehyra oceanica*, *Hemiphyllodactylus typus*, *Lepidodactylus lugubris*, *Nactus pelagicus*, *Cryptoblepharus eximius*, *Emoia concolor*, *E. impar*, *E. nigra*, *E. trossula*, *Lipinia noctua*, and *Leiolopisma alazon*. Its occurrence with the geckos, except *Nactus* was observed on Viti Levu, where it presumably has been forced into a cryptic lifestyle by continual mongoose predation. On Rotuma, it was syntopic with *E. nigra* and *E. trossula*. No interactions were observed between it and the latter species, but *E. nigra* was seen chasing *E. cyanura* on several occasions and twice capturing these skinks. This predation by *E. nigra* on *E. cyanura* was not observed on Koro where the 2 were abundant and syntopic. However, the lower density of the Koro study site suggests *nigra* predation, and the absence or very low abundance of *E. cyanura* in wooded habitats (Western Samoa) where *E. nigra* densities were high suggests *E. nigra* as a common predator of *E. cyanura*.

The linear regression for live SVL (X) to live body mass (Y) is $Y = -2.439 + 0.092X$ ($r^2 = 0.84$, $n = 54$).

Behavior. E. cyanura is a diurnal skink, becoming active shortly after sunrise, even when overcast (and not raining) with air temperatures at least 24.5°C, and remaining active to shortly before sunset. They are preferentially heliophilic and most active/visible when the sun is shining. They bask, usually on elevated ground litter (branches, palm fronds, rocks, etc.), predominantly horizontally and seldom more than 50 cm above the ground. If frightened from basking sites, these skinks jump or run quickly undercover into thick vegetation, beneath detritus, or into shaded areas of the forest. Often within a few minutes, they begin to return to the sunlit areas. The smallest individuals appear 1st, then progressively larger individuals arrive, displacing the smaller individuals from the "best" basking sites. This successive displacement of smaller individuals by larger ones suggests the presence of a dominance hierarchy.

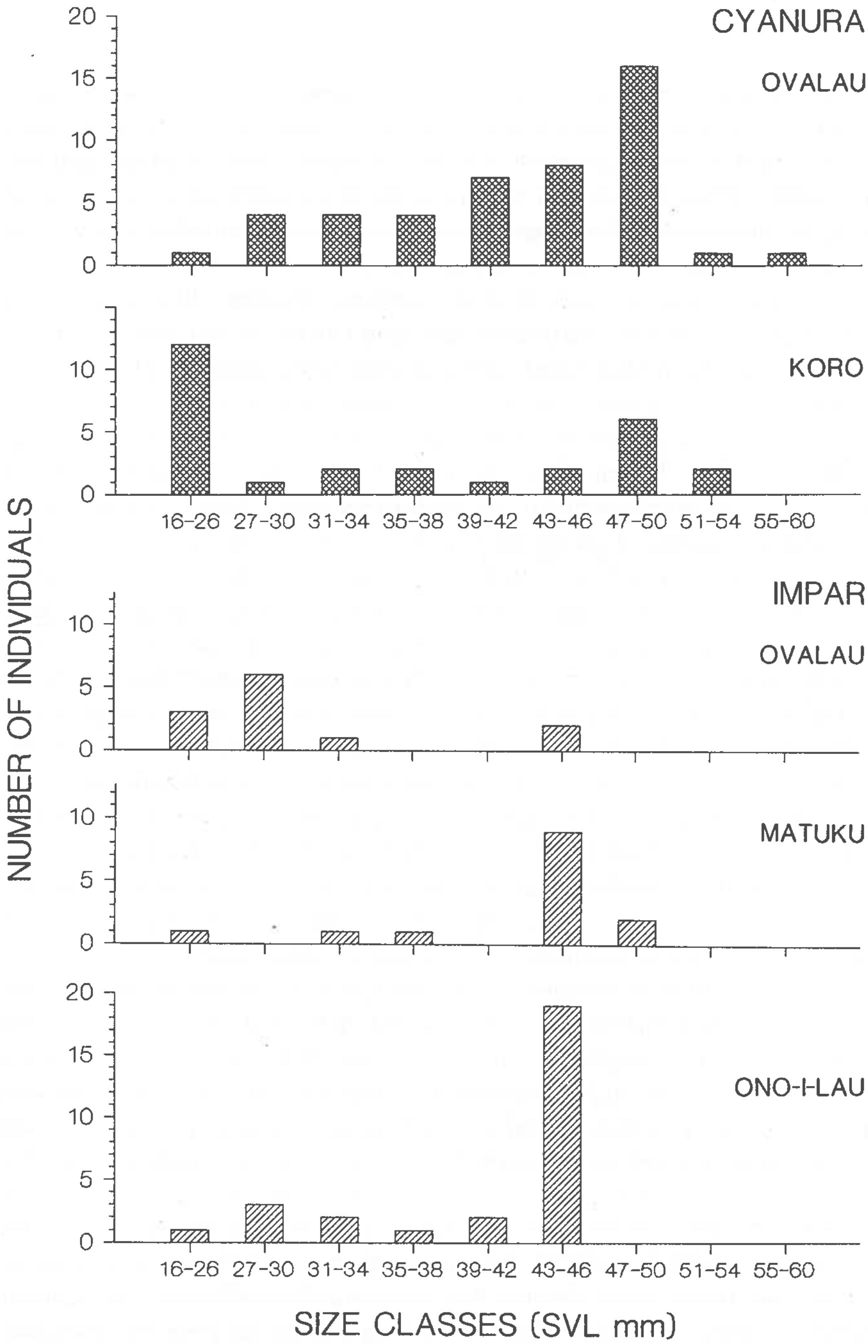


Figure 11. Comparison of the size structure of 2 *Emoia cyanura* samples (Ovalau and Koro) and 3 *E. impar* samples (Ovalau, Matuku, and Ono-i-Lau). Both species attain sexual maturity in the 39.0–42.9 size class.

Head bobbing is an aspect of this social interaction, although its actual role is unknown. Lizards of the same size occasionally displace one another by biting. Basking time is variable, commonly <30 sec at midday with bright sun and high temperatures. When undisturbed under conditions of partly cloudy weather, the sequence of appearance at basking sites is the same, with the smallest appearing 1st in patches of sunlight, and the largest last.

Once heated, these lizards are constantly on the move, presumably in a continuous search for prey. On the ground, they move over and under the floor litter; they climb grass stems, shrubs, trunks of small and large trees, but seldom climb higher than 1 m. Their movements appear jerky with short pauses interrupting a steady walking pace. When reaching the end of a branch, they jump to an adjacent branch or to the ground; jumping or dropping from elevated perches is also a common escape behavior. I have the impression (i.e., no quantitative data) that *E. cyanura* has no territories/home ranges. This impression derives from 2 classes of observations: (1) In forested areas with little ground cover, skinks move ahead and to the side of a collector in a wave; once the disturbance passes, the skinks emerge and slowly reoccupy the vacated area. (2) Also in forested areas, a stationary observer will see skinks moving into, through, and out of an area, seemingly in small groups or packs. In sparsely canopied or canopyless areas with dense ground cover, my impression is that the skinks occur everywhere with concentrations around detritus piles, and possibly the movements of individuals in such habitats are more localized.

In the latter habitats, the skinks appear to recognize and "accept" local landmarks. They move directly to preferred basking or hunting sites. They will move over and onto old items in their environment and generally avoid newly added items, such as recently fallen palm fronds. Apparently they must familiarize themselves with new items before the items are accepted as pathways or basking sites.

A small sample of body temperatures from Rotuman *E. cyanura* shows the importance of sun in their thermoregulatory behavior. Individuals captured from sunlit sites had a mean body temperature of 33.0°C (range 28.2–34.6°C, $n = 9$), whereas an individual from a shaded site had a body temperature of 28.2°C. The difference between sun-heated vs. shaded lizards is even more pronounced when comparing body-air temperature differences, 5.1°C (3.4–7.7°C) and 1.6°C, respectively.

Reproduction. Gravid females bore 2 (occasionally 1) oviducal eggs (ellipsoidal, 11.1–12.0 mm maximum length). Oviducal eggs occurred in samples from April (Matuku) and May (Koro, Ovalau, and Rotuma). Adult females with midterm vitellogenic follicles to oviducal eggs were rare in all samples, comprising less than 5% of samples. Most adult females showed 3–4 sets of ovarian follicles with the largest set being 1.0–1.5 mm diameter and at the beginning of vitellogenesis. The smallest female with oviducal eggs was 46.9 mm SVL; the smallest female with midterm vitellogenic follicles (>4.0 mm diameter), 43.8 mm SVL; the smallest female with early vitellogenic follicles, 41.0 mm SVL. Many females in the 40–45 mm range appeared immature, with small (<1.0 mm) follicles and small, unfolded oviducts; thus maturity may occur at 39–41 mm, but most females are probably not mature until 45–46 mm. The smallest males undergoing spermiogenesis were 39.4 mm and 42.1 mm SVL; a 37.4 mm male showed active spermatogenesis but no differentiating spermatids. Hatchling size is about 22–23 mm SVL. Eggs are laid in communal nests, usually 6–10 in a nest, and incubation is about 40–51 days (Samoa, Schwaner 1980; note that Schwaner's sample contained both *cyanura* and *impar*).

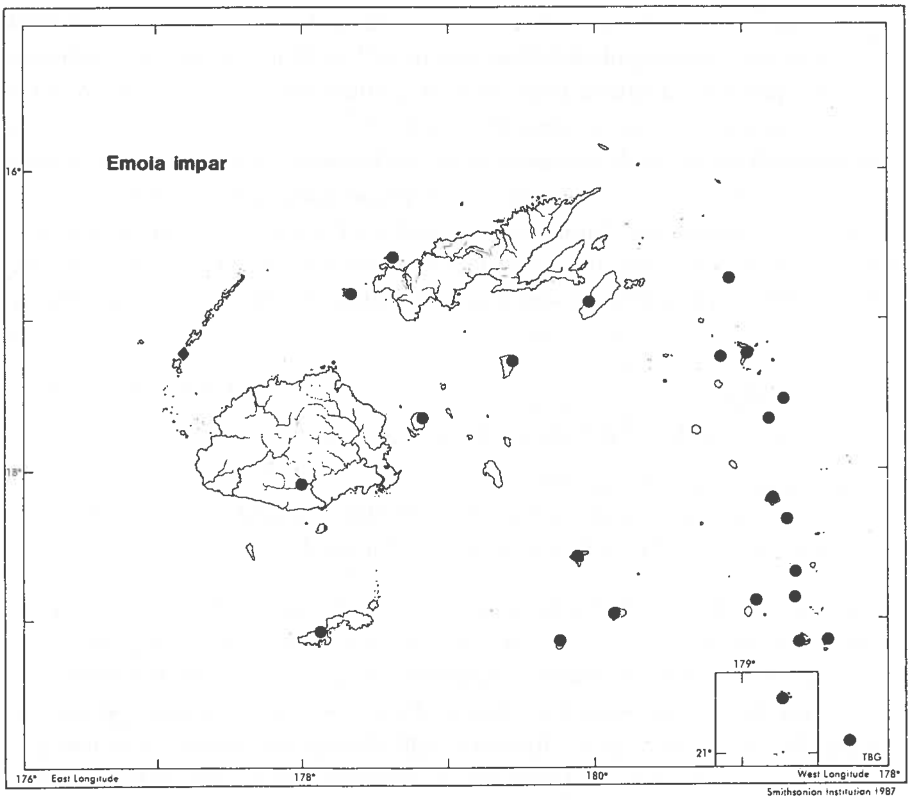
Emoia impar Family Scincidae
Blue-Tailed Copper-Striped Skink

Lygosoma (*Emoa*) *impar* Werner 1898:553. Type locality, "Ralum und Mioko."
Lygosoma cyanurum var. *schauinslandi* Werner 1901:384. Type locality, "Molokai (Kalae)."
Mabuya deserticola Dunn 1936:554. Type locality, "Mollendo, Peru."

Description. Adults 40–48 mm SVL, hatchlings about 22–23 mm SVL. Males and females are equal size. Unregenerated tail length 1.25–1.75X SVL and proportionately equal in females and males. Moderately stout lizards with well-developed limbs; tip of 4th toe extending to or near axilla when hindlimb is adpressed to side of body. Head conical, slightly flattened, and distinct from neck by moderately enlarged jowls (temporal area). Digits of fore- and hindfeet long and strongly clawed. Hindtoe length pattern 4>3>5>2>1. Tail long and moderately robust, round in cross-section, and tapering gradually to a point.

Smooth, shiny, imbricated scales on body. Middorsal scales subequal or only slightly larger than those on sides; 1 or more of the middorsal pairs of scales fused, forming 1 or a series of large middorsal scales; 51–62 rows between parietal scales and base of tail; 26–33 (mode 29–30) scale rows at midbody. Subdigital lamellae smooth, narrow, and numerous with 40–53 beneath the 4th finger and 57–82 (rarely <60) beneath 4th toe. Head scales smooth. Rostral broad, abutting frontonasal across moderate suture. Supranasals medium size and narrowly rectangular; prefrontals widely separated by frontonasal-frontal contact. Frontoparietal single and fused with interparietal; no epiphyseal eye in this scale. One pair of greatly enlarged nuchal scales. Anterior loreal higher than long, usually distinctly smaller than posterior loreal. Lower eyelid movable, with large transparent disc surrounded by small opaque scales. Seven (rarely 6) supralabial scales, enlarged 5th (rarely 4th) supralabial beneath eye and 5–7 (mode 6) infralabials.

Brightly striped with black and copper longitudinal stripes on head and back, often with bluish tail. Middorsal coppery beige stripe from tip of snout to base of tail;



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

similarly colored pair of dorsolateral stripes from above eye to midbody. These 3 stripes lightly edged in black and often fading on posterior half of body and sides. The spaces between stripes are black or more commonly dark copper, produced by each scale with copper center and black border. Tail turquoise in juveniles, fading but remaining bluish in adults. Venter dusky to gray, darkest on belly, thighs, and base of tail.

Variation. Females and males share a similar scalation except for significantly fewer midbody scales in females (Appendix:Table C). Females are significantly smaller than males in head length, body length, and hindlimb length.

Interisland comparison is possible for 3 islands (Ovalau, Matuku, and Ono-i-Lau; *n*, 13, 14, 44). The range of variation is slight for all scale traits, and they have similar means. The most variable (but not significantly different) traits are dorsal scale rows ($\bar{x}$, 55.4–58.2), midbody scale rows (29.3–31.0), and 4th toe lamellae (69.5–71.4). There is no discernible geographic pattern in the variation of these traits.

Taxonomic comments. The synonymy derives from Ineich & Zug (1991), who also provide a full nomenclatural history. They note that the use of *impar* for the Oceanic populations is not fully resolved. Specifically, if the New Guinean populations are genetically distinct, the Oceanic populations will become *E. schauinslandi* and *E. impar* will be restricted to the New Guinea-Solomon area populations.

Distribution. Emoia impar is widespread throughout Fiji, sharing much of the same geographic range, if not the same habitats, with *E. cyanura* (Map 14). It is absent from Rotuma. It is also a common and broadly distributed Pacific species, occurring from the Bismarcks (but not mainland New Guinea) through the Solomons and Vanuatu eastward to and including Polynesia (Ineich & Zug 1991).

Ecology. During my field work, I did not differentiate between *E. cyanura* and *impar*. Only through the use of my extensive voucher samples am I able to discern some differences in ecology and behavior of these 2 sibling species. A few of the differences seem striking now that I recognize the existence of 2 species. Foremost, *E. impar* is a forest skink, occurring principally in moderate- to closed-canopied forest and occasionally at the forest edge and in human-disturbed habitats. This habitat segregation was most overt in my Matuku and Ono-i-Lau samples. In Matuku, I made a transect from a well-developed secondary forest through gardens and a village to a beach. The forest *Emoia* were *impar*; at the forest edge and thereafter, all specimens were *cyanura*. Two Ono-i-Lau collections from uninhabited islands of Davora and Estad are dominated (>85%) by *E. impar*; I collected along a narrow beach and in the forest and did not record the habitat of each specimen.

No population density estimates are available for this species, although its abundance in some forested areas appears equivalent to many *E. cyanura* populations. Population structure can be examined at 3 sites, although samples from all sites are small. In the 2 forested sites, adults comprise the majority of the population (Fig. 11). At the Ovalau study site (open garden), juveniles dominated. The adult sex ratios (females:males) of the larger samples are: 2:3 Kadavu; 6:5 Matuku; 12:8 Ono-i-Lau/ Davora. Only the Ono-i-Lau sample is significantly different (χ^2 >2.7, 1 df) from 1:1.

Since *E. impar* is a widespread forest lizard, it probably occurs in association with most of the other lowland Fijian lizards. I found it syntopic with *Gehyra oceanica*, *Nactus pelagicus*, *Cryptoblepharus eximius*, *Emoia nigra*, *Lipinia noctua*, and *Leiolopisma alazon*. These occurrences were principally observed in the Moala and

Ono-i-Lau groups. Because it occurs syntopically with *E. nigra* it is undoubtedly prey of this large skink, although I observed no such predation on Koro.

I suspect the existence of exclusion interactions between *E. impar* and *cyanura*. The Matuku transect revealed no mixing of the 2 in the forest or open areas. The Ovalau removal survey showed a dominance of *E. cyanura* in an open, human-disturbed habitat. During the 4 days of the survey, the number of *E. impar* increased from 2 of 18 "cyanura" on the first day to 7 of 15 on 4th and final day, indicating an emigration of *E. impar* as *E. cyanura* were eliminated. This interpretation is supported by the *E. impar* being small juveniles.

Behavior. As noted above, I did not discriminate between *E. cyanura* and *E. impar* during my field work. In hindsight, I remember no striking differences and believe that most of the behaviors described for *E. cyanura* are equally appropriate for *E. impar*, thus I will not repeat them here.

Reproduction. No gravid females were found. *E. impar* likely bears 2 (occasionally 1) eggs, as do most other *Emoia*. Adult females with midterm vitellogenic follicles were also absent in all samples. Adult females showed 3–4 sets of ovarian follicles with the largest set being 1.0–1.5 mm diameter and at the beginning of vitellogenesis. The smallest female with early (1.0–1.5 mm diameter) vitellogenic follicles was 41.0 mm SVL. Many females in the 40–45 mm range appeared immature with small (<1.0 mm) follicles and small, unfolded oviducts. Although maturity may occur in some 39–40 mm females, most females probably do not mature until 45–46 mm. The smallest males undergoing spermiogenesis were 41.0 mm and 42.8 mm SVL. Hatchling size is about 22–23 mm SVL based on a 22.7 mm juvenile with a yolk-sac scar. Eggs are laid in communal nests, usually 6–10 in a nest, and incubation is about 40–51 days (Samoa, Schwaner 1980; note that Schwaner's sample contained both *cyanura* and *impar*).

Emoia nigra — Family Scincidae

Pacific Black Skink

Eumeces niger Jacquinot and Guichenot in Hombron and Jacquinot 1853:11. Type locality, specimen without locality data.
Emoa nigrita Girard 1857:197. Type locality, "Navigator Islands."
Lygosoma nigrum Boulenger 1887:297. Emendation for *niger*.
Emoia whitneyi Burt 1930:1. Type locality, "Shortland, Solomon Islands."

Description. Adults 88–112 mm SVL, hatchlings 35–37 mm SVL. Males and females are equal size. Tail length 1.5–2.0X SVL and equal in females and males. Robust lizards with well-developed limbs; tip of 4th toe extending to axilla or slightly beyond when hindlimb is adpressed to side of body. Head conical, slightly flattened, and demarcated from neck by thickened jowls. Digits of the fore- and hindfeet (Fig. 8) long and strongly clawed. Hindtoe length pattern 4>3>5>2>1. Tail long and robust, round in cross-section, and tapering gradually to a point.

Smooth, shiny, imbricated scales on body; middorsal scales subequal or only slightly larger than those on sides, 60–69 rows between parietal scales and base of tail; 32–40 (rarely <36) scale rows at midbody. Subdigital lamellae smooth with 20–24 beneath 4th finger and 31–39 (rarely <34) beneath 4th toe. Head scales smooth (Fig. 12). Rostral broad, abutting frontonasal across moderate-sized suture. Supranasals medium-sized, elongate rectangles or triangles; prefrontals usually separated medially; frontal and frontoparietal large and subequal. Interparietal distinct. One pair of enlarged nuchal scales. Anterior loreal usually as long or longer than high, and smaller than posterior loreal. Lower eyelid movable, with large transparent disc surrounded by small opaque scales. Seven to 8 supralabial scales, enlarged 5th or 6th supralabial beneath eye, and 6 (rarely 4, 5, or 7) infralabials.

In life, adults black with no dorsal pattern; head and body usually of same intensity in adults, occasionally with tail lightening toward brown. Venter dusky (brownish white) to dull golden brown, chin to anterior chest often strongly suffused with brown in males. Juveniles 2-tone: back (head to tail) dusky brown with lighter brown flecking, sides dark brown to black; venter a grayish ivory.

Variation. Males have significantly longer and wider heads, and longer hindlimbs than females (Appendix: Table C). None of the other morphometric or scalation traits show a dimorphism between adult females and males. Samples are too small for interisland comparisons.

Taxonomic comments. Brown & Marshall (1953) noted, without explanation, in their introductory remarks that *E. whitneyi* Burt and *E. nigrita* Baird are synonyms of *E. nigra*; the latter but not the former had long been recognized as a synonym. Brown (1991) later explained that the type of *E. whitneyi* possessed the characteristics of Solomons' juvenile *E. nigra.* Brown (1954) also noted that *Euprepes longicaudis* Macleay (1878a) was a member of the *Emoia cyanogaster* species group, rather than of the *nigra* group.

Distribution. Emoia nigra occurs in the Solomons and Vanuatu, eastward through Fiji to Tonga and Samoa. *E. nigra* is spottedly distributed in Fiji (Map 15). Old records (pre-1880 and pre-mongoose) demonstrate its former occurrence on Vanua Levu and Viti Levu. Its extinction on the main islands likely resulted from mongoose predation.

Ecology. I observed this skink on only 2 Fijian islands, Koro and Rotuma. It was abundant and ubiquitous on both islands, although seemingly more abundant in

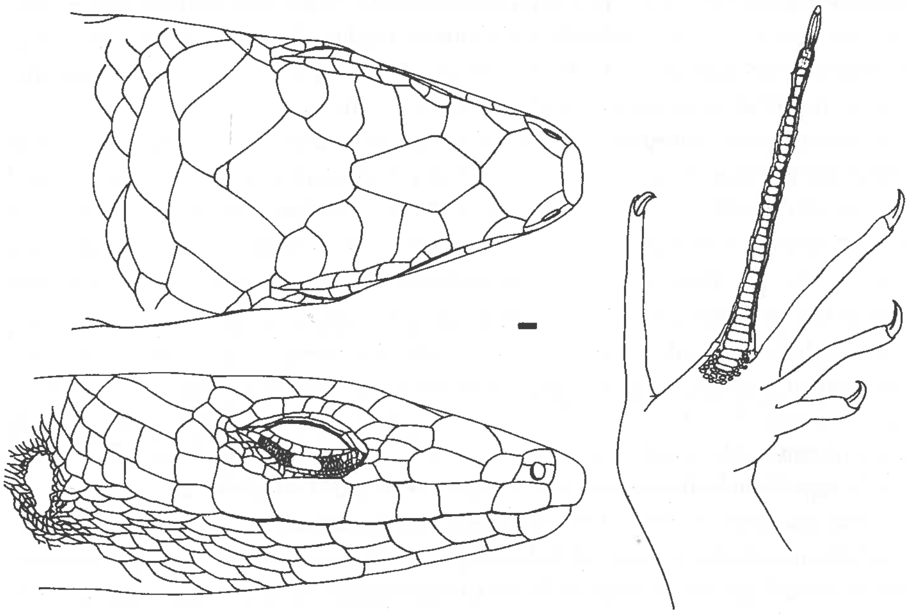
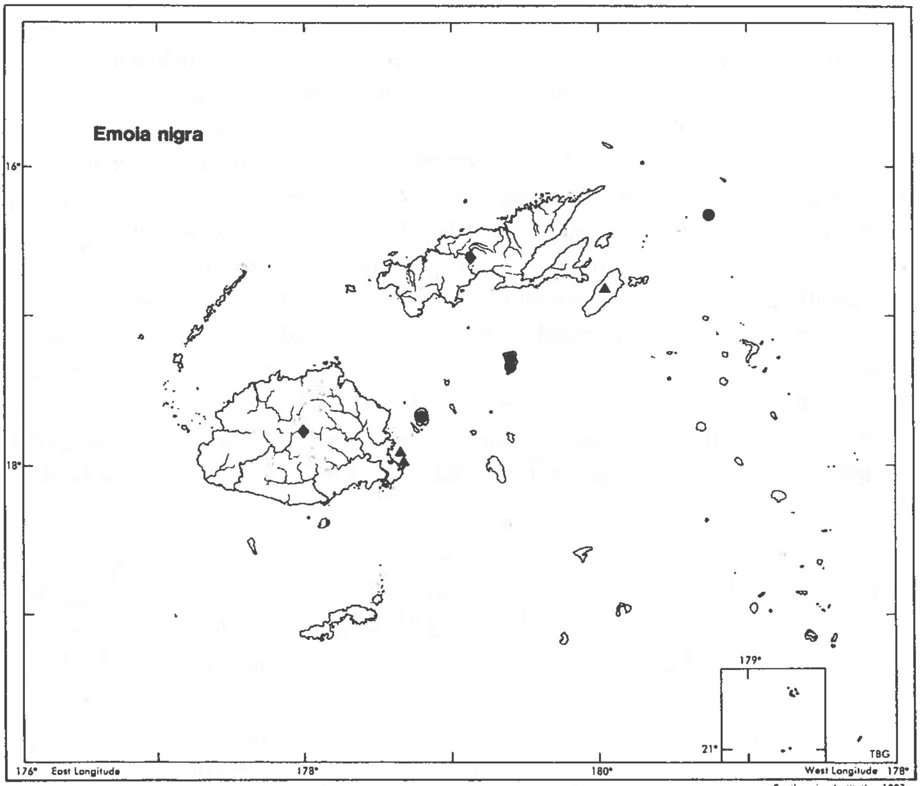


Figure 12. Head (dorsal & lateral) and hindfoot (plantar) of *Emoia nigra*, USNM 230073, Koro, Fiji. Scale = 1.0 mm.

wooded or forest-edge habitats, particularly those with thick ground cover of either vegetation, logs, or rocks. On Koro, in pastures or other open, human-disturbed areas, *E. nigra* tended to be concentrated along fence rows and appeared to be territorial with an adult spaced every 3–4 m; the "territories" centered around a rock, fallen log, or tree buttress. This presumed territoriality was not evident in Rotuma, where often 2 or 3 large juveniles and/or adults would be seen sharing the same tree, usually at midday; they were more solitary earlier in the day while foraging and basking. I made no formal population census on either island; however, I estimate that densities ranged from 10–50 *nigra* ha^{-1}. Sample sizes are too small to delineate age/size distributions for the *E. nigra* population. My observations suggest that the populations are composed predominantly of adults and large (>60 mm SVL), maturing juveniles. Of the adults collected, the sex ratio was 4:2 (female:male, $n = 6$) on Koro and 1:4 (5) on Rotuma.

On Rotuma, *E. nigra* occurred syntopically with *E. cyanura* and *E. trossula*, preying on the former. On Koro, *E. nigra* and *E. cyanura* lived side by side on the ground, and the former would escape upward into trees occupied by *E. concolor*.

The linear regression for live SVL (X) to live body mass (Y) is $Y = -22.131 + 0.477X$ ($r^2 = 0.88$, $n = 19$).



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

Behavior. Emoia nigra is diurnal and strongly heliophilic. They are rarely seen on overcast days, but become highly visible on days of bright sunshine. Their activity is largely confined to midday, approximately 1000–1500 hrs. Daily activity begins with basking, typically on elevated perches such as logs, rocks, detritus piles, or on the ground, occasionally low (<2 m) on sides of trees; they usually select a horizontal surface. Once heated, they begin to move about on the ground in a slow, methodical search pattern with quick bursts of speed when chasing a prey or escaping a predator. Around noon and thereafter, many of these skinks shift their area of activity from the ground to the trunks of large trees; they are then in the shade and from 1–4 m above the ground. They are not in a basking posture; if vertical on the trunk, they are as likely to be in a head-up as a head-down posture and are often in a crotch or on a horizontal branch. These individuals felt cooler than those caught foraging in the sun. Also at this time, they may aggregate with as many as 3–4 individuals on the same tree, particularly if the tree was the only large one in a gardening area. No aggressive interactions were observed between adjacent individuals.

Actively foraging skinks escape by either running away across the ground or hiding in mounds of detritus. Skinks basking on tree trunks are usually <1 m from the ground, poised head down, and escape by dropping to the ground; if cornered, they climb upward and disappear into the crown of a palm or the canopy of other trees. The "afternoon-resting" skinks almost always climbed upward to escape.

A small sample of body temperatures from Rotuman *E. nigra* shows the importance of sun in their thermoregulatory behavior. Individuals captured basking or foraging in the sun were warmer ($\bar{x}$, = 32.5°C, range 31.6–34.8°C, n = 4) than individuals caught resting in the shade ($\bar{x}$, = 30.6°C, 29.0–30.8°C, n = 3). The difference between sun-heated vs. shaded lizards is even more pronounced when comparing body-air temperature differences: 4.6°C (2.4–7.0°C) and 2.8°C (1.2–4.2°C), respectively.

Reproduction. E. nigra is oviparous, laying clutches of 2–3 ellipsoidal, leathery-shelled eggs (2–4, mode 2 eggs; Samoa, Schwaner 1980). A single clutch of eggs was found (Rotuma) buried in rotten, pulverized wood at the base (ca. 0.5 m above the ground) of an abandoned termite gallery in an upright trunk (ca. 15 cm diameter). These eggs were 22.6–23.5 x 15.1–15.7 mm (measured after hatching) and hatched as they were being collected. The hatchlings literally burst from the eggs on the run. The one hatchling caught was 37.2 mm SVL; a smaller (35.4 mm) juvenile with a yolk-sac scar was caught in Koro. Incubation is approximately 65 days (Samoa, Schwaner 1980).

The smallest female with oviducal eggs was 98.6 mm SVL; the smallest female with early vitellogenic follicles (2.0–2.5 mm diameter) was 84.7 mm. Histological examination of 3 males showed spermiogenesis in a 95.7 mm SVL individual, but none in an 88.0 mm one; however, a 86.9 mm male had enlarged testes (5.5 mm, maximum length).

Emoia parkeri Family Scincidae
Fijian Copper-Headed Skink

Emoia parkeri Brown, Pernetta, & Watling 1980:350. Type locality, "Naleboleba, Sigatoke [*sic* Nalebaleba, Sigatoka] Valley, Viti Levu Island, Fijis."

Description. Adults 43–52 mm SVL, hatchlings 23–26 mm SVL. Females and males are equal size. Tail length about 1.5X SVL and equal in females and males. Moderate-sized lizards with well-developed limbs; tip of 4th toe extending to or slightly beyond axilla when hindlimb is adpressed to side of body. Head elongate with long, roundtipped, and distinctly flattened snout; head grading imperceptibly into neck. Digits of fore- and hindfeet (Fig. 8) long and strongly clawed. Hindtoe length pattern 4>3~5>2>1. Tail moderately robust, round in cross-section, and tapering gradually to a point.

Smooth (or very faintly striated), shiny, imbricated scales on body; middorsal scales slightly larger than those on sides; 54–60 rows between parietal scales and base of tail; 28–33 (rarely <30) scale rows at midbody. Subdigital lamellae smooth with 22–30 beneath 4th finger and 31–41 beneath 4th toe. Head scales smooth. Rostral broad and broadly in contact with frontonasal. Supranasals moderate size; prefrontals usually in contact medially, rarely separated; frontoparietal single. Parietals and interparietal distinct. Usually a single row of enlarged nuchal scales (occasionally 2 or 3 rows). Anterior loreal much longer than high and subequal to or slightly smaller than posterior loreal. Lower eyelid movable, with large transparent disc surrounded by small opaque scales. Usually 8 (occasionally 7, rarely 9) supralabial scales, enlarged 6th (occasionally 5th, rarely 7th) supralabial beneath eye, and 6 (rarely 5 or 7) infralabials.

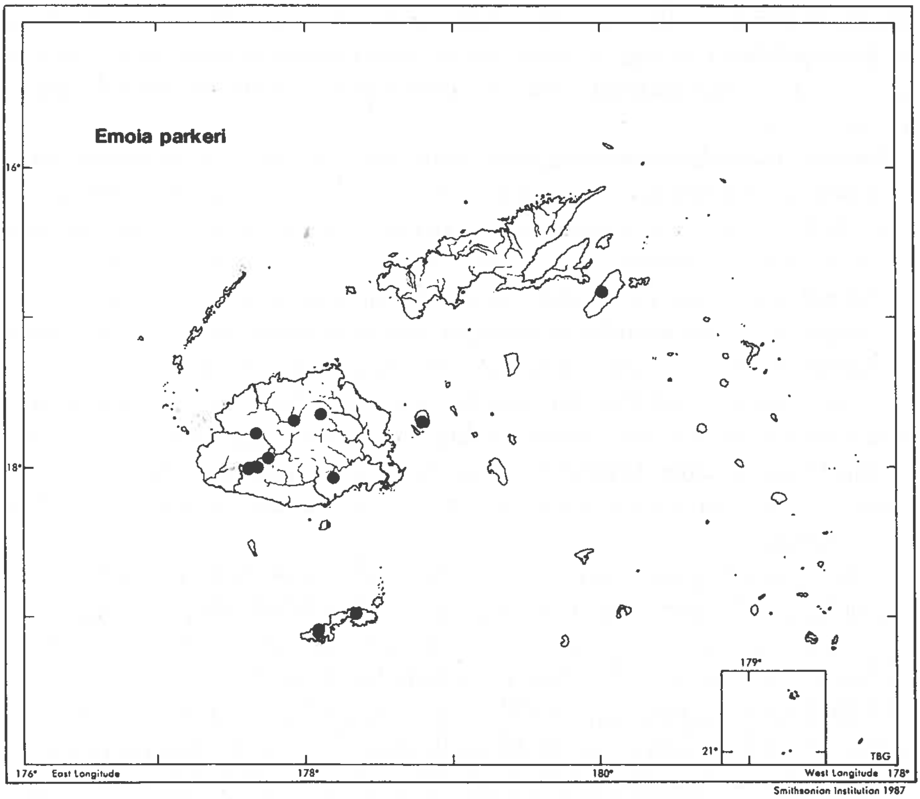
In life, greenish copper-colored lizard with bright copper head and neck. Bright copper head and upper lip accentuated by dark-brown, nearly black eye stripe; dark stripe as broad as orbit, extending from tip of snout through eye above ear opening and axilla onto sides of body, where it gradually breaks up. Back and sides speckled with dark-brown scales, occasionally speckles coalescing into pair of parasagittal stripes from neck to base of tail. Middorsally, shiny copper fading into coppery olive to olive brown on posterior part of body. Tail iridescent coppery green. Ventrally, chin and throat coppery ivory and remainder of venter light yellowish green with belly occasionally emerald green.

Variation. Females and males are similar in morphometrics and scalation. Only the number of eyelid scales is significantly different between females and males (Appendix: Table C). Sample sizes are too small to examine interisland variation.

Distribution. Emoia parkeri is a Fijian endemic, known only from Kadavu, Viti Levu, Ovalau, and Taveuni (Map 16).

Ecology. The Fijian copper-headed skink occurs in a variety of forest types: rain forest from the coast to 500 m, secondary forest, and the drier forest of the western side of Viti Levu. It has been observed primarily on tree trunks, usually below 7 m; it occurs most frequently on trees with buttresses, deep fissures, or a covering of epiphytes or vines, although it does forage on the ground.

In a recently logged forest (Nausori Highlands, Viti Levu), *E. parkeri* was very common; 5–6 individuals were observed in some of the larger tangles of branches left by the logging operation. If these numbers are characteristic of its densities,



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

estimates would be 50–100 *E. parkeri* ha^{-1}. In this area, they occurred syntopically with *Emoia concolor*.

The earliest natural history notes on *Emoia parkeri* (identified as *E. atrocostata*) are Pickering's observations (in Girard 1858:265) that it "keeps mostly on the ground, among stones." This observation does not match present day ones, but likely derives from coastal populations, which are now largely extinct.

Behavior. This skink is diurnal and semiarboreal. They are active and alert lizards; they stop and bask only briefly. If pursued, they escape both upward and downward. They do not move far away from their home log or tree, but hide nearby and reappear within minutes. I observed no aggressive inter- and intraspecific interactions.

Reproduction. A single clutch of 2 eggs was found in an earth-filled fissure between the trunks of 2 rain trees, just above ground level (Brown & Gibbons 1986). Egg dimensions were 9 x 13 mm.

Emoia trossula Family Scincidae

Barred Tree Skink

Emoia trossula Brown & Gibbons 1986:47. Type locality, "Ovalau Island, Fijis."

Description. Adults 74–107 mm SVL, hatchlings about 32–34 mm SVL. Males (74–107 mm) average larger than females (75–100 mm). Tail length 1.5–1.75X SVL and equal in females and males. Moderately robust lizards with well-developed limbs; tip of 4th toe extending to region of axilla when hindlimb is adpressed to side of body. Head elongate with somewhat pointed snout; head distinct from neck by enlarged jowls. Digits of fore- and hindfeet (Fig. 8) long and strongly clawed. Hindtoe length pattern 4>3>5>2>1. Tail long and slender, round in cross-section, and tapering gradually to point.

Smooth, shiny, imbricated body scales; middorsal scales larger than those on sides, 58–77 rows between parietal scales and base of tail; 30–40 scale rows at midbody. Subdigital lamellae smooth with 27–42 beneath 4th finger and 42–56 beneath 4th toe. Head scales smooth. Rostral broad, contacting frontonasal across moderate-sized concave suture. Supranasals moderate and elongate; prefrontals narrowly separated or in moderate contact medially; frontoparietal single and smaller than frontal. Interparietal distinct. One row of enlarged nuchal scales. Anterior loreal longer than high and usually smaller than posterior loreal. Lower eyelid movable, with large transparent disc surrounded by small, opaque scales. Usually 8 (occasionally 7 or 9) supralabial scales, enlarged 6th (rarely 5th or 7th) supralabial beneath eye, and 7 (occasionally 6 or 8) infralabials.

In life, greenish olive-brown, usually with irregular transverse dark bars and elongate white spots dorsally. Head same color as body with some dark flecking. Venter bluish white with variable amounts of dark flecking.

Variation. Adult females are statistically smaller in SVL, head width, head length, body length, and hindlimb length (Appendix: Table C). In scalation, dimorphism occurs only in the number of middorsal scale rows ($\bar{x}$ = 68.6 vs. 66.0, females vs. males) and number of 4th toe lamellae (53.7 vs. 51.3).

Interisland comparison is possible for Rotuma, Yadua/Yadua Tabu, and Aiwa (Appendix: Table D). The Rotuman population differs strikingly from the "Fijian" populations in SVL, dorsal scale rows, 4th finger lamellae, and 4th toe lamellae. In contrast, the Yaduan population is larger and has fewer dorsal scale rows, and fewer finger and toe lamellae. The Aiwa sample is similar to the Yaduan one in SVL, dorsals, and finger and toe lamellae. The Ovalau and Gau samples are intermediate between Yadua and Aiwa samples. This pattern of variation suggests either longer isolation or major ecological differences for the outlying Rotuman population.

Brown (1991) observed that some coloration differences might exist between the Fijian, Tongan, and Cook populations, but that the differences were not easily quantified. Certainly within Fiji, there appear to be some color pattern differences, although I have not been successful in quantifying them. For example, the chest and belly can range from nearly immaculate in the Rotuman *E. trossula* to heavily flecked with black in the Lauan *E. trossula*; the ventral surface of the tail is flecked with black in all Fijian populations. The intensity and unity of the dark crossbars and the number of white streaks on the dorsum also appear variable among the Fijian island populations.

Distribution. When first described, *Emoia trossula* was recognized as a Fijian-Rotuman endemic. John Gibbons had discovered a *trossula*-like skink in Tonga, but its status was too uncertain to include in the original description. Shortly thereafter, Crombie & Steadman (1988) reported *trossula*-like skinks from Rarotonga, Cook Islands. These outlying populations are now recognized as *E. trossula* (Brown 1991). Within Fiji, *E. trossula* has a spotty distribution, occurring on both large and small islands (Map 17). There are no recent records from Viti Levu (ZMB R01976-77 from 1800s) and Vanua Levu, so it may be extinct (Brown & Gibbons 1986). It occurs from the coast to 650 m (Gau Island.)

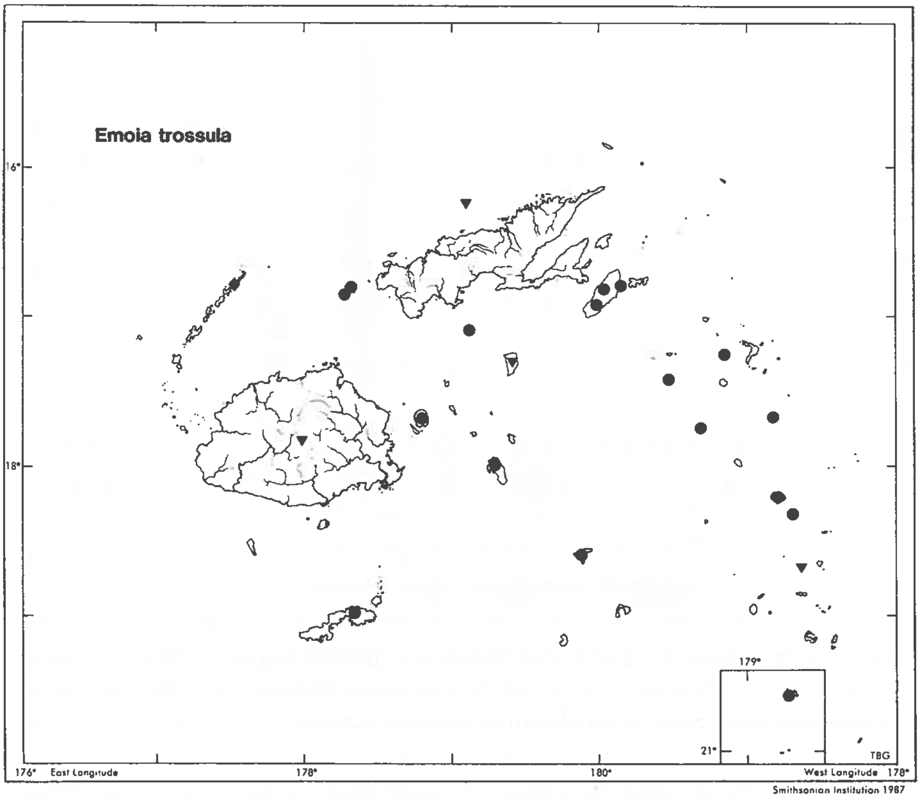
Ecology. Emoia trossula is predominantly a forest-edge and open scrub-forest species. It also occurs in forests with nearly closed canopies, in gardens, and in pastoral areas with scattered trees or wooded fence rows, but in these latter 2 areas it appears to be less numerous.

The relative abundance of these skinks varies greatly from island to island. On most islands, it is an uncommon skink, e.g., 1 lizard observed during several hours or days of searching. In contrast, densities may be very high, such as on Yadua Tabu (J. Gibbons, pers. comm.) and Rotuma. On Rotuma, it was the 2nd most abundant lizard (*E. cyanura* was the most abundant species); 15–20 *E. trossula* hr^{-1} were regularly observed on bright, sunny days. Density might easily be as high as 100 *E. trossula* ha^{-1} on Rotuma.

The population structure (Fig. 13) based on my total Rotuman collection shows a preponderance of large, maturing juveniles and adults; this matches my general impression of the wild populations. The adult sex ratio for this sample is 17:17.

E. trossula was syntopic with *E. cyanura* and *E. nigra* on Rotuma. I saw no interactions between *E. trossula* and these latter species.

The linear regression for live SVL (X) to live body mass (Y) is $Y = -9.459 + 0.234X$ ($r^2 = 0.90$, $n = 57$).



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

Behavior. The barred tree skink is diurnal and semiarboreal. Brown & Gibbons (1986) reported that it was a forest species foraging on the forest floor and sleeping on open tree branches. My observations were derived principally from the Rotuman population and indicate a wider range of habitat preferences, from forest through coconut plantations to wooded fence rows in pastures and around villages. Early morning observations also suggest that many individuals sleep at ground level in or near the base of trees and climb 1–2 m to bask head down on the trunk before beginning to feed. Many ascended the trunk and assumed basking position before sunlight reached their basking sites. I also discovered that initial foraging may occur in the low (1–4 m) hanging branches, but by midmorning many individuals have descended to the ground and were foraging there. Between 1130 and 1330, it was not uncommon to see the skinks returning to the forest edge or to isolated trees and

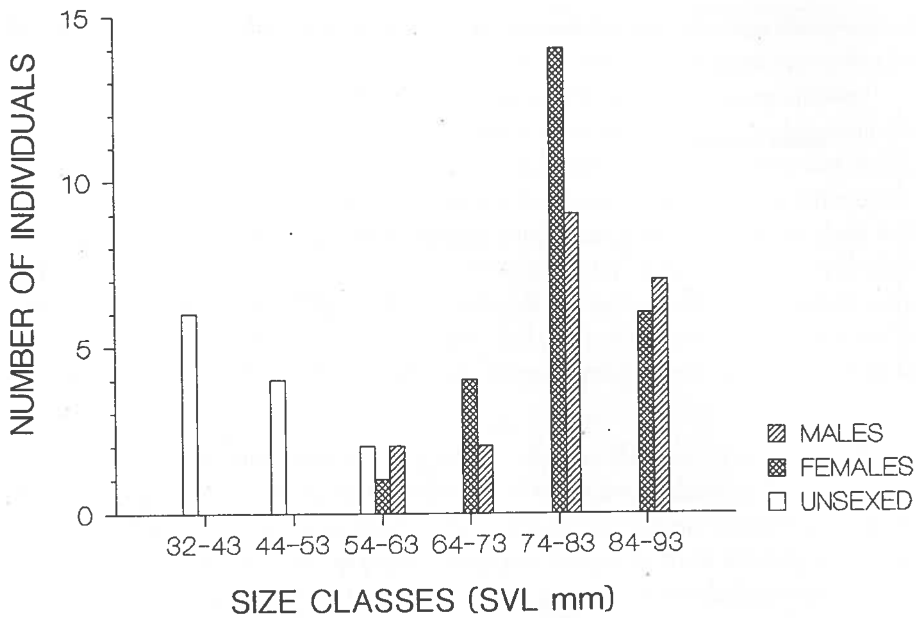


Figure 13. Size structure of the *Emoia trossula* sample from Rotuma. The size classes are: <44.0, 44.0–53.9, 54.0–63.9, 64.0–73.9, 74.0–83.9 and 84.0–93.9 mm SVL. Open bars = sex unknown; cross-hatch = females; diagonal lines = males.

ascending to 1–4 m, often selecting shaded sites on the trunk or horizontal limbs. If disturbed when resting or basking on a tree, *E. trossula* most frequently climbed upward, and in coconut palms, they would ascend into the crown if chased; however, typically they would move out of reach (4–8 m) and to the opposite side of the trunk.

These skinks actively bask and are most evident on sunny days. Individuals captured basking or foraging in the sun had mean body temperatures of 31.9°C (range 30.2–35.0°C, $n = 10$), those caught in the shade 29.7°C (28.0–31.0°C, $n = 12$). The difference between sun-heated vs. shaded lizards is even greater when comparing body-air temperature differences, 3.7°C (1.2–6.2°C) and 1.4°C l(0.0–3.2°C), respectively.

Reproduction. Gravid females bore 2–3 oviducal eggs and occurred in April (Yadua Tabu) and May (Rotuma). No egg clutches were located in the wild. Oviducal eggs are ellipsoidal and about 14.0–14.2 mm in maximum length. Juveniles with yolk-sac scars ranged 32.9–35.3 mm in SVL.

Sexual maturity is attained in some individuals of both sexes at 74–75 mm SVL. The smallest female with oviducal eggs was 81.6 mm SVL; with vitellogenic follicles (>1.5 mm diameter), 75.4 mm. Nonetheless, some larger females (e.g., 79 and 84 mm) appear immature with tiny previtellogenic follicles and virgin oviducts. Histological examination of testes and epididymides show active spermiogenesis and/or sperm in all males >73 mm SVL, although some individuals (76–80 mm) not examined histologically had small, immature-appearing testes. Another confounding factor is the possibility of maturity occurring at different sizes in different insular populations.

Leiolopisma alazon Family Scincidae
Lauan Ground Skink

Leiolopisma alazon Zug 1985:221. Type locality, "Fiji, Ono-i- Lau, Yanuya Island, 20°37′S 178°41′W."

Description. Adults 42–60 mm SVL, hatchlings SVL unknown. Males (51–60 mm SVL) average larger than females (42–48 mm). Tail length 0.75–1.25X SVL and equal in females and males. Elongate, robust bodies with short, well-developed limbs; tip of 4th toe not extending beyond midbody when hindlimb is adpressed to side of body; fore- and hindfeet widely separated when adpressed toward one another. Head conical, slightly flattened, and broadly jowled. Digits of fore- and hindfeet (Fig. 14) stout and strongly clawed. Hindtoe length pattern 4>3>2>5>1. Tail robust and subcylindrical, tapering to a point.

Smooth, shiny, imbricated body scales; middorsal scales subequal or only slightly larger than those on sides, 71–78 rows between parietal scales and base of tail; 34–37 (mode 34) midbody scale rows. Subdigital lamellae smooth with 12–15 (mode 15) beneath 4th finger and 20–23 (mode 22) beneath 4th toe. Head scales smooth (Fig. 14). Rostral rectangular and broadly contacting frontonasal. Supranasals absent; prefrontals moderate size and widely separated by frontal-frontonasal contact; frontoparietal paired. Interparietal distinct. One row of enlarged nuchal scales. Anterior loreal higher than long and smaller than posterior loreal. Lower eyelid movable, with large transparent disc surrounded by small opaque scales. Seven supralabial scales, enlarged 5th supralabial beneath eye, and 5–7 (mode 6) infralabials.

In life, brownish olive background, spotted with light-gold and dark-brown scales dorsally. Head similar to body but with distinct brown spots or bars on lips and chin. Venter golden beige; tail colors range from rufous orange through shades of salmon to beige.

Variation. Although the adult sample is small, several traits appear to be sexually dimorphic (Appendix: Table C). Females appear to mature at a smaller size and may not attain the maximum lengths of males. Similarly, head width, head length, and hindlimb length are smaller in females.

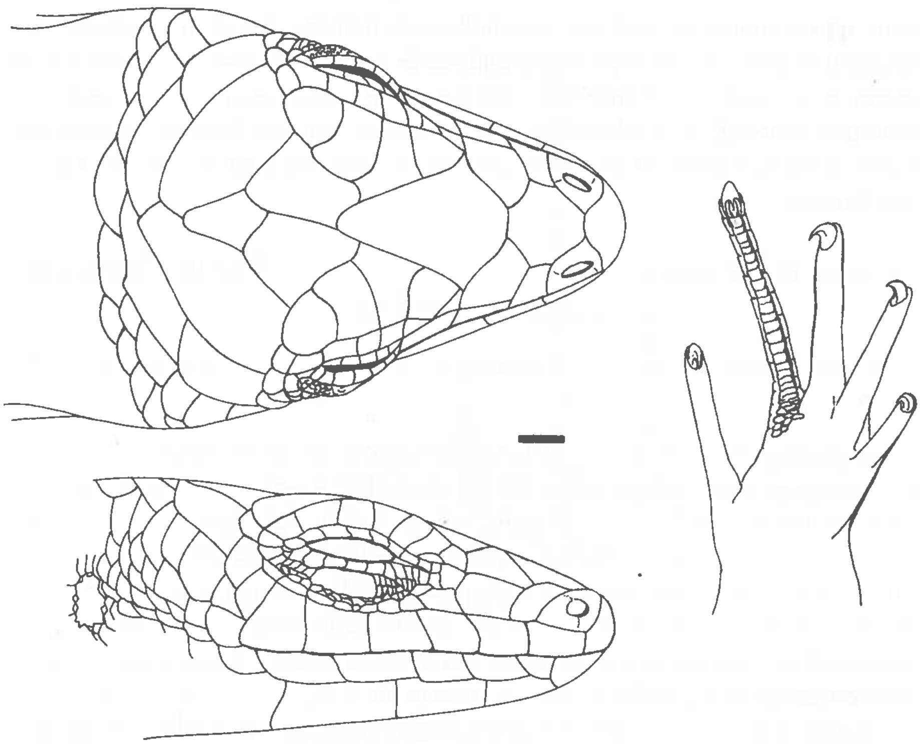


Figure 14. Head (dorsal & lateral) and hindfoot (plantar) of *Leiolopisma alazon*, USNM 230000, Ono-i-Lau, Fiji. Scale = 1.0 mm.

Distribution. This species is currently known only from the type locality, Yanuya Island, Ono-i-Lau.

Ecology. This skink was found beneath rotten logs on the forest floor. It was reasonably abundant; 13 individuals were found during 3 hrs. of searching. It occurred syntopically with *Nactus pelagicus* and *Emoia cyanura.*

Behavior. Presumably, *Leiolopisma alazon* is strictly diurnal; however, all but 1 individual were found beneath small logs. A juvenile was 1st seen on a short blade of grass adjacent to a log. When uncovered, these skinks immediately darted back under the log or into the adjacent forest floor litter.

Reproduction. Unknown.

Lipinia noctua Family Scincidae

Moth Skink

Scincus noctua Lesson 1826:pl. 3, fig. 4. Type locality, "à Oualan" in Lesson 1830:48.
Lygosoma vertebrale Hallowell 1861:487. Type locality, "Sandwich Islands."
Euprepes novarae Steindachner 1867:47. Type locality, "Taïti, Samoa-Inseln."
Lygosoma (*Lipinia*) *aurea* Meyer 1874:132. Type locality, "Jobi."
Lygosoma (*Mocoa*) *noctua* var. *ternatensis* Peters & Doria 1878:347. Type locality, "Ternate."
Lygosoma miotis Boulenger 1895:29. Type locality, "Ferguson Island, D'Entrecasteaux Group, British New Guinea."
Lygosoma (*Liolepisma*) *subnitens* Boettger 1896:2. Type locality, "Bongu, Astrolabe Bai, Neu Guinea."

Description. Adults 37–47 mm SVL, neonates 21–25 mm SVL. Females (37–47 mm SVL) average larger than males (38–43 mm). Tail length 1.0–1.25X SVL and somewhat longer in females than in males. Stout lizards with short, well-developed limbs; tip of 4th toe extending anterior to midbody when hindlimb is adpressed to side of body. Head conical, slightly flattened, and slightly differentiated from neck. Digits of fore- and hindfeet (Fig. 15) long and strongly clawed. Hindtoe length pattern 4>3~5>2>1. Tail thick, oblong in cross-section, and tapering gradually to a point.

Smooth, shiny, imbricated body scales; middorsal scales slightly larger than those on sides, 46–57 rows between parietal scales and base of tail; 24–28 (mode 26) scale rows at midbody. Subdigital lamellae smooth with 11–17 beneath 4th finger and 17–23 beneath 4th toe. Head scales smooth (Fig. 15). Rostral broad, abutting frontonasal across moderate suture. Supranasals absent. Prefrontals narrowly to widely separated medially by contact of frontonasal and frontal. Frontoparietals paired. Interparietal distinct and as large as frontoparietal. Usually 2 (occasionally 3 or 4) pairs of enlarged nuchal scales. Anterior loreal higher than long and slightly smaller than nearly square posterior loreal. Lower eyelid movable, with large transparent disc surrounded by small opaque scales. Seven (rarely 8) supralabial scales, enlarged 5th (rarely 6th) supralabial beneath eye, and 6 (rarely 5 or 7) infralabials.

In life, brown with bright, light spot on head. Head dusky with dark brown marks on edges of some scales. Bright white spot centered on parietals, separated from middorsal stripe by an incomplete restriction. Stripe extending from nape to base of tail, gradually becoming beige and darker posteriorly. On nape and neck, spot and middorsal stripe edged by dark brown, remainder of dorsum brown. Sides dark brown and spotted with small beige spots, beginning as narrow postorbital stripe and broadening toward axilla and continuing to broaden onto side of tail; tail dorsal area beige. Entire venter from chin to tail dusky beige.

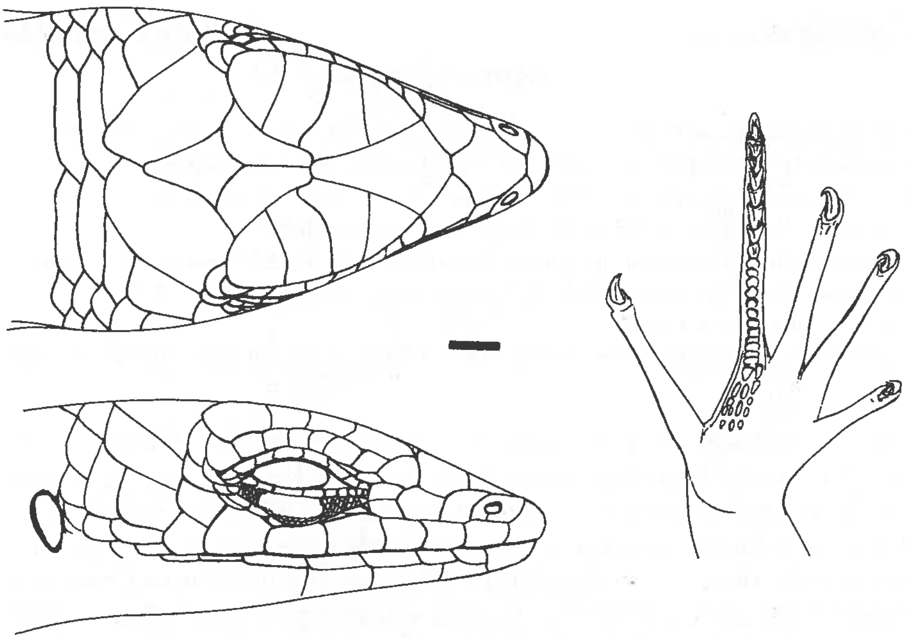


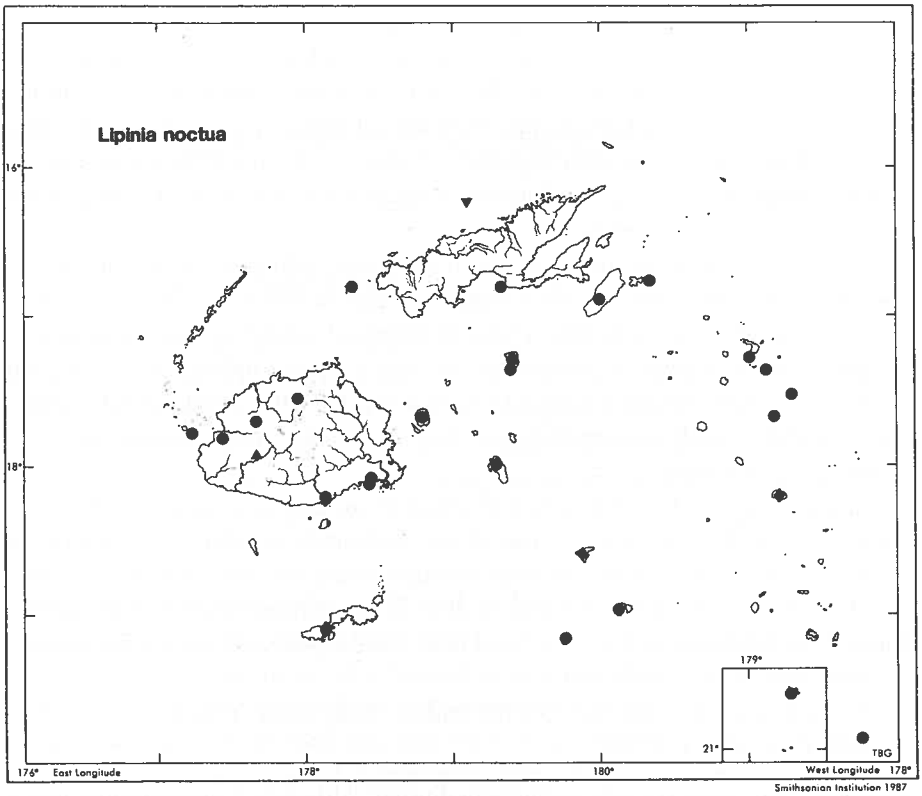
Figure 15. Head (dorsal & lateral) and hindfoot (plantar) of *Lipinia noctua*, composite of USNM 230254,–58,–60, Matuku, Fiji. Scale = 1.0 mm.

Variation. Females are significantly larger than males in SVL, tail length, and body length; females also have significantly more rows of dorsal scales (Appendix: Table C). Conversely, males have longer heads than females (only marginally significant), but because females are larger on the average, the male's head is proportionately larger.

Zweifel (1979) examined geographic variation in *Lipinia noctua*, emphasizing the populations in the New Guinea area. He noted that the latter populations displayed considerable variation in contrast to the homogeneity of scalation and coloration of the Pacific island populations. The geographic variation of different characters was not concordant and suggested no regional differentiation of populations. Interisland comparisons within Fiji (Rotuma, Taveuni, Yadua, Kadavu, Totoya, and Matuku; *n*, 9–13) reinforce Zweifel's observation on the homogeneity of Oceanic populations. There is little or no variation among the Fijian samples, and the sexual dimorphism observed in the total Fijian sample persists in the subsamples.

Taxonomic comments. The synonymy derives from Zweifel's review (1979) of this species. Greer & Mys (1987) removed *Leiolopisma rouxi* from Zweifel's synonymy.

Distribution. Lipinia noctua is widespread in Fiji, occurring on most islands (Map 18). It is a cosmopolitan Pacific species occurring from Sulawesi eastward across



Symbols: circle, museum specimens examined and identification verified; diamond, museum specimen examined and identification verified, locality data to island only; inverted triangle, museum specimen record, specimen not examined; square, literature record; triangle, photograph or sight record or knowledgeable observer.

northern New Guinea through the Solomons and Vanuatu to Tuamotu Archipelago and Marquesas Islands and northward to the Hawaiian Islands (Zweifel, 1979:figs. 1, 8).

Ecology. The moth skink occurs in a variety of forested or partially forested habitats. My impression is that *L. noctua* populations on different islands have different habitat preferences. In Rotuma, no *L. noctua* were observed on the forest floor either on or under litter or at bases of trees; all were found in elevated situations, e.g., beneath bark or in cavities of dead trees or in axils of palms (in all but 1 instance, on upright trunks). On other islands (e.g., Taveuni and Totoya), these skinks occurred on the ground beneath detritus and occasionally basked low on the sides of trees as well as in the Rotuma-like microhabitats.

Abundance was also very variable among different islands. In Taveuni, Matuku, and Totoya, I collected 2–3 *L. noctua* hr^{-1}. Abundance was noticeably less on other islands: 0.5–1.0 *L. noctua* hr^{-1} on Ovalau and Rotuma, 0.1–0.5 *L. noctua* hr^{-1} on Koro, <0.1 *L. noctua* hr^{-1} on Viti Levu. None were observed on Nayutuira (Yagasa group) or Estad (Ono-i-Lau); however, collecting time was limited on these islands. More striking was their apparent absence on Yanuya (Ono-i-Lau) and the relatively high abundance of *Leiolopisma* in the ground-litter microhabitat typically occupied by *L. noctua* elsewhere.

None of my collections are adequate to accurately delineate size distribution of *noctua* populations; however, they suggest a high variation in this demographic feature. A 30 m^2 surface litter plot consisting largely of rotting coconut husks yielded 7 *noctua* in a coconut grove-pasture site on Taveuni; only 1 individual was an adult (male). The Totoya sample contained 11 individuals, 6 adult females, 4 adult males and 1 juvenile. Adult female:male sex ratios from other island samples are: 6:3, Matuku; 2:5, Rotuma.

L. noctua occurred syntopically with different groups of lizards on different islands. Only on Rotuma was it found almost exclusively in arboreal microhabitats and shared these with *Gehyra oceanica* and an occasional *Emoia cyanura*. On other islands where it was more terrestrial, it shared microhabitats with *Lepidodactylus lugubris* in rock crevices (Viti Levu) and with *Nactus pelagicus* and *Emoia cyanura* in forest-floor litter (most islands).

The linear regression for live SVL (X) and live body mass (Y) is $Y = -1.417 + 0.067X$ ($r^2 = 0.89$, $n = 12$).

Behavior. This skink is likely exclusively diurnal. Although it is commonly found beneath bark and forest-floor litter, individuals were also seen basking in direct sunlight, resting on a shaded tree trunk, or moving about on the ground. It is best considered semiterrestrial, being found nearly equally on the ground or on trees (as high as 4 m). When in a tree, its escape reaction is downward or into a crevice or similar hiding place. It moves quickly, but only short distances, and usually along the edge of or under cover.

Reproduction. Lipinia is the only live-bearing (viviparous) lizard in Fiji. Females bear 2 (occasionally 1) fetuses. The largest follicles were 5.4 mm (maximum diameter), oviducal eggs 8.0 mm, and near-term fetuses 8.5–12.9 mm (maximum length in fetal posture). Postnatal lizards with yolk-sac scars range from 20.6–25.4 mm SVL. The gestation period is unknown.

The smallest female with oviducal eggs or fetuses was 39.4 mm SVL; she was smaller than any females with vitellogenic follicles. Two 38 mm SVL males displayed spermiogenesis and had testes lengths >2.9 mm; no smaller males possessed testes of this minimum length. Thus, males and females reach maturity at 38–39 mm SVL. Gravid and pregnant females occurred in April (Matuku and Totoya) and May (Yadua).

Geographical Ecology

Lizard Assemblages

"Assemblage" is used to denote a group of lizards occurring syntopically, active at the same time, and potentially sharing some of the same resources (e.g., food and basking or resting sites). "Community" is often used in an equivalent manner, but the word implies some degree of organization and coevolution. My sampling technique and delineation of species co-occurrence are not sufficiently rigorous to recognize or verify organization or coevolution in the Fijian lizard assemblages examined.

Composition. In general, the skinks and geckos divide the day into diurnal and nocturnal assemblages. Within the nocturnal assemblages, *Lepidodactylus lugubris* is the most abundant species in urban environments (except where *Hemidactylus frenatus* has become established, outnumbering syntopic geckos (e.g., *Gehyra mutilata* and/or *Hemidactylus garnotii*) >2:1. As conditions become more rural, *L. lugubris* remains the dominant species on buildings, the other 2 species may or may not persist, and *Gehyra oceanica* appears, often equal in abundance to *L. lugubris*. *Hemiphyllodactylus typus* may also occur with *L. lugubris* and *G. oceanica*, but it is always a rare species and confined to the darker edges of any lighted habitat. Moving from buildings to vegetation in rural to natural situations, *G. oceanica* becomes the dominant nocturnal species, with *L. lugubris* occurring sporadically. *Gehyra mutilata* is a rural commensal and always occurs in low numbers. In forests or tree plantations, *Nactus pelagicus* occurs with *G. oceanica* and *L. lugubris*, although *N. pelagicus* is less arboreal and stays low on tree trunks or on the ground. The nocturnal activity of Fijian *Hemiphyllodactylus* in semi-natural or natural habitats has not been documented. Presumably, *Gehyra vorax* and *G. oceanica* co-occur in the least disturbed forest habitats; however, there are no nocturnal field observations of *G. vorax*. A similar absence of nocturnal observations exists for *Lepidodactylus gardineri* and *L. manni*; both occur sympatrically with *G. oceanica* so they may also share nocturnal foraging sites.

The following assemblages have been discovered in various diurnal retreats for these largely nocturnal species: *G. oceanica*, and *L. gardineri* (hollow branches); *G. oceanica* and *Lipinia noctua* (beneath bark of dead trees); *G. oceanica*, *H. typus*, *L. lugubris*, and *Emoia cyanura* (leaf axils of pandanus); *L. gardineri* and *L. noctua* (hollow branches); *L. lugubris* and *L. noctua* (rock cracks); *N. pelagicus*, *E. cyanura*, and *L. noctua* (forest-floor litter, coconut-shell mounds); *N. pelagicus*, *E. cyanura*, and *Leiolopisma alazon* (beneath rotten logs).

The urban, diurnal assemblages are dominated by *Emoia cyanura* and the high densities of *E. cyanura* continues through rural-agricultural habitats to forest-edge habitats. Of all the Fijian skinks, *E. cyanura* appears to have benefited most from habitat alteration by humans. Presumably, it was originally a forest-margin ecotonal species, so human fragmentation of forests has allowed *E. cyanura* to expand throughout the islands, although it does appear to be rare or absent from upland habitats in Viti Levu. In the lowlands, it occurs with *Cryptoblepharus eximius* in littoral situations. Further inland, it occurs with *E. nigra* and *E. trossula*, and *Lipinia noctua*. The combinations and relative abundance of species is variable. For example, *E. cyanura*, *E. nigra*, and *E. trossula* formed the terrestrial-low arboreal assemblage on Rotuma; *E. cyanura* and *L. noctua* constituted this assemblage on Taveuni; *E. cyanura*, *E. nigra*, and an occasional *L. noctua* occurred together on Koro; on Ovalau, *E. cyanura* occurred alone, and the other species were rarely observed; this latter situation was the usual situation for assemblages in the Lau and Moala island groups. Yanuya was the only island with *Leiolopisma alazon*, and there it and *E. cyanura* occurred within centimeters of one another, although *L. alazon* was usually found beneath logs on which *E. cyanura* sat or ran. *Emoia impar* is the dominant lizard in canopied forest habitats and shares the same species associations as *E. cyanura*. Because of my failure to discriminate between the 2 species, insufficient effort was placed on sampling forest habitats for "cyanura" and my data is not as explicit on these associations as I would like. The other striped skink, *Emoia caeruleocauda* occurs at only a few sites on 2 islands. It appears to be a recent introduction with limited success in colonization.

Abundance. Emoia cyanura is ubiquitous and the dominant diurnal species on all islands. It occurs, often abundantly, from the supralittoral zone into the mountains and upland plateaus. Of all the species observed, it was the only one for which density estimates were obtained, 1,300–4,000 lizards ha^{-1}. These estimates provide a reasonable range for the densities on islands not populated by the mongoose. The mongoose is common on Viti Levu, and there *E. cyanura* populations are greatly reduced: approximately 0–2 individuals were observed per hour of field work. Yet on satellite islands less than 100 m from Viti Levu, but separated by a constant saltwater barrier (thus no mongooses), *E. cyanura* populations occurred in high densities.

None of the other skink species approach the abundance of *E. cyanura*. *Cryptoblepharus* may be locally as abundant; however, their high abundance occurs in a narrow (<5 m or less) band along the supralittoral zone or a cliff face. *Lipinia* is similar in size, but is nowhere as abundant (1–4 lizards hr^{-1}). The large skinks, *Emoia concolor*, *nigra*, and *trossula*, were of variable abundance, both within and among islands. I observed dense populations of *E. concolor* only on Matuku; on nearby Totoya, none of these large skinks were seen during twice the field time. *E. concolor* was less abundant (<3 lizards hr^{-1}) on Koro, Ovalau, and in Nausori Highlands of Viti Levu; these were areas in which I did not observe any *E. trossula*. *E. trossula* does obtain high densities (>50 lizards ha^{-1}), as observed on Rotuma and the Yadua Tabu island (pers. comm., J.R.H. Gibbons). Elsewhere, I did not see any *E. trossula* or <0.5 lizards hr^{-1}. I saw *E. nigra* only on Koro and Rotuma; on both islands they were reasonably abundant (>10 lizards hr^{-1}). Their visibility is greatly affected by the weather, and they are rarely seen unless there is sunlight.

The abundance of nocturnal geckos is difficult to assess, because few geckos were observed during night field work in semi-natural and natural habitats. *Gehyra oceanica* was commonly found under shelter during the day (also occasionally seen basking in late afternoon), so it is likely the most abundant gecko in gardens and forested habitats—and also the most ubiquitous native Fijian gecko. *Nactus pelagicus* ranks next in relative abundance in natural habitats, but its densities are likely half or less those of *G. oceanica*, based on diurnal encounters. *Lepidodactylus lugubris* is the most abundant of the human commensal geckos and occurs in very low numbers in many natural habitats. Estimates of densities for *L. lugubris* range from 1–20 lizards per 100 m^2 of external wall surface, depending directly upon nocturnal lighting and availability of diurnal shelters. *Hemidactylus frenatus* is a recent arrival in Fiji, and its populations are expanding at the expense of *L. lugubris*. *Hemidactylus garnotii* and *Gehyra mutilata* are assumed to be older, human-assisted colonizers that persist at very low densities with *L. lugubris* on buildings; an estimate of relative abundance for the 3 would be 10–20 *lugubris*:2 *mutilata*:1 *garnotii*. Assessing the abundance of *Hemiphyllodactylus* is difficult. It rarely occurs on buildings and is difficult to observe in vegetation. It may be an abundant gecko, yet its cryptic behavior gives the impression of rarity. *Gehyra vorax* and *Brachylophus* were not observed in the field. The latter is likely rare in most areas, the former difficult to observe in its forested home.

Body size distribution. A set of islands (Table 3) was selected to portray the full range of island sizes within Fiji and to include islands that have been well sampled. "Well sampled" is a relative term, because my samples are composites of incidental collections made over the last 100 years. The species representation for the larger islands (Viti Levu through Rotuma, Table 3) are, I believe, accurate censuses of the native lizard faunas (including recently extinct species), but the species compositions for the smaller islands are likely underestimates of the actual species diversity.

To search for patterns in body size distribution, I compared the minimum size (measured as SVL) of sexually mature females from islands of different size (Fig. 16).

TABLE 3

Island Size and Native Lizard Species Density for Select Fijian Islands

The maximum length (km) and approximate area (km^2) were estimated from the *Fiji Islands* map, scale 1:750,000, 2nd ed., Lands and Survey Dept., Fiji, 1984. Species-area equations ($S = C A^z$) for these data are: Geckos = $1.135 A^{0.17}$; Skinks = $2.963 A^{0.13}$; Total Lizards = $4.389 A^{0.15}$.

Island			*Number of Species*			
	Length	Area	Geckos	Iguanas	Skinks	Total
Viti Levu	140	7000	5	2	9	15
Kadavu	56	400	4	1	7	12
Ovalau	13	95	3	1	8	12
Rotuma	15	50	3	0	5	8
Cicia	7	25	0	0	3	3
Tuvuca	5	10	1	0	5	6
Aiwa	2	1	2	1	1	4

Aside from the reduction in species diversity, the only trend is the absence of the large arboreal gecko from the moderate and small islands. *G. vorax* does not appear to occur on islands of less than 90 km^2, whereas the largest skink, *E. nigra*, is missing from the smallest island (Aiwa). The 2nd-ranked skink of similar size (*E. trossula*) persists on that island. The loss of the large gecko may result from the absence of appropriate forest types. The absence of the largest skink may also be habitat-related or possibly associated with inadequate food resources, particularly if small skinks are its major prey; however, the presence of *E. nigra* on 2 islands of <3 km^2 makes this suggestion tenuous. Thus, the comparison has revealed no distinct trend in the relation of body size and island size for Fijian lizards.

Habitat shifts. Although my observations were often of limited duration, some behavioral differences appear to exist between populations of the same lizard species on different islands. These differences were not quantified.

Lipinia noctua is a terrestrial lizard throughout the main Fijian islands. It may occasionally bask 1–2 m high on a tree trunk, but it is found/seen most frequently on the ground and beneath surface detritus. On Rotuma, *Lipinia* was never found on the ground, only within dead, upright trees or in palm axils (see "Predatory interactions," p. 97).

Cryptoblepharus eximius is typically a supralittoral inhabitant, occurring on rock

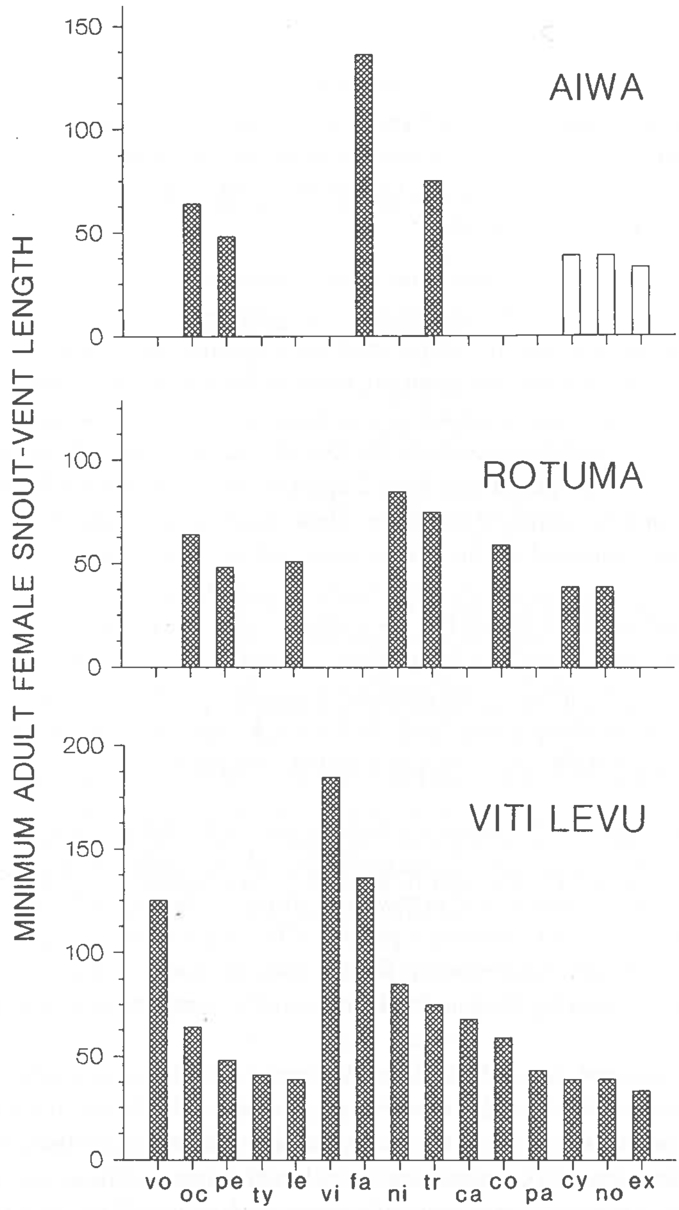


Figure 16. Comparison of the body sizes of lizard faunas from different sized Fijian islands. The body size portrayed for each species is the minimum snout-vent length of sexually mature females. Abbreviations: ca, *Emoia campbelli*; co, *Emoia concolor*; cy, *Emoia cyanura*; ex, *Cryptoblepharus eximius*; fa, *Brachylophus fasciatus*; le, *Lepidodactylus gardineri* or *manni*; ni, *Emoia nigra*; no, *Lipinia noctua*; oc, *Gehyra oceanica*; pa, *Emoia parkeri*; pe, *Nactus pelagicus*; tr, *Emoia trossula*; ty, *Hemiphyllodactylus typus*; vi, *Brachylophus vitiensis*; vo, *Gehyra vorax*. The open bars denote species occurrence not verified by voucher specimens.

faces and on vegetation within a few meters or less of the high-tide mark and occasionally on stucco/stone buildings and cliff faces within tens of meters from the shore. On Viti Levu, it is more widespread, occurring on cement gun bunkers more than a kilometer from the shore and on cliff faces and rock outcrops in the Nausori Highlands, 20 + km from the shore.

Competitive interactions. There is no clear evidence of competition among native Fijian lizards. Circumstantial evidence can be proposed for competition between lizards of similar size, such as *Lipinia* and *Emoia cyanura*, but it can be equally well argued that if such competition occurred, it was in the distant past or even that niche differences developed before these 2 species began to share the same insular habitats. Another pair of possible competitors are *Emoia concolor* and *E. trossula*. Pernetta & Watling (1979) proposed that these 2 species (their *samoensis* = *trossula*) partitioned habitats on islands of sympatry. Their observations suggested that *E. concolor* is largely confined to the coastal zone and to open, intermediate-elevation forests, while *E. trossula* occurs in lowland and montane forest. I observed both species in lowland open forests but not sympatrically or syntopically. My observations indicate that *E. concolor* is an arboreal lizard and *E. trossula* a semiarboreal species, so that the 2 species could potentially occupy the same tree and interact with one another at an intermediate level on the trunk. Since this interaction does not occur and I did not find the 2 species together, competition may be keeping them segregated.

My observations on *E. parkeri* are limited, although I did not find it sharing the same habitats with *E. cyanura*. *E. parkeri* is also strongly arboreal in general habits, although it tends to remain low in trees and shrubs. This pair and the former pair are the only native skinks showing a pattern of occurrence with at least the appearance of habitat/resource partitioning. Both *E. concolor* and *E. parkeri* occurred side by side on tree-falls in the Nausori Highlands, and no antagonistic interactions were observed.

Recently, the newly arrived *Hemidactylus frenatus* has begun to replace the much older colonizer *Lepidodactylus lugubris*. *H. frenatus* is displacing and eliminating *L. lugubris* on the campus of the University of the South Pacific and likely elsewhere, but my observations of abundance are limited to the campus. The actual manner of displacement is open to speculation. Minimum adult size of *H. frenatus* is 48 mm SVL and a maximum of 44 mm for *L. lugubris*. The size difference may permit predation by the bigger species on the smaller one, particularly on hatchlings and juveniles; however, I have no evidence of Fijian *H. frenatus* preying on *L. lugubris*. Another possibility is competition for diurnal resting sites. Partial evidence for this suggestion is the survival of *L. lugubris* in areas where crevices appear too small to permit the entry of *H. frenatus*. A final suggestion is that *H. frenatus* is more

TABLE 4

Relative Abundance of *Emoia cyanura* and *E. impar* on Select Fijian Islands With (+) and Without (−) the Mongoose

Abundance is estimated by the number of lizards collected per hour.

Island	*Mongoose*	*Abundance*	*Total Collecting Time (hr)*
Koro	−	1.0–6.7	16.8
Ono-i-Lau	−	2.3–7.0	8.2
Ovalau	−	1.2–9.0	8.8
Viti Levu	+	0	16.2

successful in capturing prey and/or interferes with the ability of *L. lugubris* to feed. No evidence is available to confirm or to deny this suggestion.

In the Cocos Islands (eastern Indian Ocean), *Gehyra mutilata*, an earlier colonist, showed various populational responses to the more recently colonizing *H. frenatus* (Cogger et al. 1983). *G. mutilata* was abundant on several islands in 1947, but when the islands were resurveyed in 1978, it was absent and totally replaced by *H. frenatus*. On islands adjacent to the preceding ones, *G. mutilata* remained abundant and *H. frenatus* occurred in low densities in marginal habitats. This variable response is not evident between *H. frenatus* and *L. lugubris* in Fiji, where *H. frenatus* appears to become the dominant house gecko once it colonizes.

Predatory interactions. I noted earlier the shift of *Lipinia* to cryptic arboreal sites in Rotuma. I propose that this habitat shift was driven by the predatory pressure of *E. nigra* on the slow-moving *Lipinia*. *E. nigra* was observed chasing and catching *E. cyanura* on Rotuma, so *Lipinia*, being less abundant, would be more quickly affected by intense predation. The low abundance of *Lipinia* and high abundance of *E. nigra* on Koro partially supports this speculation of a predator-driven habitat shift. No other predator interactions have been observed or hypothesized among Fijian lizards. The high degree of species co-occurrences and the lack of complementary species presence/absence data among the native species indicates that no Fijian lizard species can cause the local extinction of another species by predation or competition.

The major lizard predator on Fiji appears to be the mongoose. The mongoose occurs on Viti Levu and Vanua Levu, and on these islands, the abundance of diurnal, terrestrial lizards is extremely low. The great reduction in densities is readily demonstrated by contrasting collection data for *E. cyanura* (the most abundant and widespread of the Fijian lizards) from islands inhabited by mongooses and those not inhabited (Table 4). These data demonstrate the extremely low abundance of *E. cyanura* on Viti Levu. Furthermore, *E. cyanura* is seen to occur only in areas of dense vegetation or in other cryptic situations. Additional evidence of the mongoose's predation on lizards is the absence of recent records or sightings of *E. nigra* and *E. trossula* on Viti Levu and Vanua Levu. Museum vouchers show that both species occurred on these islands prior to the 1880s; now they are probably extinct, and the mongoose is the most likely cause of their extinction.

Zoogeographic Comments

For the analysis of zoogeographic patterns, I have divided Fijian lizards into native and exotic species, and only the former are examined here. Native species are those species that arrived prior to the arrival of humans and without their assistance (Table 1 and Appendix: Table E). Exotic species are those lizards whose colonization of Fiji was aided by humans (accidentally or intentionally) and whose arrival coincides with or postdates the arrival of humans. The criteria for the recognition of exotic species are: (1) documentation of recent arrival (*Hemidactylus frenatus*); (2) occurrence predominantly as human commensals (*Gehyra mutilata*, *Hemidactylus garnotii*, and *Lepidodactylus lugubris*); or (3) irregular and limited geographic occurrence within Fiji but widespread occurrence elsewhere (*Emoia caeruleocauda*). The recognition of native and exotic species is generally easy, although the assignments of a few species remain uncertain. The most enigmatic species is *Hemiphyllodactylus typus*, which I believe to be a native species. The Oceanic populations of *H. typus* are unisexual in contrast to the bisexual populations in the Philippines and mainland Asia, thereby suggesting a single speciation event by interspecific hybridization for the origin of Oceanic *H. typus*. *Hemidactylus garnotii* appears to occur only in association with humans, but tends to be a rural species. *L. lugubris* is not confined to human habitation, although it is most abundant and nearly ubiquitous in that situation. This latter aspect and its wide occurrence throughout the world leads me to consider it a recent introduction. However, Ineich's (1988) recognition of 5 clones and a bisexual population in French Polynesia and the occurrence of the clones and bisexual morphs in Fiji suggest a more ancient arrival and divergence in Oceania. The *lugubris* situation is confounded further by the biochemical recognition (using allozymes) of 3 diploid clones and 8 triploid clones in Oceania (Pasteur et al. 1987), and the possibility of multiple origins of the clones and multiple colonizations of each island group by different *lugubris* clones. The latter aspect argues for the exclusion of *lugubris* from biogeographic analysis until all clones can be recognized morphologically and thus treated as separate entities in the analysis.

Intra-Fijian patterns. Species occurrences for Fiji are summarized in Appendix: Table E. The distributional patterns and species diversities within Fiji follow the expected patterns of greater endemicity and diversity on the larger islands. However, these biogeographic aspects cannot be analyzed and interpreted in great detail because of the absence of comparable sampling for all the islands. Examination of the distribution maps (Maps 1-18) reveals the overall poverty of voucher specimens, hence lack of adequate sampling, from Vanua Levu in comparison to Viti Levu or Ovalau. Other islands and island groups (e.g., Cikobia and Gau) are similarly poorly sampled, so only biogeographic tendencies, not conclusions, can be derived from the current data.

For the comparison of lizard distributions, the Fijian islands were divided into 13 island groups (each group represents a major island or cluster of islands; species occurrences are delineated in Appendix: Table E). The fauna of each island group was tabulated and compared with every other group (Table 5). Vanua Levu and Viti Levu have the highest species diversity, and their faunas differ by the absence of *Lepidodactylus manni*, *Emoia campbelli*, and *E. parkeri* from Vanua Levu. Taveuni, Ovalau, and Kadavu also have comparable species diversity, sharing the absence of *Brachylophus vitiensis*, *Hemiphyllodactylus*, and *E. campbelli.* Koro, the Moalas, and the north and south Laus possess a species diversity slightly more than half that of Viti Levu, and other island groups show a diversity of half or less than half that of Viti Levu. This declining diversity is partially real and partially artifactual. Cikobia illustrates this point well. In size, Cikobia is larger than many of the Lau islands, yet it has fewer confirmed species. The absence of *E. cyanura* from its fauna highlights the incompleteness of the survey. Even within these limitations, it is still possible to construct a list of "core species" for the Fijian islands (specifically, for those islands >1 km^2 and with some native Fijian forest/bush). The core Fijian lizard fauna comprises 2 geckos, *Gehyra oceanica* and *Nactus pelagicus*; an iguana, *Brachylophus*; and 5 skinks, *E. concolor*, *E. cyanura*, *E. impar*, *E. trossula*, and *Lipinia noctua*.

Island size certainly affects species diversity (Table 3), but the relatively low energy demands of lizards permits the existence of several lizard species even on small islands (e.g., Yanuya is approximately 1 hectare in area and has at least 4 species of skinks and 1 species of gecko, based on a 3 hr survey). The minimal effect of area on species diversity is reflected in the range of z (slope, 0.13–0.17) of the species-area equations (MacArthur & Wilson 1967). Such low values are unexpected for insular populations. Several interpretations are possible: (1) constant immigration to maintain "supersaturated" faunas; (2) most species are present at extremely low population densities, permitting the survival of numerous species; (3) species possess high "ecological tolerance" and occur at moderate to high population densities. I favor the last interpretation, since my observations indicate that population densities of most

TABLE 5

Matrix of Number of Shared Native Lizard Species (lower left) and Otsuka's Coefficients (× 100) of Similarity (upper right) for the Major Fijian Islands

The diagonal presents the total numbers of native species known to occur on each island.

	Islands or Island Groups												
	Cik	VaL	Tav	Kor	Gau	Ova	ViL	Yas	Kad	Moa	LaN	LaS	Ono
Cik	**3**	48	50	55	47	48	43	41	50	58	58	58	0
VaL	3	**13**	88	88	68	85	90	78	80	83	83	83	63
Tav	3	11	**12**	91	71	96	87	71	92	87	87	87	65
Kor	3	10	10	**10**	77	88	79	67	82	84	84	84	60
Gau	2	6	6	6	**6**	68	61	58	71	68	68	68	46
Ova	3	11	12	10	6	**13**	90	69	96	83	83	83	68
ViL	3	13	12	10	6	13	**16**	70	87	75	75	75	57
Yas	2	8	7	6	4	7	8	**8**	71	82	82	82	67
Kad	3	10	11	9	6	12	12	7	**12**	87	77	87	65
Moa	3	9	9	8	5	9	9	7	9	**9**	89	100	76
LaN	3	9	9	8	5	9	9	7	8	8	**9**	89	63
LaS	3	9	9	8	5	9	9	7	9	9	8	**9**	76
Ono	0	6	6	5	3	6	6	5	6	6	5	6	**7**

* Abbreviations. Cik = Cikobia. VaL = Vanua Levu group. Tav = Taveuni and Ringgold islands. Kor = Koro. Gau = Gau. Ova = Ovalau. ViL = Viti Levu group, including Vatulele and Beqa. Yas = Yasawa group. Kad = Kadavu group. Moa = Moala group. LaN = northern Lau group, islands north of 18°30′S/Oneata Passage. LaS = southern Lau group, islands south of 18°30′S. Ono = Ono-i-Lau.

Fijian lizards are moderate to high, and that each species occupies a wide range of habitats. Constant immigration of numerous species for all islands—whether nearby or widely separated—seems most unlikely. Only *E. cyanura* has population densities and habitat preferences to permit such continuous dispersal. Survival without extinction at low population densities is highly improbable. Over long periods of time, random fluctuations in population size are sufficient to cause extinction.

The presence of core species on even the smaller islands contributes to the unusually low z values, and it is noteworthy that most of these islands lack significant elevation or relief (which would increase habitat diversity). The core Fijian species include several widespread Pacific species (*G. oceanica*, *Nactus*, *E. cyanura*, *E.*

impar, and *Lipinia*), 1 endemic species (*E. concolor*) and 2 "near endemic" species (*Brachylophus fasciatus* and *E. trossula*). (The extra–Fiji-Tongan distribution of the latter 2 species is real, but is it natural? I suspect not; rather, that it was human-mediated. Nonetheless, without convincing evidence, I treat the extralimital occurrence as natural in the subsequent analyses/discussions.) The widespread occurrence of core species indicates that all of them have good across-water dispersal ability, because most of the small islands (all the Lau islands, Yasawa islands, and many of the Lomaiviti islands, etc.) would have been submerged during the last interglacial rise in sea level and since then have not had a land connection (Fig. 17), thereby requiring across-water colonization.

The core species affect the measurement of faunal similarity (Table 5). Because the core species are nearly half of the total native Fijian lizard fauna, any coefficient of similarity will produce values ≥50%. Of the many coefficients available (see Peters 1968), I chose Otsuka's coefficient for its simplicity of calculation and its incorporation of unequal sample sizes. (The coefficient equals the number of species shared between 2 islands divided by the square root of the product of the 2 islands' total number of species.) The resulting coefficient is a relative percent of shared species when multiplied by 100. The coefficients demonstrate the inadequacy of the present samples for many islands and island groups as well as the generally high levels of faunal similarity among the Fijian islands. Ignoring the inadequacies, the major patterns are: (1) Ono-i-Lau has the least similar or most distinct lizard fauna; (2) the small island groups (Yasawas, Moalas, north and south Laus), composed of small, generally low-lying islands, are more similar to one another than to their nearest-neighbor large islands; and (3) the larger islands (Taveuni, Vanua Levu, Viti Levu, and the Lomaiviti and Kadavu groups) are most similar to one another. These patterns are easily interpreted: (1) Ono-i-Lau does not have a full complement of the core species and possesses the endemic *Leiolopisma alazon*; (2) the faunas of the small islands consist largely of core species; and (3) the large islands possess the typical Fijian endemics (e.g., *Lepidodactylus manni* and *Emoia parkeri*) in addition to core species and a few widespread Pacific species—*Gehyra vorax*, *Hemiphyllodactylus typus*, and *Emoia nigra*.

Geographic patterns of variation are largely nonexistent or indistinct. This poor resolution of patterns may result, in part, from the limited number of statistically adequate samples for most species, and from species being represented by different sets of localities. Nonetheless, a few patterns can be discerned. The Fijian iguanas divide between an arid-rainshadow species, *B. vitiensis*, in the Yasawas and the north coast of Vanua/Viti Levu and into a more mesic species, *B. fasciatus*, from the wetter areas of Vanua/Viti Levu eastward through the Laus to southern Tonga. No other species shows this climate-associated pattern, although *Cryptoblepharus* and *E. trossula* show a cline of decreasing scale counts from the larger islands to the Laus,

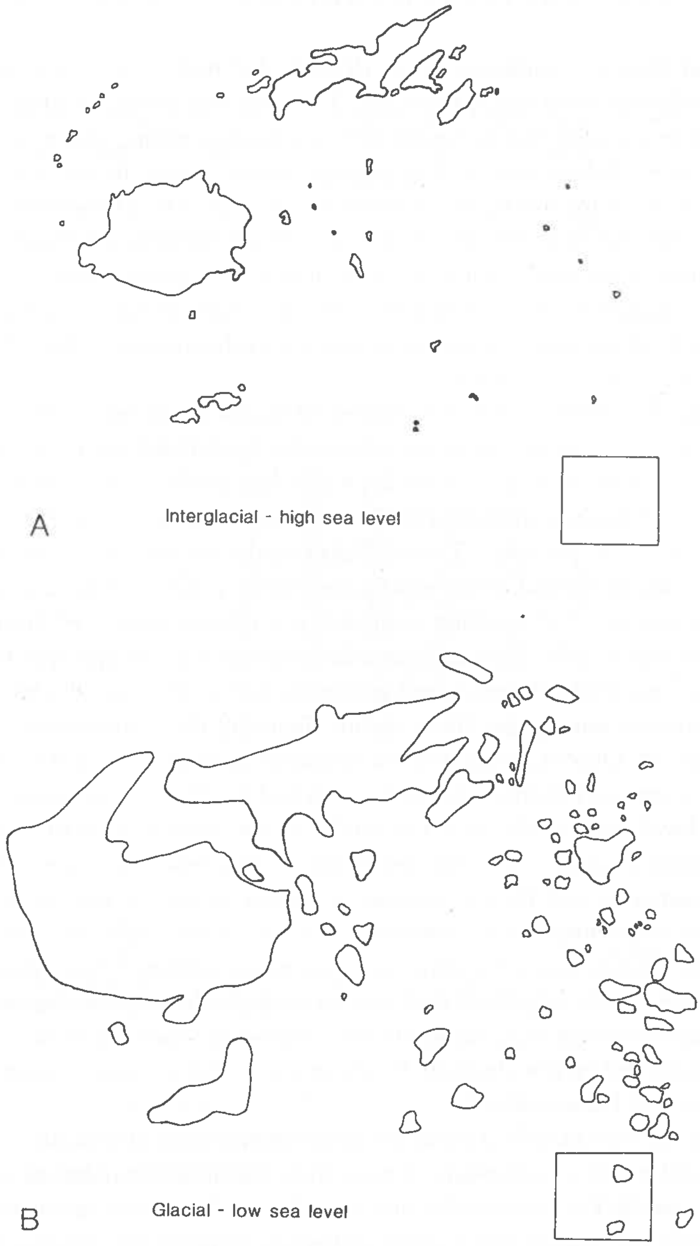


Figure 17. Diagrammatic depiction of Fijian shorelines, island size, and number during the Pleistocene glacial and interglacial periods. A. Shorelines at maximum sea level, approximately 10 m above present level. B. Shorelines at minimum sea level, approximately 100 m below present level (after Gibbons & Clunie 1986:fig. 2). Today's shorelines are shown in Fig. 1; that map served as the template for these diagrams. The box inset presents the Ono-i-Lau group.

and from larger islands to Gau-Kadavu-Moala groups for *E. concolor*. *Nactus* and *E. trossula* from Rotuma are divergent in scalation and body size, respectively, from the other Fijian samples. *Gehyra oceanica*, *E. cyanura*, and *Lipinia* show no patterns. The *Lipinia* samples are particularly homogeneous, the situation noted by Zweifel (1979) for all Oceanic populations.

Due to the limited number of geographic samples within each species and the incompleteness of the censuses for many islands, I offer only a generalized interpretation of the present distributions and variation patterns within the Fijian islands (excluding Rotuma). Today's distributions and patterns reflect the growth (positive and negative) of islands through their emergence and submergence in response to the Pleistocene glacial and interglacial sea level changes. Gibbons (1985) stressed the emergence aspect, but neglected the submergence of coastlines and islands—equally important events. During the elevated sea levels of the interglacials (Fig. 17), most species were confined to the large western islands, since most of the Lau islands were submerged. The land area of the western islands were not greatly reduced, so a diversity of habitats remained and extinction of residents would have been unlikely. With the lower sea levels of glacial periods, the land areas expanded greatly, approximately double that of today (Fig. 17). The number of habitats likely remained the same, although their total areas would have been much greater, hence the total population size of each species was correspondingly larger. The larger and more numerous islands were separated by shorter water gaps, permitting—even, perhaps enhancing— dispersal.

If this geological scenario is correct in general outline, even if not in specifics, several hypotheses concerning lizard distribution and divergence can be proposed: (1) *Brachylophus fasciatus* and *B. vitiensis* may represent a Pleistocene speciation event. The ancestral *B. vitiensis* population could have been isolated in Yasawa (or a similar small, dry area) during an interglacial rise in sea level and diverged at that time. The divergence was then retained and reinforced during glacial lowering of sea levels, owing to *B. vitiensis*' adaptation to drier environments. These Pleistocene events produced allopatric populations relative to their current distributions. (2) The Lauan and Tongan distribution of *B. fasciatus* is human mediated. This species would be expected to disperse slowly from the large islands and to have been eliminated from the Laus when the sea level was at maximum height. It was regularly eaten by the Fijians, so its transplantation to "vacant" islands seems likely. A larger species of *Brachylophus* was eaten and exterminated by the early Tongans (Pregill 1989), and no *B. fasciatus* fragments occurred in these food middens or any other middens, thereby indicating *B. fasciatus*' initial absence from Tonga. Further, Gibbons (1981) reported no morphological differentiation among Fijian and Tongan *B. fasciatus*. (3) The core Fijian lizards would have persisted even on the small, isolated islands during maximum sea elevation, and the populations of these islands and the high (western) islands would have provided colonizers for the islands that emerged when the sea level dropped. The homogeneity of the core species supports the hypothesis of continual emigration and immigration (gene flow) among the islands. (4) For *Leiolopisma alazon* to survive the higher sea levels of the interglacial eras, a portion of Ono-i-Lau would have had to have been subaerial or *L. alazon* would have had to occur widely throughout the Lau group. If the latter is the case, this species will be found on other islands of the Lau group. (5) The distributions of the high (western) islands' endemics, *Emoia campbelli*, *Lepidodactylus manni*, and *E. parkeri*, require contrasting explanations. *E. campbelli* appears to be confined to the Rairaimatuka Plateau and is supposedly closely related to *E. concolor* (Gibbons & Brown 1986). No Pleistocene event provides an obvious explanation for *E. campbelli*'s origin by allopatric speciation; thus, its origin is presumably earlier and *E. campbelli* persisted in upland Viti Levu throughout the Pleistocene and had no interglacial dispersal. *L. manni* and *E. parkeri* have not been confirmed from all the high islands (e.g., neither was reported from Vanua Levu), but *E. parkeri*'s distribution from Kadavu to Taveuni indicates that it and likely *L. manni* are present throughout these islands. The island reconstructions (Fig. 17) show narrow water barriers during glacial periods. Presumably, they dispersed throughout the high islands at that time, thus they should also be found in the Lomaiviti group, at least on Gau, since the frog *Platymantis* occurs on the latter and it would seem to have similar dispersal abilities and opportunities. (6) *Cryptoblepharus* and *Emoia nigra* appear to disperse readily but have special habitat requirements so their colonization success (persistence) is variable.

Pacific area patterns. The Fijian herpetofauna is divided into 2 components, labeled VITI and LAU (Table 6), for comparison with the faunas of other Pacific island groups. This division reflects the differences in species composition of the large Fijian islands and their satellites (represented by the group labeled VITI) and the small, low coral islands of the Lau group (LAU). The inclusion of Ono-i-Lau in the latter group makes LAU a potential biogeographic composite because of the Ono-i-Lauan endemic *Leiolopisma*. The species' occurrences for all the islands are summarized in Appendix: Table B. It would have been desirable to include Wallis and Futuna islands in the comparison, but apparently the herpetofaunas of these islands have never been surveyed. The Society Islands' list (SOCI) is a composite of the faunas of the Society Islands and the Tuamotu Archipelago; this island complex is included in the comparison to represent an Oceanic fauna whose origin is clearly dependent on long-distance dispersal (natural or human-mediated). As with the intra-Fijian comparison, the surveys of the different fauna are unequal, so interpretations drawn from them are tentative. The tentativeness is further compounded by the lack of phylogenetic studies of species relationships. Currently, the assumed relationships are based entirely on

TABLE 6

Matrix of Number of Shared Native Lizard Species (lower left) and Otsuka's Coefficients (× 100) of Similarity (upper right) for the Pacific Island Groups

The diagonal presents the total numbers of native species known to occur on each island group.

	*Island Groups**							
	VANU	VITI	SOCI	LAU	TONG	TONN	SAMO	ROTU
Vanuatu	**15**	39	47	45	43	47	46	49
Viti	6	**16**	75	65	50	45	62	57
Lau	6	10	**11**	70	60	55	75	57
Tonga, South	6	9	8	**12**	58	52	61	65
Tonga, North	5	6	6	6	**9**	80	47	50
Samoa	6	6	6	6	8	**11**	53	68
Rotuma	5	7	7	6	4	5	**8**	53
Society	5	6	5	6	4	6	4	**7**

* Abbreviations. VANU = Vanuatu. VITI = Vanua Levu, Vitu Levu, and associated islands. LAU = Lau group. TONG = Tonga islands, Vava'u group through Tongatapu group. TONN = Nina fo'ou and Niuaatoputapu group. SAMO = Western and American Samoa. ROTU = Rotuma Islands. SOCI = Society Islands and Tuamoto Archipelago.

phenetic similarities, and historical biogeographic hypotheses have little reliability without knowledge of phylogenetic relationships—no matter what biogeographic paradigm is used (e.g., panbiogeography, Page 1987; vicariance-consensus, Nelson & Platnick 1981; vicariance-parsimony, Brooks 1985). Within these limitations, I believe that it is still useful to offer hypothetical interpretations of current distributions.

Comparisons of shared faunal elements (Table 6) show only a moderate similarity (40–70%) among the 8 faunas. Otsuka's coefficient is partially responsible for this result. Since this coefficient uses the sizes of the paired faunas in the denominator, unequal-sized faunas will appear dissimilar even if one is a subset of the other. For example, Western and American Samoa (SAMO) and southern Tonga (TONG) have a higher score than VITI and LAU, yet the pairs share 8 or 9 species (1 less than the total of the smaller fauna of each pair), but VITI has a larger fauna than SAMO, hence a lower VITI/LAU score. I do not wish to add to the continuing debate on the "best" faunal-comparison coefficient, but rather to stress that the coefficient used here is a relative percentage score and attention should be directed to the actual number of shared species and the identity of the shared species.

In this respect, French Polynesia, with the smallest fauna, serves to identify the basic Oceanic fauna. French Polynesia (SOCI) shares 5 or more species with Vanuatu (VANU), Fiji (VITI & LAU), TONG, and SAMO. *Gehyra oceanica*, *Nactus pelagicus*, *Emoia cyanura*, *E. impar*, and *Lipinia noctua* are common to all 5 island groups. These species form the core fauna for all 8 island groups (*Nactus* assumed to be present in TONN) in this comparison. Samoa and French Polynesia have the most similar faunas, uniquely sharing the same species of *Cryptoblepharus*. The Samoan and northern Tongan (TONN) faunas are most similar. The latter is nearly a subset of the former; northern Tonga shares the Samoan *Emoia*s: *adspersa*, *lawesii*, *murphyi*, but not *samoensis*, and has the Fijian *Cryptoblepharus* rather than the Samoan species. The Fijian faunas (VITI, LAU, and ROTU) form a hierarchical set wherein Lau and Rotuma are subsets of the larger Fijian islands and differ from one another by only a single endemic species (Lauan *Leiolopisma alazon*, Rotuman *Lepidodactylus gardineri*). As a unit, these 3 faunas do not link closely with any of the other faunas (Table 6), although they are most similar to the southern Tongan fauna. This similarity arises from their sharing of the core species, as well as *Emoia nigra*, *E. trossula*, and *Brachylophus fasciatus*. Even though *B. fasciatus* may not be a native Tongan lizard, *Brachylophus* (with multiple species) is a Fiji-Tongan endemic. The southern Tongan fauna has its unique components, *Lepidodactylus euaensis*, *Tachygyia microlepis*, and possibly a new species of *Cryptoblepharus* (Zug, unpublished data). Vanuatu shares only the core species and the widespread, but spottedly occurring, *Emoia nigra* with the Oceanic faunas.

Gibbons (1985) viewed the Pacific lizard fauna as entirely derived through across-water dispersal. He recognized a number of adaptations that permit such dispersal to and colonization of islands that were always isolated by saltwater barriers. His interpretations centered on recent (i.e., Pleistocene to present) dispersal events. Beckon (1992) proposed that the distribution and pattern of scale variation for *Gehyra oceania* is best explained by dispersal in association with the prehistoric human colonization of the Pacific. I believe that components of the Oceanic herpetofauna have more ancient origins, mid-Miocene and possibly earlier, and I suggest the following generalized geological history (Fig. 18) of the Southwest Pacific as an interpretative base to examine the distributional and relationship patterns. While tectonic activity in this area has been extremely complex, the following scenario is much simplified and does not attempt to include all major events.

The formation of the Southwest Pacific island chains (Fig. 18) began with the separation and migration of the Indoaustralian Plate from the Antarctic Plate. The episodic convergence of the Indoaustralian and Pacific plates produced a series of volcanic arcs, parts of which may have been subaerial, along the northeastern edge

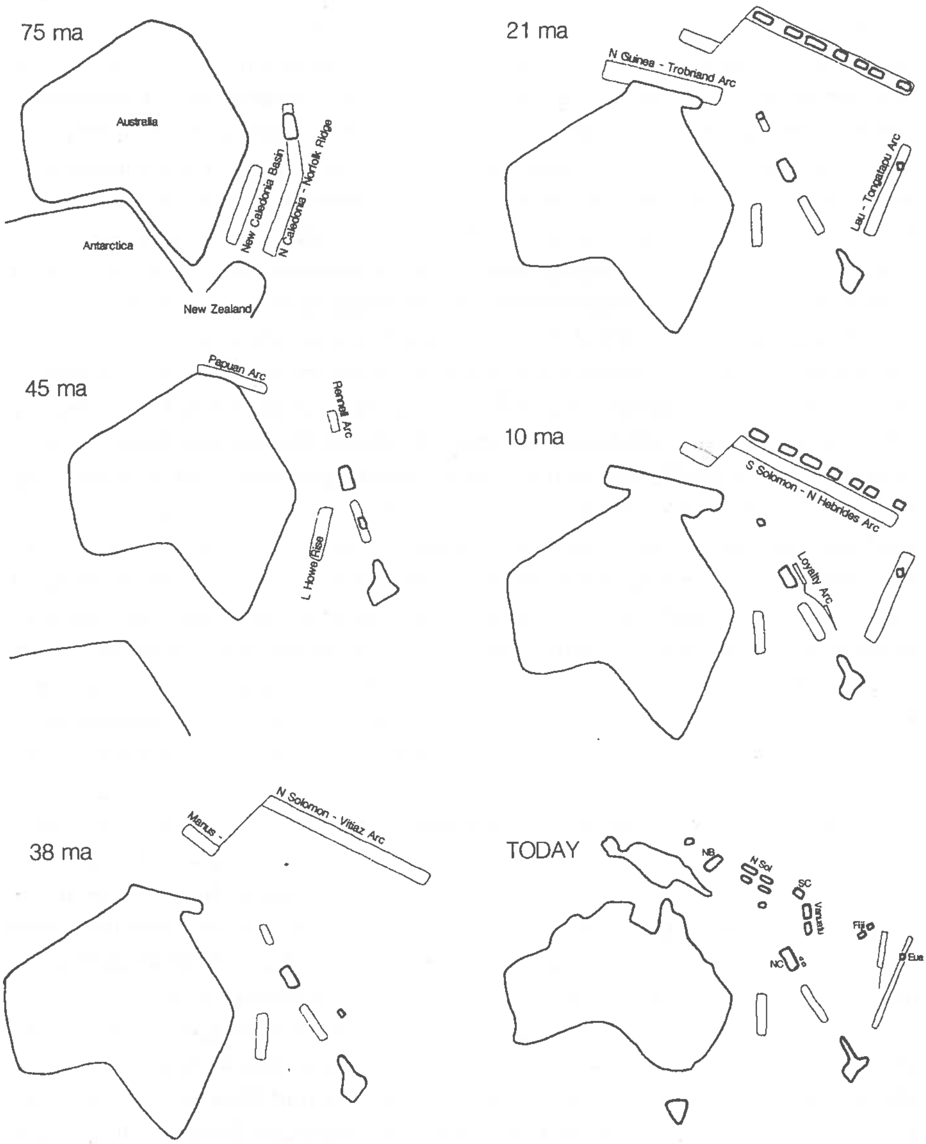


Figure 18. Diagrammatic depiction of the geological history of southwest Pacific island groups. Details of tectonic activity are presented in the text.

of the Indoaustralian Plate. In addition, these areas have experienced considerable fragmentation and fusion. In the late Cretaceous (70–80 million annum before current era [MA]), the area lying between Australia and the Northern Cape of New Zealand was cleft by sea floor spreading, creating the Tasman and New Caledonian basins and giving origin to the Lord Howe Rise and New Caledonia-Norfolk Ridge. Concurrently, vulcanism along the New Caledonia-Norfolk Ridge created a volcanic arc-chain from eastern New Guinea eastward to Rennell Island and then southward to New Zealand. The convergent zone jumped northeast onto the Pacific Plate in the early Oligocene (ca. 38 MA). Vulcanism along the Indoaustralian Plate side of this new zone formed the North Solomon-Vitiaz Arc; volcanic activity continued along this arc into the early Miocene (ca. 20 MA). At this time, a new area of tectonic activity produced the Lau-Tongatapu Arc; this arc extended north from the Eastern Cape of New Zealand. Vulcanism shifted position again at the end of the Miocene (ca. 10 MA). A small Loyalty Arc developed adjacent to New Caledonia along the Norfolk Ridge, and the South Solomon-New Hebrides Arc formed parallel and abutting the North Solomon-Vitiaz Arc. This tectonic activity was followed soon by a fracture and rotation of the various arcs. The New Hebrides and Fijian portions of the doubled Vitiaz Arc split; the New Hebrides portion rotated clockwise, the Fijian portion counter-clockwise. The latter rotation swung Fiji southeastward where it collided with the Lau Ridge which had formed by a rift in the Lau-Tongatapu Arc. The New Hebrides swung southward towards New Caledonia and away from Fiji and other central Pacific island groups. Volcanic activity likely occurred intermittently on the Pacific Plate adjacent to the convergence zones. Samoa appeared in the mid- to late Miocene from such vulcanism. The origin of Rotuma and the northern Tonga Outliers is less certain. (This description was derived principally from Kroenke [1984, Chapt. 8]; other useful geologic summaries are contained in Ewart [1988], Springer [1982] and Zug et al. [1989].)

The geologic summary and the small amount of phylogenetic information permit only a limited interpretative summary of Pacific lizard biogeography. The following observations and hypotheses can be derived from the available data. (1) Two lizard taxa are ancient immigrants and survivors in the Oceanic islands of the Southwest Pacific. *Brachylophus* is a true iguanine, and hence must be a New World derivative. Its arrival in the Southwest Pacific cannot be dated and a transpacific dispersal seems probable. If the nearest relatives of *Leiolopisma alazon* are among the New Zealand leiolopisma skinks, as suggested by phenetic similarities, the ancestral *Leiolopisma alazon* may have entered Oceania in the early- to mid-Miocene via the Lau-Tongatapu Arc. The survival of *Leiolopisma* in Ono-i-Lau indicates that it may persist in southern Tonga as well as the northern Laus. (2) The other Fijian taxa entered Oceania from the west along the Vitiaz or New Hebrides arcs. Using speciation as a dating criteria, *Lepidodactylus* (excluding *lugubris*) and the *Emoia samoensis* complex are the earliest Indopapuan immigrants, possibly arriving in the early- to mid-Miocene. *Gehyra*'s arrival may also fit that hypothesis, with *G. vorax* preceding the less differentiated *G. oceanica.* (3) The arrivals and origins of *Hemiphyllodactylus typus* and *Nactus pelagicus* are presently unresolvable. The

Oceanic populations of both are unisexual, so they presumably had their origins in an island(s) along the eastern/northeastern edge of the Indoaustralian Plate and spread eastward into Oceania. Biochemical data may suggest times of origin; current knowledge of distributions and morphological differentiation provide no clues. (4) The uniformity and wide distributions of *Emoia cyanura*, *E. impar*, and *Lipinia noctua* suggest their relatively recent (Pliocene or later) dispersal throughout Oceania. (5) The persistence of ancient taxa and their speciation on different island groups indicate the continual presence of emergent islands throughout the long history of Indoaustralian-Pacific plate interactions. These aspects also demonstrate an ability to survive and disperse by island-hopping. Such dispersal and survival are suggested by the high similarity between the Lau and western Fiji faunas and the occurrence of *Leiolopisma alazon* in Lau. (6) The Rotuman herpetofauna is distinctly a Fijian one, in spite of the great cross-water distance. Was Rotuma closer to Fiji more recently than current geologic interpretations predict? Recent long-distance dispersal seems highly unlikely. (7) The latter comment seems to be reinforced by the distinct speciation of *Emoia samoensis* complex members in Samoa and the absence of the Samoa species from down-current Rotuma. Also it seems likely that this complex reached Samoa from Fiji prior to Fiji's separation and rotation from the original Vitiaz alignment. (8) The French Polynesian fauna represents the core Oceanic fauna and identifies those species of lizards capable of long-distance, cross-water dispersal.

Appendix

Table A

Statistical Summary of Body Measurements (mm) and Scale Counts for Fijian Geckos

The data are organized with mean ± 1 SD on the 1st line and the range on the 2nd line. The sample size (*n*) is for the maximum number of individuals in the sample and is applicable to the majority of the traits; however, tail length was analyzed only if the tail was complete or fully regenerated and its sample size is commonly half of the total sample. The female and male samples consist of adults only; the "All" sample includes all individuals, hatchlings through adults. Only ranges are presented for the measurement and precloacal pore counts in the "All" samples, because means are dependent on the number of immature individuals in the sample. SVL = snout-vent length; TailL = tail length; HeadW = width of head; HeadL = length of head; BodyL = body length; BtwNs = number of scales on snout between nasal scales; Labl = number of supralabial scales in front of eye; Fing4 = number of lamellae on the 4th digit of the forefoot; Toe4 = number of lamellae on the 4th digit of the hindfoot; Pores = number of left and right femoral and precloacal pores.

	n	*SVL*	*TailL*	*HeadW*	*HeadL*	*BodyL*	*BtwNs*	*Labl*	*Fing4*	*Toe4*	*Pores*
Gehyra mutilata											
M	2	43.7	41.5	9.1	10.8	17.8	0	5.0	8.0	8.5	33.0
		43.5–43.8	41–42	9.0–9.1	10.6–10.9	17.7–17.9	–	5	8	8–9	32–34
All	4	–	–	–	–	–	0	5.0 ± 0.0	7.3 ± 1.0	8.3 ± 0.5	–
		36.3–43.8	41–43	7.1–9.1	9.2–10.9	13.7–18.6	–	5	6–8	8–9	0–34
Gehyra oceanica											
F	27	71.1 ± 4.9	69.7 ± 7.3	14.2 ± 1.0	18.2 ± 1.3	31.2 ± 3.6	1.1 ± 0.3	7.1 ± 0.7	12.5 ± 0.8	13.9 ± 0.9	0
		63.8–83.5	62–86	12.2–16.2	14.9–21.6	22.7–39.4	1–2	6–8	11–14	12–16	–
M	41	73.6 ± 5.3	71.1 ± 8.9	15.4 ± 1.4	19.4 ± 1.1	31.5 ± 3.6	1.2 ± 0.4	7.0 ± 0.5	12.4 ± 0.7	13.7 ± 0.7	32.0 ± 6.9
		59.3–82.4	56–91	12.4–17.9	17.3–21.4	20.8–36.9	1–2	6–8	11–14	12–15	0–41
All	115	–	–	–	–	–	1.1 ± 0.3	7.1 ± 0.7	12.4 ± 0.9	13.8 ± 0.8	–
		28.9–83.5	24–91	6.6–17.9	7.5–21.6	11.0–39.4	1–2	5–9	10–14	12–16	0–41
Gehyra vorax											
F	8	134.0 ± 5.7	104.0	27.0 ± 1.4	33.6 ± 3.2	59.9 ± 3.4	1.2 ± 0.4	8.0 ± 0.6	19.8 ± 1.2	21.0 ± 1.5	0
		125.7–141.8	–	25.8–29.6	29.0–37.6	55.5–63.9	1–2	7–9	18–21	19–23	–
M	8	138.7 ± 13.8	103.0	27.2 ± 3.2	34.0 ± 3.0	57.0 ± 8.8	1.3 ± 0.5	8.6 ± 0.5	18.9 ± 1.1	20.1 ± 0.7	64.7 ± 11.1
		122.0–156.0	–	23.2–32.3	30.3–38.0	44.8–67.0	1–2	8–9	18–21	19–21	46–78
All	18	–	–	–	–	–	1.51.1	8.3 ± 0.6	19.5 ± 1.2	20.7 ± 1.3	–
		115.0–156.0	103–104	23.2–32.3	29.0–38.0	44.8–67.0	1–5	7–9	18–22	19–23	0–78

Table A (continued)

	n	*SVL*	*TailL*	*HeadW*	*HeadL*	*BodyL*	*BtwNs*	*Labl*	*Fing4*	*Toe4*	*Pores*
Hemidactylus frenatus											
F	4	49.4±1.2	52.0±1.4	9.1±0.4	12.9±0.6	21.6±0.9	1.0±0.0	5.5±0.6	8.0±0.0	10.0±0.8	0
		47.9–50.4	51–53	8.6–9.4	12.1–13.5	20.9–22.9	1	5–6	8–8	9–11	–
M	9	51.8±3.1	55.0±6.0	10.2±0.9	13.1±0.7	22.1±1.8	0.4±0.5	5.2±0.7	7.3±0.9	9.0±1.1	28.8±5.3
		48.5–55.5	49–62	9.1–11.5	11.9–13.9	19.7–25.4	0–1	4–6	6–9	8–11	15–32
All	21	–	–	–	–	–	0.7±0.5	5.4±0.6	7.6±0.7	9.1±1.1	–
		20.1–55.5	36–62	4.0–11.5	6.0–13.9	7.9–25.4	0–1	4–6	6–9	8–11	0–32
Hemidactylus garnotii											
F	10	55.1±2.1	62.7±4.9	9.8±0.4	13.5±0.5	24.0±1.1	1.3±0.5	7.2±0.8	11.0±0.5	13.2±0.5	0
		51.1–57.8	57–66	8.9–10.2	12.2–14.1	21.4–25.4	1–2	6–8	10–12	12–14	–
All	18	–	–	–	–	–	1.3±0.5	7.4±0.7	10.9±0.6	13.5±0.6	0
		24.8–57.8	27–66	5.4–10.2	7.5–14.1	9.0–25.4	1–2	6–8	10–12	12–14	–
Hemiphyllodactylus typus											
F	2	41.4	–	6.2	8.7	21.6	2.0	4.5	5.0	6.5	18.5
		40.8–41.9	–	6.0–6.4	8.6–8.7	20.5–22.6	2	4–5	5	6–7	12–25
All	12	–	–	–	–	–	1.8±0.5	4.9±0.5	5.3±0.5	6.3±0.5	–
		27.5–41.9	25–36	4.9–6.4	6.6–8.7	13.5–22.6	1–2	4–6	5–6	6–7	0–26
Lepidodactylus gardineri											
F	7	50.5±1.9	39	8.9±0.2	11.5±0.3	22.9±2.9	2.6±0.5	5.9±0.9	14.1±1.1	13.3±1.8	0
		47.7–52.6	–	8.6–9.2	11.1–12.0	18.8–27.0	2–3	5–7	13–16	12–17	–
M	6	50.1±1.4	45.5±2.1	9.8±0.2	11.9±0.3	23.5±1.6	3.2±0.4	6.0±0.6	14.2±1.0	12.8±1.0	40.5±2.2
		48.5–52.1	44–47	9.6–10.1	11.5–12.5	21.6–25.4	3–4	5–7	13–15	12–14	37–43
All	30	–	–	–	–	2.8±0.6	5.9±0.6	14.4±1.2	12.9±1.1	–	–
		29.2–52.6	28–47	5.9–10.1	7.3–12.5	13.3–27.0	1–4	5–7	12–17	11–17	0–43
Lepidodactylus lugubris											
F	93	39.8±2.2	41.0±3.3	7.4±0.4	9.4±0.7	17.7±1.6	2.0±0.8	6.5±0.7	12.9±1.2	11.6±1.2	0
		34.0–44.2	33–49	6.5–8.3	8.1–10.9	13.4–24.3	1–3	5–8	9–14	9–15	–
All	152	–	–	–	–	–	2.0±0.7	6.5±0.7	12.8±1.3	11.7±1.3	0
		19.6–44.2	20–49	4.3–8.3	5.0–10.9	8.5–24.3	1–3	5–8	9–15	9–15	–
Lepidodactylus manni											
F	11	42.6±3.1	45.2±8.2	7.9±0.5	9.9±0.6	19.3±1.5	2.3±0.6	5.5±0.7	11.4±1.4	11.0±1.3	0
		38.7–48.1	36–57	7.4–8.5	9.0–10.8	16.9–21.7	1–3	5–7	10–14	9–13	–
M	11	40.0±3.3	40.0±6.2	7.8±0.6	9.7±0.6	17.8±2.0	2.4±0.7	5.3±0.5	11.7±1.8	10.3±1.3	13.5±5.2
		35.0–44.7	32–47	6.9–8.6	8.2–10.5	14.8–20.8	1–3	5–6	8–15	9–13	10–28
All	34	–	–	–	–	–	2.4±0.6	5.4±0.6	11.6±1.5	10.8±1.5	–
		25.2–48.1	32–57	5.2–8.8	6.6–10.8	10.1–21.7	1–3	5–7	8–15	9–14	0–28
Nactus pelagicus											
F	29	55.2±4.7	62.2±6.6	10.9±0.9	15.2±1.1	22.5±2.6	0.04±0.2	3.0±0.0	18.0±1.1	21.9±1.4	0
		48.3–63.7	52–74	9.6–12.8	13.6–17.1	17.0–28.4	0–1	3	15–20	19–25	–
All	65	–	–	–	–	–	0.06±0.2	3.0±0.2	18.2±1.4	22.0±1.3	0
		23.5–65.0	28–74	5.8–12.8	7.4–17.3	7.9–28.4	0–1	3–4	15–23	19–26	–

Table B

Statistical Summary of Body Measurements (mm) and Scale Counts for Fijian Skinks

The data are organized with mean ±1 SD on the 1st line and the range on the 2nd line. The sample size (*n*) is for the maximum number of individuals in the sample and is applicable to the majority of the traits; however, tail length was analyzed only if the tail was complete or fully regenerated and its sample size is usually less than the total sample. The female and male samples consist of adults only; the "All" sample includes all individuals, hatchlings through adults. Only ranges are presented for the measurement in the "All" samples because means are dependent on the number of immature individuals in the sample. Abbreviations: SVL, TailL, HeadW, HeadL, BodyL, Fing4, Toe4, see Table A; HLegL = hindlimb length; EyeL = number of scales on free edge of upper eyelid; SLab = number of supralabials; ILab = number of infralabials; Dorsal = number of dorsal scale rows between parietals and base of tail; Midb = number of scale rows around midbody.

Body Measurements

	n	*SVL*	*TailL*	*HeadW*	*HeadL*	*BodyL*	*HLegL*
Cryptoblepharus eximius							
F	33	35.9 ± 1.6	40.7 ± 5.7	4.9 ± 0.3	7.6 ± 0.3	18.2 ± 1.2	15.7 ± 0.9
		33.0–40.3	30–50	4.2–5.4	7.1–8.1	15.9–21.4	13.8–17.5
M	33	35.3 ± 1.1	42.8 ± 4.9	5.0 ± 0.3	7.7 ± 0.2	16.9 ± 1.0	15.8 ± 0.9
		32.9–37.7	29–51	4.6–5.6	7.3–8.0	14.7–18.9	13.6–17.6
All	143	20.0–40.3	26–51	3.0–5.6	5.0–8.1	7.5–21.4	8.9–17.6
Emoia concolor							
F	15	67.0 ± 6.6	106.1 ± 23.7	9.4 ± 1.8	15.1 ± 2.0	32.9 ± 3.2	31.0 ± 3.9
		58.7–77.3	69–156	7.5–14.0	12.9–19.8	28.5–38.0	26.2–38.0
M	27	71.6 ± 9.1	117.1 ± 16.4	10.9 ± 1.7	16.8 ± 1.8	33.8 ± 4.8	34.2 ± 4.0
		56.8–85.5	81–162	8.7–14.1	13.6–20.0	26.1–41.2	27.6–40.6
All	78	25.9–89.4	44–162	4.5–14.5	7.5–21.2	11.0–41.2	12.4–41.8
Emoia cyanura							
F	55	46.1 ± 3.5	67.6 ± 7.2	6.3 ± 0.5	10.1 ± 0.6	22.5 ± 2.3	19.6 ± 1.1
		39.1–53.1	52–84	5.5–7.1	8.8–11.4	18.4–27.5	16.9–21.5
M	81	48.3 ± 3.6	71.4 ± 9.6	7.1 ± 0.6	11.1 ± 0.8	23.4 ± 2.2	21.3 ± 1.8
		39.4–55.5	52–92	5.7–8.1	9.1–12.9	18.4–28.6	17.1–24.6
All	222	22.7–55.5	36–92	4.4–8.1	5.9–12.9	9.6–28.6	10.0–24.6

Scale Counts

	n	*EyeL*	*SLab*	*ILaB*	*Dorsal*	*Midb*	*Fing4*	*Toe4*
Cryptoblepharus eximius								
F	33	3.1 ± 0.3	7.0 ± 0.2	6.0 ± 0.2	53.0 ± 3.2	25.1 ± 1.2	17.4 ± 1.0	21.1 ± 1.9
		3–4	7–8	5–6	47–60	22–27	15–19	16–26
M	33	3.1 ± 0.4	7.0 ± 0.0	6.0 ± 0.2	53.5 ± 2.6	25.0 ± 1.1	17.2 ± 1.5	21.0 ± 1.7
		3–4	7	5–6	49–58	23–27	14–20	17–24
All	143	3.0 ± 0.3	7.0 ± 0.2	6.0 ± 0.2	53.4 ± 2.9	25.0 ± 1.4	17.1 ± 1.3	20.9 ± 1.5
		2–4	7–8	5–7	46–61	21–27	13–20	16–26
Emoia concolor								
F	15	11.2 ± 1.4	7.9 ± 0.4	6.8 ± 0.8	58.1 ± 2.2	29.8 ± 1.6	40.2 ± 3.4	55.5 ± 5.0
		8–13	7–8	6–8	54–62	27–32	34–47	47–64
M	27	11.6 ± 1.1	7.7 ± 0.4	6.6 ± 0.5	57.7 ± 1.8	30.5 ± 1.4	40.3 ± 4.2	55.8 ± 6.9
		10–14	7–8	6–7	55–61	28–33	32–47	43–65
All	78	11.5 ± 1.1	7.8 ± 0.4	6.6 ± 0.6	58.1 ± 1.8	30.1 ± 1.4	40.2 ± 4.0	55.9 ± 6.1
		8–10	7–8	6–8	54–62	27–33	30–48	43–65
Emoia cyanura								
F	55	8.2 ± 0.8	7.0 ± 0.1	6.1 ± 0.3	57.6 ± 1.6	29.4 ± 1.0	44.9 ± 2.6	69.1 ± 4.1
		7–11	7–8	5–7	54–61	28–32	39–51	57–79
M	81	8.5 ± 0.9	7.0 ± 0.2	6.1 ± 0.4	57.6 ± 1.8	29.7 ± 1.3	45.1 ± 2.8	70.4 ± 3.4
		6–11	6–8	6–7	53–62	28–34	36–50	59–77
All	222	8.5 ± 0.9	7.0 ± 0.2	6.1 ± 0.4	57.7 ± 1.8	29.6 ± 1.1	45.1 ± 2.7	70.0 ± 4.0
		6–11	6–8	5–7	53–63	28–34	36–51	57–82

Emoia impar							
F	32	44.6 ± 1.6	61.2 ± 8.0	6.1 ± 0.5	9.7 ± 0.4	22.6 ± 1.0	19.4 ± 1.0
		40.0–47.4	49–75	5.7–6.9	8.9–10.7	20.1–24.5	16.9–21.1
M	30	44.9 ± 1.8	69.5 ± 6.9	6.4 ± 0.4	10.4 ± 0.5	21.9 ± 1.6	20.5 ± 1.4
		40.3–47.4	54–81	5.7–7.0	9.1–11.1	17.3–23.9	17.1–22.6
All	112	22.7–47.4	31–81	4.2–7.0	5.9–11.1	9.0–24.5	10.1–22.6
Emoia nigra							
F	8	96.5 ± 7.5	153.6 ± 40.4	14.2 ± 1.1	20.9 ± 1.5	46.1 ± 3.7	47.0 ± 3.4
		87.7–107.5	86–199	12.3–15.6	18.9–23.9	39.2–50.8	42.3–53.3
M	10	100.0 ± 7.3	149.8 ± 31.1	15.7 ± 1.3	22.6 ± 1.6	48.1 ± 4.4	50.4 ± 2.9
		88.0–112.1	94–187	13.4–18.0	20.0–25.5	42.7–56.0	44.8–53.4
All	33	35.4–112.1	43–199	6.3–18.0	9.7–25.5	14.1–56.0	20.0–53.4
Emoia parkeri							
F	8	48.5 ± 3.0	68.0 ± 8.3	7.0 ± 0.9	11.2 ± 0.6	22.4 ± 2.2	21.5 ± 1.5
		42.9–52.0	59–77	5.9–8.8	9.9–11.7	19.5–26.1	18.9–23.7
M	5	48.8 ± 1.4	72.5 ± 7.2	7.2 ± 0.4	11.7 ± 0.8	21.7 ± 1.3	21.9 ± 1.3
		46.9–50.0	66–82	6.8–7.6	10.6–12.4	20.0–23.3	20.4–23.0
All	24	22.8–52.0	39–82	3.8–8.8	6.7–12.4	8.9–26.1	10.2–23.7
Emoia trossula							
F	30	84.9 ± 6.2	129.9 ± 19.8	11.6 ± 1.3	18.6 ± 1.4	41.0 ± 4.3	38.8 ± 3.5
		75.4–100.1	91–175	9.9–15.4	16.9–21.1	34.1–52.7	34.7–46.4
M	51	91.7 ± 8.5	135.8 ± 24.6	13.9 ± 1.7	21.2 ± 1.8	43.0 ± 4.1	43.7 ± 4.8
		74.1–106.5	76–201	10.8–16.8	17.3–24.2	33.7–52.0	35.6–53.0
All	117	32.9–106.5	63–201	5.3–16.8	8.8–24.2	14.3–52.7	14.9–53.0
Leiolopisma alazon							
F	2	45.4	48.5	6.6	8.9	24.8	12.4
		42.7–48.1	45–52	6.4–6.8	8.7–9.2	22.4–27.2	12.1–12.6
M	3	56.5 ± 4.7	53.1 ± 10.6	8.6 ± 0.6	11.7 ± 0.9	31.6 ± 3.5	16.2 ± 0.4
		51.3–60.4	46–61	7.9–9.0	10.6–12.4	27.8–34.8	15.9–16.6
All	14	26.9–60.4	25–61	4.2–9.0	6.2–12.4	12.8–34.8	8.5–16.6

Emoia impar								
F	32	9.1 ± 0.7	6.9 ± 0.2	6.0 ± 0.2	56.5 ± 2.4	29.3 ± 1.2	46.0 ± 2.5	68.9 ± 4.5
		8–10	6–7	5–6	52–61	27–32	41–51	58–79
M	30	9.3 ± 0.4	6.9 ± 0.3	6.1 ± 0.3	56.3 ± 2.0	30.3 ± 1.5	46.5 ± 2.7	70.5 ± 4.7
		8–11	6–7	6–7	53–61	27–33	41–53	62–80
All	112	9.3 ± 0.8	6.9 ± 0.2	6.1 ± 0.3	56.5 ± 2.2	29.9 ± 1.4	46.0 ± 2.6	69.3 ± 4.6
		8–12	6–7	5–7	51–62	26–33	40–53	58–80
Emoia nigra								
F	8	10.6 ± 1.5	7.4 ± 0.5	6.1 ± 0.6	63.8 ± 2.9	38.1 ± 0.6	21.8 ± 1.2	35.1 ± 2.3
		8–12	7–8	5–7	61–69	37–39	20–24	32–39
M	10	10.9 ± 0.9	7.6 ± 0.8	6.0 ± 0.8	63.2 ± 0.8	37.9 ± 1.0	21.8 ± 0.8	35.2 ± 1.1
		10–12	7–8	4–7	62–64	36–40	20–23	33–37
All	33	10.7 ± 1.2	7.5 ± 0.5	6.1 ± 0.6	63.7 ± 2.1	37.5 ± 1.4	21.7 ± 0.8	34.5 ± 1.8
		8–13	7–8	4–7	60–69	32–40	20–24	31–39
Emoia parkeri								
F	8	8.8 ± 0.4	7.9 ± 0.4	6.1 ± 0.4	56.5 ± 1.4	31.0 ± 1.2	26.7 ± 2.9	36.4 ± 3.0
		8–9	7–8	6–7	54–59	30–33	22–30	31–40
M	5	9.4 ± 0.9	8.2 ± 0.4	6.0 ± 0.0	57.4 ± 2.4	31.2 ± 1.6	25.8 ± 1.5	36.4 ± 2.7
		9–11	8–9	6	54–60	29–33	24–28	34–41
All	24	9.2 ± 0.9	7.9 ± 0.4	6.1 ± 0.3	56.8 ± 1.7	31.0 ± 1.4	26.3 ± 1.9	36.8 ± 2.5
		8–12	7–9	5–7	54–60	28–33	22–30	31–41
Emoia trossula								
F	30	11.4 ± 1.0	7.9 ± 0.3	7.0 ± 0.5	68.6 ± 3.9	34.8 ± 1.4	37.2 ± 2.7	53.8 ± 4.1
		10–13	7–8	6–7	62–77	33–38	31–41	44–61
M	51	11.7 ± 1.1	8.0 ± 0.3	6.9 ± 0.3	66.0 ± 3.7	35.0 ± 1.7	36.2 ± 3.1	51.3 ± 4.5
		10–14	7–9	6–8	59–74	31–38	29–42	43–65
All	117	11.5 ± 1.1	8.0 ± 0.3	6.9 ± 0.4	67.4 ± 4.1	34.7 ± 1.8	36.2 ± 3.2	51.6 ± 4.7
		8–14	7–9	6–8	58–77	30–40	27–42	42–65
Leiolopisma alazon								
F	2	8.5	8.0	5.5	73.0	34.5	14.5	22.5
		8–9	8	5–6	72–74	34–35	14–15	22–23
M	3	10.0 ± 0.0	8.0 ± 0.0	6.0 ± 1.0	72.7 ± 1.5	36.0 ± 1.0	14.3 ± 0.6	21.7 ± 0.6
		10	8	5–7	71–74	35–37	14–15	21–22
All	12	9.5 ± 0.9	8.0 ± 0.0	5.9 ± 0.5	74.5 ± 2.0	35.0 ± 1.0	13.9 ± 1.3	21.5 ± 0.9
		8–11	8	5–7	71–78	34–37	12–15	20–23

Table B (continued)

Body Measurements

	n	SVL	TailL	HeadW	HeadL	BodyL	HLegL
Lipinia noctua							
F	32	42.7 ± 2.3	52.3 ± 5.7	5.7 ± 0.7	8.3 ± 0.6	22.2 ± 2.1	16.2 ± 0.7
		37.3–47.3	41–62	5.1–8.6	5.8–8.6	17.7–25.5	14.4–17.5
M	28	40.1 ± 1.5	49.0 ± 3.6	5.7 ± 0.3	8.6 ± 0.3	19.5 ± 1.0	16.0 ± 0.8
		38.0–43.2	42–55	5.3–6.2	7.8–9.2	17.5–21.4	14.4–18.2
All	96	20.6–47.3	26–62	3.3–8.6	5.6–9.2	6.9–25.5	6.7–18.2

Scale Counts

	n	EyeL	SLab	ILaB	Dorsal	Midb	Fing4	Toe4
Lipinia noctua								
F	32	9.3 ± 1.1	7.0 ± 0.0	6.0 ± 0.3	53.4 ± 2.4	26.8 ± 1.0	14.4 ± 1.2	20.2 ± 1.3
		7–11	7	5–7	46–57	24–28	12–17	17–23
M	28	9.4 ± 1.1	7.0 ± 0.2	5.9 ± 0.3	52.2 ± 1.9	26.4 ± 0.9	14.5 ± 1.6	20.4 ± 1.2
		7–11	7–8	5–6	49–56	25–28	11–17	18–23
All	96	9.3 ± 1.1	7.0 ± 0.1	6.0 ± 0.2	52.5 ± 2.3	26.2 ± 1.0	14.2 ± 1.3	20.2 ± 1.2
		7–12	7–8	5–7	46–57	24–28	11–17	17–23

TABLE C

Summary of Potential Sexual Dimorphic Traits for Adult Geckos and Skinks

A Bartlett χ^2 test was used to test for homogeneity of variance between the female and male samples of each species, and a Student's t test to test for difference between the means of the 2 sexes. Only those traits showing a significant difference ($\alpha < 0.05$) are listed. Abbreviations for traits and for female and male sample sizes are the same as in tables A and B.*

	χ^2	t	P	Means Female	Male
Gehyra oceanica					
HeadW	1.957	−3.746	<0.001	14.2	15.4
HeadL	0.355	−3.982	<0.001	18.2	19.4
Gehyra vorax	–				
Hemidactylus frenatus					
HeadW**	2.052	−2.387	0.036	9.1	10.2
Lepidodactylus gardineri					
HeadW	0.117	−6.855	<0.001	8.9	9.8
HeadL	0.009	−2.289	0.043	11.5	11.9
BtwNs	0.385	−2.223	0.048	2.6	3.2
Lepidodactylus manni	–				
Cryptoblepharus eximius					
BodyL	1.844	−4.773	<0.001	18.2	16.9
Emoia concolor					
HeadW	0.011	−2.530	0.016	9.4	10.9
HeadL	0.147	−2.829	0.007	15.1	16.8
HLegL	0.006	−2.502	0.017	31.0	32.2
Emoia cyanura					
SVL	0.016	−3.498	0.001	46.1	48.3
HeadW	1.752	−5.630	<0.001	6.3	7.1
HeadL**	6.852	−7.589	<0.001	10.1	11.1
BodyL	0.250	−2.244	0.027	22.5	23.4
HLegL**	12.823	−5.785	<0.001	19.6	21.3
Emoia impar					
HeadL	1.741	−6.848	<0.001	9.7	10.4
BodyL**	5.726	−2.080	0.042	22.6	21.9
HLegL**	2.022	−3.508	0.001	19.4	20.5
Midb	1.174	−2.645	0.010	29.3	30.3
Emoia parkeri					
EyeL	0.015	−2.571	0.026	8.8	9.4

Table C (continued)

	χ^2	t	P	*Means* *Female*	*Male*
Emoia nigra					
HeadW	0.083	−2.632	0.018	14.2	15.7
HeadL	0.029	−2.216	0.042	20.9	22.6
HLegL	0.210	−2.289	0.036	47.0	50.4
Emoia trossula					
SVL**	3.316	−3.826	<0.001	84.9	91.7
HeadW**	2.948	−6.409	<0.001	11.6	13.9
HeadL**	3.256	−6.620	<0.001	18.6	21.2
BodyL	0.043	−2.137	0.036	41.0	43.3
HLegL**	2.802	−4.600	<0.001	38.8	43.0
Dorsal	0.095	−3.012	0.003	68.6	66.0
Toe4	0.398	−2.426	0.018	53.7	51.3
Leiolopisma alazon					
SVL	0.037	−2.751	0.071	45.4	56.4
HeadW	0.454	−4.191	0.025	6.6	8.6
HeadL	0.703	−3.728	0.034	8.9	11.7
HLegL	0.004	−11.287	0.001	12.4	16.2
Lipinia noctua					
SVL**	4.472	−5.171	<0.001	42.7	40.1
HeadL**	9.140	−1.971	0.054	8.3	8.5
BodyL	13.089	−6.336	<0.001	22.2	19.5
Dorsal	1.085	−2.230	0.030	53.4	52.2

* The Fijian samples of *Hemidactylus garnotii*, *Hemiphyllodactylus typus*, *Lepidodactylus lugubris*, and *Nactus pelagicus* consist entirely of females.

** The variance of the female and male samples are not equal, hence the significance of Student's t is uncertain.

TABLE D

Summary of the Analysis of Geographic Variation in Morphometric and Scale Characteristics of Fijian Geckos and Skinks

NO OR UNDOCUMENTED VARIATION

One Island Species	*No Significant Difference*[1]	*Inadequate samples*
Lepidodactylus gardineri	Gehyra oceanica	Brachylophus
	Lepidodactylus lugubris	Gehyra mutilata
	Nactus pelagicus	Gehyra vorax
	Cryptoblepharus eximius	Hemidactylus frenatus
	Emoia impar	Hemidactylus garnotii
	Lipinia noctua	Hemiphyllodactylus typus
		Lepidodactylus manni
		Emoia caeruleocauda
		Emoia nigra
		Emoia parkeri

DEMONSTRABLE GEOGRAPHIC VARIATION[2]

Species	*Islands or Island Groups*						
Emoia concolor	*Yadua*	*VitiL*	*Gau*	*Kadavu*	*Matuku*		
n	9	12	7	19	7		
SLab	7.9	7.9	7.9	7.9	7.4		
Dorsal	57.1	57.7	58.3	59.3	58.3		
Midb	28.7	29.2	30.4	31.4	30.1		
Fing4*	35.1	36.6	44.6	41.7	42.6		
Toe4*	47.5	49.9	62.1	57.9	60.7		
Emoia cyanura	*Rotuma*	*Taveuni*	*Koro*	*Ovalau*	*Kadavu*	*Totoya*	*Ono*
n	31	17	47	54	22	15	47
SLab	7.0	7.0	6.9	7.1	7.0	6.9	6.9
Dorsal	56.8	57.3	57.1	58.4	56.8	58.8	55.5
Midb	29.1	30.1	29.5	30.4	29.4	30.3	29.3
Fing4	43.3	46.6	45.7	45.8	43.3	46.0	46.9
Toe4	68.0	71.2	71.2	71.0	66.1	71.9	71.4
Emoia trossula	*Rotuma*	*Yadua*	*Aiwa*				
n	35	25	10				
SLab	8.0	8.0	7.7				
Dorsal	69.7	64.3	65.5				
Midb	35.5	35.4	34.2				
Fing4*	38.4	36.9	32.5				
Toe4*	55.6	52.3	47.5				
SVL-male*	84.2	98.9	95.4				

1. These species have no significant differences among character means for the different island samples.
2. Some character means vary among the different geographic samples. Asterisks mark characters with significant differences between one or more pairs of means.

Table E

Species Occurrence of the Native Terrestrial Herpetofaunas in the Major Island Groups of the Fiji Archipelago

P, species present (museum voucher or literature/sight record); "–", species absent or not reported.

Species	*Islands or Island Groups**												
	Cik	VaL	Tav	Kor	Gau	Ova	ViL	Yas	Kad	Moa	LaN	LaS	Ono
Frogs													
Platym. vitianus	–	P	P	–	P	P	P	–	–	–	–	–	–
Platym. vitiensis	–	P	P	–	–	P	P	–	–	–	–	–	–
Lizards													
Gehyra oceanica	P	P	P	P	–	P	P	P	P	P	P	P	–
Gehyra vorax	–	P	P	P	P	P	P	–	P	–	–	–	–
Nactus pelagicus	–	P	P	P	–	P	P	–	P	P	–	P	P
Hemiphyl. typus	–	P	–	–	–	–	P	–	–	–	–	–	–
Lepidod. manni	–	–	–	–	–	P	P	–	P	–	–	–	–
Brachyl. fasciatus	P	P	P	P	P	P	P	–	P	P	P	P	–
Brachyl. vitiensis	–	P	–	–	–	–	P	P	–	–	–	–	–
Emoia concolor	P	P	P	P	P	P	P	P	P	P	P	P	–
Emoia cyanura	–	P	P	P	P	P	P	P	P	P	P	P	P
Lipinia noctua	–	P	P	P	P	P	P	P	P	P	P	P	P
Emoia impar	–	P	P	P	–	P	P	P	P	P	P	P	P
Emoia trossula	–	P	P	P	P	P	P	P	P	P	P	P	P
Cryptobl. eximius	–	P	P	–	–	P	P	P	P	P	P	P	P
Emoia nigra	–	P	P	P	–	P	P	–	–	–	P	–	–
Emoia parkeri	–	–	P	–	–	P	P	–	P	–	–	–	–
Emoia campbelli	–	–	–	–	–	–	P	–	–	–	–	–	–
Leiolopisma alazon	–	–	–	–	–	–	–	–	–	–	–	–	P
Snakes													
Candoia bibroni	P	P	P	P	P	P	P	P	P	P	P	P	P
Ogmodon vitianus	–	–	–	–	–	–	P	–	–	–	–	–	–

* Abbreviations. Cik = Cikobia. VaL = Vanua Levu group. Tav = Taveuni and Ringgold islands. Kor = Koro. Gau = Gau. Ova = Ovalau. ViL = Viti Levu group, including Vatulele and Beqa. Yas = Yasawa group. Kad = Kadavu group. Moa = Moala group. LaN = northern Lau group, islands north of 18°30′S/Oneata Passage. LaS = southern Lau group, islands south of 18°30′S. Ono = Ono-i-Lau.

TABLE F

Species Occurrence of the Native Terrestrial Herpetofaunas
of the Fiji Islands and Adjacent Island Groups

P, species present (museum voucher or literature/sight record); "–", species absent or not reported.

	*Islands Groups**							
		Fiji						
Species	VANU	VITI	LAU	TONG	TONN	SAMO	ROTU	SOCI
Frogs								
Platymantis vitianus	–	P	–	–	–	–	–	–
Platymantis vitiensis	–	P	–	–	–	–	–	–
Lizards								
Gehyra oceanica	P	P	P	P	P	P	P	P
Gehyra vorax	–	P	–	–	–	–	–	–
Hemiphyllodactylus typus	–	P	–	P	–	–	–	P
Lepidodactylus euaensis	–	–	–	P	–	–	–	–
Lepidodactylus gardineri	–	–	–	–	–	–	P	–
Lepidodactylus manni	–	P	–	–	–	–	–	–
Nactus pelagicus	P	P	P	P	–	P	P	P
Perochirus guentheri	P	–	–	–	–	–	–	–
Brachylophus fasciatus	–	P	P	P	–	–	–	–
Brachylophus vitiensis	–	P	–	–	–	–	–	–
Caledoniscincus atropunct.	P	–	–	–	–	–	–	–
Cryptoblepharus eximius	–	P	P	–	P	–	–	–
Cryptobl. novohebridicus	P	–	–	–	–	–	–	–
Cryptobl. poecilopleurus	–	–	–	–	–	P	–	P
Cryptobl. nsp.	–	–	–	P	–	–	–	–
Emoia adspersa	–	–	–	–	P	P	–	–
Emoia aneityumensis	P	–	–	–	–	–	–	–
Emoia atrocostata	P	–	–	–	–	–	–	–
Emoia caeruleocauda	P	–	–	–	–	–	–	–
Emoia campbelli	–	P	–	–	–	–	–	–
Emoia concolor	–	P	P	–	–	–	P	–
Emoia cyanogaster	P	–	–	–	–	–	–	–
Emoia cyanura	P	P	P	P	P	P	P	P
Emoia impar	P	P	P	P	P	P	–	P
Emoia lawesii	–	–	–	–	P	P	–	–

Table F (continued)

Species	*Islands Groups**							
		Fiji						
	VANU	VITI	LAU	TONG	TONN	SAMO	ROTU	SOCI
Emoia murphyi	–	–	–	–	P	P	–	–
Emoia nigra	P	P	P	P	P	P	P	–
Emoia nigromaculata	P	–	–	–	–	–	–	–
Emoia parkeri	–	P	–	–	–	–	–	–
Emoia samoensis	–	–	–	–	–	P	–	–
Emoia sanfordi	P	–	–	–	–	–	–	–
Emoia trossula	–	P	P	P	–	–	P	–
Leiolopisma alazon	–	–	P	–	–	–	–	–
Lipinia noctua	P	P	P	P	P	P	P	P
Tachygyia	–	–	–	P	–	–	–	–
Snakes								
Candoia bibroni	P	P	P	P	–	P	P	–
Ogmodon vitianus	–	P	–	–	–	–	–	–

* Abbreviations and data sources. VANU = Vanuatu: Brown 1991; Medway & Marshall 1975; Sadlier 1986. VITI = Vanua Levu, Vitu Levu and associated islands: Table A. LAU = Lau group, Fiji: Table A. TONG = Tonga islands, Vava'u group through Tongatapu group: SDNH & USNM colln., Gibbons & Brown 1988. TONN = Niuafo'ou and Niuatoputapu group: USNM colln. SAMO = Western and American Samoa: Crombie ms. ROTU = Rotuma Islands: Zug et al. 1989. SOCI = Society Islands and Tuamotu Archipelago: USNM colln.; Ineich & Blanc 1989. *Candoia bibroni*: McDowell 1979. *Ogmodon vitianus*: Gorham 1970, Zug & Ineich 1991.

TABLE G

Specimens Examined

For brevity, only island names are provided with museum numbers. Precise locations are shown on the maps. Islands arranged north to south and west to east. The spelling of island names follows the *Fiji Islands* map, scale 1:750,000, 2nd ed., Lands and Survey Dept., Fiji, 1984; names absent from this map follow Motteler's (1986) *Pacific Island Names*. Abbreviations used for institutional collections are those recommended by Leviton et al. (1985); private collections: Dick Watling, DWa; William Beckon, WmB.

Brachylophus fasciatus. Vanua Levu: BMNH 87.8.25.40. Nairai: USNM 230302. Viti Levu: BMNH 1938.8.2.8; BPBM 1824; USNM 51410. Kadavu: BMNH 82.8.29.70–71; USNM 230303–05. Lau/Yacata: BPBM 1484. Lau/Aiwa: BPBM 1499. Lau/Fulaga: BPBM 1483. Fiji: BPBM 1261; USNM 51000–01, 58807.

Brachylophus vitiensis. Yadua Tabu: USNM 230300.

Gehyra mutilata. Rotuma: USNM 268123–24. Ovalau: USNM 267965. Viti Levu: USNM 267925.

Gehyra oceanica. Rotuma BMNH 97.7.29.1–2; USNM 268125–41. Cikobia: AMNH 29008. Kia: AMS R116254. Yadua Tabu: AMS R106768–69. Vanua Levu: AMS R116252–53. Sau Sau: AMS R109923–24. Taveuni: DWa F12, F521–23, F598, F625; USNM 229898–901. Koro: USNM 230018. Ovalau: AMS R30434–35; MCZ 16961–62. Viti Levu: AMS R106829; BMNH 65.5.29.2; BPBM 1650; CAS 102359, 102474; MCZ 118889; USNM 230183–84, 267966–70. Toberua: AMS R109946. Mamanuca/Malolo Lailai: CAS 156048. Mamanuca/Tavarua: AMS R116250–51. Nukulau: BMNH 1927.11.20.1–2. Kadavu: AMS R30444; CAS 159430–32; MCZ 16883. Kadavu/Ono: FMNH 3490. Totoya: USNM 230266. Matuku: AMNH 41694; BMNH 82.8.29.58; USNM 230197–207. Lau/Tuvuca: MCZ 16926–29. Lau/Aiwa: AMNH 29023–26, 29028–29. Lau/Moce: AMNH 41947–50. Lau/Komo: AMNH 41844–45, 41849. Lau/Namuka-i-Lau: AMNH 41920–24. Lau/Nayabo: BPBM 735–42, 1556. Lau/Fulaga: MCZ16924–25. Lau/Ogea Levu: BPBM 1557. Lau/Ogea Driki: AMNH 41852–53. Lau/Vatoa: MCZ 16923. Lubrica: FMNH 3489 (2). Sava: FMNH 69243.

Gehyra vorax. Taveuni: MCZ 15007. Koro: AMNH 40475. Ovalau: BMNH 55.8.16.3–4. Gau: DWa F567. Viti Levu: AMNH 121273; AMS R4768; MCZ 158241; UMMZ 180470–71; WmB 136–37, 151. Fiji: AMS R242, R294; USNM 5699 (2). Vitu Leoa: AMS R9515.

Hemidactylus frenatus. Vanua Levu: AMS R116245–49; WmB 1985.10. Vita Levu: AMS 96558–59; CAS 159495–97; DWa F577–78; USNM 267926–27, 267971–6. Mamanuca/Malolo Lailai: WmB 1985.8–.9.

Hemidactylus garnotii. Viti Levu: AMNH 81734–45; USNM 267977; WmB 1976.7–9, 115P, 116P, 172.

Hemiphyllodactylus typus. Vanua Levu: AMS R107894. Viti Levu: BMNH 1938.8.2.7; USNM 230185, 267828, 267978–79; WmB 80–82, 148, 169, 173, 175.

Lepidodactylus gardineri. Rotuma: BMNH 1946.8.22.35; USNM 268142–69.

Lepidodactylus lugubris. Rotuma: BPBM 1764–66; USNM 268170–79. Druadrua: WmB 1985.17(a). Kia: AMS R116210. Yadua: AMS R112040–41; DWa F611. Vanua Levu: AMS R107892–93, R112044–47, R114851, R116204–09; WmB 181, 1985.11, 1985.17(b), 1985.15. Taveuni: BMNH 1938.8.2.2, 1940.1.17.5; NMNZ R1094(3), no #(2); USNM 229902–08. Makogai: DWa F518–19. Ovalau: AMS R30537–40, R30629–33; USNM 267980–82, 268001–02. Gau: DWa F531–35. Viti Levu: AMS R3685(3)–86(3), R6740, R8536, R116194–96, BMNH 1938.8.2.6, 1940.1.17.4, 1947.3.1.81; BPBM 1776, 1941; CM 64481; NMNZ R537–43, R547; UMMZ 127548; USNM 230186–88, 267983–8000, 268003–04; WmB 1985.16. Mamanuca/Malolo: CAS 156049. Mamanuca/ Malolo Lailai: DWa F556–57. Kadavu: AMS R30466–74, R30500–10; BPBM 1777–78; FMNH 3493(5). Moala: AMNH 40211; BMNH 1947.3.1.78. Totoya: USNM 230267. Matuku: AMNH 41693. Lau/Wailagi Lala: AMNH 41648. Lau/Vanua Balavu: BMNH 1947.3.1.80. Lau/Mago: AMNH 41747. Lau/Tuvuca: FMNH 3492(2). Lau/Cicia: AMNH 41805. Lau/Aiwa: AMNH 41646. Lau/Vanua Vatu: BMNH 1947.3.1.79. Lau/Oneata: AMNH 41647. Lau/ Komo: AMNH 41650, 41745, 41846–48, 41850. Lau/Namuka-i-Lau: AMNH 41925–30. Lau/Nayabo: AMNH 41649. Lau/Fulaga: FMNH 3491(2). Lau/Ogea Driki: AMNH 41643–45. Nadavalalu: BMNH 1938.8.2.3–.5. Onio: BMNH 61.1.6.37–38.

Lepidodactylus manni. Vitu Levu: AMNH 81746–51; CAS 156006–07, 158930–32, 159417–22; 159424–28; DWa F549; MCZ 16880; UPNG 7846–49. USNM 252423, 268005–06, 268394. Kadavu: WmB 152.

Nactus pelagicus. Rotuma: USNM 268180–88, 268383. Nawi: NMNZ R1090. Taveuni: USNM 229895–97. Makogai: MCZ 45990(2). Ovalau: AMS R30541, 30626–28, 64821; FMNH 13646–49. Toberua: AMS R109936. Viti Levu: AMNH 24716, 41651, 81732–33; CAS 102362–63; FMNH 3488; MCZ 16882, 48954; UMMZ 182797, 183217; USNM 268007–09; WmB 174, 1976.4–.5. Beqa: WmB 1976.6. Kadavu: AMS R30443, R30593, R64820; BMNH 82.8.29.45–.46; CAS 159440; USNM 267929–32; WmB 154. Moala: AMNH 40207–10. Totoya: USNM 230264–65. Lau/Aiwa: AMNH 29027. Lau/ Ono-i-Lau: USNM 229981. Fiji: AMS R3687, R11067.

Carlia fusca. Viti Levu: MMSU 42, likely erroneous locality.

Cryptoblepharus eximius. Yadua: NMNZ R995. Vanua Levu: BMNH 1940.3.26.1. Yadua Tabu: AMS R111452–66, R111875. Ovalau: AMS R30635–41; USNM

230090–103. Viti Levu: AMNH 113580–84, 113586–87, 113589–92, 113598; MCZ 45991; NMNZ R553–54; USNM 195739(3)–41. Kadavu: AMS R30448, R30464, R30482–83, R30495–99, R30533–34, R30607, R30614–15; BMNH 1969.1529; MCZ 16970–71; USNM 267933. Moala: AMNH 41744; MCZ 6455. Totoya: AMNH 41736. Matuku: AMNH 41707; USNM 230209–20. Lau/Wailagi Lala: AMNH 41659. Lau/Kanacea: AMNH 41653–54. Lau/Tuvuca: MCZ 16963–64. Lau/Cicia: BMNH 1947.3.1.88–41673. Lau/Karoni: AMNH 41674. Lau/Namuka-i-Lau: AMNH 41939, 41942. Lau/Navutu-i-Ra: USNM 230013–17. Lau/Nayabo: AMNH 41668–69, 41675–78. Lau/Ono-i-Lau: MCZ 16958–59, 16967–68; USNM 229939–50.

Emoia caerulocauda. Fiji: USNM 58317.

Emoia campbelli. None examined.

Emoia concolor. Rotuma: BMNH 97.7.29.8. Cikobia: AMNH 29007. Yadua: AMNH 40504; AMS R111429–30, R111432–36. Yadua Tabu: AMS R106767; DWa F604. Vanua Levu: BMNH 87.8.25.41. Taveuni: MCZ 48. Koro: USNM 230019–21. Makogai: DWa F520. Ovalau: FMNH 13641; USNM 230104–05. Gau: DWa F526, F543, F572–76. Viti Levu: BMNH 1940.1.17.7, 1945.3.1.86–.87, 1945.11.5.9; BPBM 1647, 1938; DWa F501; MCZ 22077, 48958; MCZ 6459, 9133–34; UMMZ 183218; UPNG 7745. Mamanuca/Malolo Lailai: DWa F559. Kadavu/Dravuni: CM 8142. Kadavu: BMNH 82.8.29.169–.170; MCZ 15014, 16930, 16932–40, 16943–44; USNM 267934–36. Moala: AMNH 41708. Matuku: AMNH 41706; USNM 230221–26. Lau/Kanacea: AMNH 41750. Lau/Vanua Balavu, Lau/Mago, Lau/Katafaga: AMNH 41962–64, 41970. Lau/Cicia: AMNH 40195. Lau/Moce: AMNH 41944–45. Lau/Vatoa: MCZ 16954. Yanuca Loa: AMNH 40505.

Emoia cyanura. Rotumá: USNM 268191–95, 268198–200, 268202–04, 268207, 268209, 268212–15, 268217–20, 268223, 268225–26, 268228, 268230, 268232–34, 268236–37. Yadua: AMS R107887–88, 111446–50. Vanua Levu/Nawi: NMNZ 1091 (2). Taveuni: USNM 229915–16, 229918–24, 229926–27, 229930, USNM 229909–12, 229914. Koro: USNM 230022–37, 230039–41, 230043–44, 230047–72. Ovalau: USNM 230106–10, 230112–40, 230142–59, 230161–62, 230170–72. Gau: AMNH 40502. Viti Levu: NMNZ R555, USNM 230194–95, 268010–11. Mamanuca/Tavua: NMNZ R1092. Kadavu: BPBM 1779, AMNH 40493–501, AMS R30475–79, R30595–97, R30601–03, R30606, R30610. Moala: AMNH 40214. Matuku: USNM 230241–52. Totoya: 230268–76, 230278, 230280–83, 230287. Lau/Katafaga: AMNH 41661–62. Lau/Tuvuca AMNH 40538. Lau/Oneata: AMNH 41664. Lau/Ono-i-Lau: USNM 229966, 229982, 229986.

Emoia impar. Yadua: AMS R107889–91, 111451. Vanua Levu: AMNH 29036. Tavenui: NMNZ R1093 (2), USNM 229913, 229917, 229925–29. Koro: USNM 230042. Ovalau: USNM 230111, 230118, 230141, 230147–48, 230160, 230163–69. Kadavu: AMS R30477, R30594, R30598–600, R30604–05. Moala: AMNH 40216–20, 40222. Matuku: USNM 230227–40. Totoya: USNM 230277, 230279, 230284–86, 232088. Lau/Wailagi Lala: AMNH 41660. Lau/Vanua Balavu: AMNH 41658. Lau/Mago: AMNH 41666. Lau/Katafaga: AMNH 41663. Lau/Oneata: AMNH 41665. Lau/Namuka-i-Lau: AMNH 41667. Lau/Fulaga: AMNH 41655. Lau/Ogea Levu: AMNH 41656. Lau/Ono-i-Lau: USNM 229951–78, USNM 229983–85, 229987–88, 230001–012.

Emoia nigra. Rotuma: BMNH 97.7.29.10; BPBM 1760–63; USNM 268245–55, 268387. Vanua Levu: BMNH 71.4.16.23(2). Nukubasaga: AMNH 40509. Koro: USNM 230073–81. Ovalau: BMNH 82.8.29.167–.168; CAS 158979–80. Viti Levu: BMNH no #(1).

Emoia parkeri. Taveuni: BMNH 1938.8.2.11. Ovalau: BMNH 55.8.16.10; BPBM 1648. Viti Levu: AMNH 117700; CAS 146961–64, 156005; USNM 268013–14; Unknown museum 81757. Kadavu: CAS 147570–73; USNM 267937–38, 268012, 268396. Fiji: BMNH 63.5.11.16; CAS 146965–66; USNM 5643.

Emoia trossula. Rotuma: BMNH 97.7.29.9–.10; USNM 268256–311, 268388. Yadua: AMS R111431, Yadua Tabu: AMS R106753–66, R107885, R111425–28. CAS 155959, 156128–29; DWa F612; USNM 230201. Taveuni: BMNH 1938.8.2.9, 1959.1.2.32; CAS 155958; MCZ 16947; UPNG 7746. Namenalala: BPBM 1504. Ovalau: AMNH 40488; BMNH 81.10.12.19; FMNH 13644–45. Gau: DWa F524–25, F541–42, F571. Yasawa: AMNH 40507. Kadavu: BMNH 82.8.29.185; CAS 158978; USNM 267939. Moala: AMNH 40223. Lau/Kanacea: AMNH 29030. Lau/Vatu Vara: AMNH 29010–11. Lau/Tuvuca: MCZ 16955–56. Lau/Cicia: AMNH 40196. Lau/Lakeba: MCZ 16965. Lau/Aiwa: AMNH 29015, 29017–22, 29031–32; BPBM 1485. Lau/Ono-i-Lau: MCZ 16941–42. Buki Levu: MCZ 16945. Fiji: AMNH 88359–60; BMNH 62.10.23.4, 75.12.31.6; BPBM 1718.

Leiolopisma alazon. Lau/Ono-i-Lau: USNM 229989–230000.

Lipinia noctua. Rotuma: BMNH 97.7.29.5; USNM 268312–23. Yadua: AMS R107895, R111437–45; NMNZ R996. Vanua Levu: BMNH 87.8.25.42–.44; NMNZ R1019. Taveuni: NMNZ no #(1); USNM 229931–38. Koro: USNM 230082–83. Ovalau: USNM 230173–75. Viti Levu: BMNH 1940.1.17.8; CAS 102360; MCZ 16966; USNM 230189, 268015. Kadavu: AMS R30447, R30463, R30465, R30493–94, R30528–29, R30531–32, R30609, R30611, R30613. Moala: AMNH 40215, 40221. Totoya: USNM 230289–99. Matuku: USNM 230253–63. Lau/Vanua Balavu: MCZ 15013. Lau/Munia: MCZ 16957. Lau/Katafaga: AMNH 41965–69, 41971. Lau/Tuvuca: MCZ 15012. Lau/Lakeba: AMNH 41652. Lau/Vatoa: MCZ 16960. Lau/Ono-i-Lau: USNM 229979–80.

Sphenomorphus solomonis. Viti Levu: MMSU 41, likely erroneous locality.

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An asterisk at the end of the citation indicates that the publication contains information on Fijian herpetofauna, but the article is not cited in this bulletin.

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