



Report at a Glance

Source: A Rapid Biodiversity Assessment of the Nakauvadra Range, Ra Province, Fiji: 11

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Chapter 2

Herpetofauna of the Nakauvadra Range, Ra Province, Fiji

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SUMMARY

A total of 11 frog and reptile species were documented from the Nakauvadra Range, Ra Province, Fiji representing approximately 33% of Fiji's terrestrial herpetofauna. This included three frog species, four skinks and four geckoes. In addition, skin sheds from the snake *Candoia bibroni* were also observed. All species were observed in relatively low abundances.

Four of the species are endemic to Fiji (*Platymantis vitianus*, *P. vitiensis*, *Emoia concolor* and *E. parkeri*). With the exception of the introduced cane toad (*Bufo marinus*), and the mourning gecko (*Lepidodactylus lugubris*), the remaining species are native to Fiji and the Pacific.

This survey documented the only known extant population of *P. vitianus* on Viti Levu. This frog species was thought to have been extirpated from Viti Levu in the last 20 years and as such this result highlights the conservation significance of the Nakauvadra Range for herpetofauna biodiversity.

Several threats to herpetofauna in the area were identified and are discussed in light of potential mitigation measures and future research.

INTRODUCTION

Fiji is home to 32 species of terrestrial herpetofauna: three frogs (two endemic species), three iguanas (two endemics), four snakes (two endemics), 10 geckoes (two endemics) and 10 skinks (six endemics). Over forty percent of these are endemic, with possibly more (new) endemic species to be described in near future.

Despite the wide geographic distribution of Fiji's native terrestrial herpetofauna, their conservation status is unknown. With the exception of the Fiji crested iguana (*Brachylophus vitiensis*) and the Fiji ground frog (*Platymantis vitianus*), there has been no recent assessment of the population status of any of Fiji's terrestrial herpetofauna other than accounts from opportunistic surveys conducted by visiting biologists and through baseline biodiversity surveys (Bustard 1970, Gibbons 1981, 1984, Zug 1985, 1991, Zug and Ineich 1983, Harlow and Biciloa 2001, Worthy 2001, Morrison 2003a, 2003b, 2003c, Kuruyawa et al. 2004, Morrison et al. 2004, Morrison 2005, Thomas, 2006; Harlow et al. 2007). To date, no specific herpetofauna surveys have been conducted in the Nakauvadra Range and consequently, its herpetofauna diversity is poorly known.

The primary aim of this survey was to identify the herpetofauna species found in the Nakauvadra Range using a combination of nocturnal and diurnal active surveys. In addition, we also wanted to identify potential threats to the herpetofauna community in the area.

Reason for the RAP Survey

In April 2008, the Fiji Water Foundation and Conservation International (CI) entered into a three-year grant agreement to protect the natural resources of Viti Levu, Fiji. One of the three key objectives of the Fiji Water Grant involves technical assessments and community consultations to facilitate conservation initiatives within the Yaqara and Nakauvadra watersheds. As part of the implementation of this objective, one of the key components was to gain an understanding of the existing environment in the Yaqara Valley and conduct an ecological baseline assessment of the Nakauvadra Range.

METHODS AND SITE DESCRIPTION

Site descriptions

Site 3: Volivoli Creek, Nabiya and Toluwalu Streams – Base Camp 1 (Map 3)

Nabiya Stream and Toluwalu Stream are at the headwaters of Volivoli Creek; Base camp 1 (Camp 1) was located along the stream bank at the confluence of the two streams. A notable feature of the Toluwalu and Nabiya streams, and Volivoli Creek was the decrease in water level each consecutive day during the expedition. Toluwalu Stream and Nabiya Stream were at least 20 m wide, with an average depth of 1.5 m when flowing with water. Dry sections of the two stream beds (approximately 100 m in length) were intermittent with non-stagnant water pools which appeared to filter water under the soil onto the next pool (Plate 1). Undisrupted water flow along the Volivoli Creek began again approximately 100 m downstream from Camp 1.

The sections of Volivoli Creek downstream of Camp 1 were dominated by big boulders (Plate 2) within the streams whilst the (dry) sections: Nabiya Stream and Toluwalu Stream were dominated by cobbles, pebbles and exposed bedrock (Plate 3). Both the vegetation and stream characteristics displayed ideal herpetofauna habitats observed in other parts of Fiji: good riparian vegetation cover, big boulders, tree branches overhanging the river, fallen tree branches along the river bank, dense canopy cover within the forest, ground cover dominated by saplings, rotting wood, leaf litter, trees with large crevices and tree trunks and branches covered with epiphytes.

Sites 3a and 3b were surveyed on two dates: 20th and 21st November 2008. Sites 3c and 3e were surveyed during the diurnal surveys on the 19th, 20th, 21st and 22nd November, 2008 (see Appendix 3 for site locations).

Sites 5, 6 and 7: Vuniqesa Stream and dried up tributary – Base camp 2 (Map 3)

The width of Vuniqesa Stream was at least 10 m. Unlike Nabiya Stream and Toluwalu Stream, Vuniqesa Stream did not have many dry sections (Plate 4). Base camp 2 (Camp 2) was located adjacent to a steep riffle and pools section of the river, with vegetation overhanging the stream. Sections of the river 100 m upstream (Site 5a) and downstream of Camp 2 (Site 5c) were dominated by big boulders. Interestingly, the section just above 100 m upstream of Camp 2 was relatively flat and open, and clear of the dense vegetation observed around the base camp. Both the vegetation and stream characteristics displayed ideal herpetofauna habitats (as described above for Camp 1).

Sections of the river bank (behind Camp 2, Site 5c) surveyed at night were probably ephemeral creeks, as they were water-logged and quite swampy. Diurnal surveys were conducted inland, along ridges and upstream along the Vuniqesa Stream (Sites 6 and 7).

Survey methods

Opportunistic diurnal and standardized nocturnal visual encounter survey methods were used to assess the biodiversity of the herpetofauna and ensuing threats in the survey sites.

Skinks are more likely to be seen during day, particularly during hot and sunny conditions. Diurnal surveys were thus conducted along trails enroute to Camps 1 and 2, along stream edges, and in forest habitats surveyed by other survey teams in the expedition: vegetation and flora survey sites, mammal (native and invasive) survey sites, and freshwater fauna survey sites (Map 3). The surveys began at 08:00 and ended at 17:00 each day from the 19th – 22nd; 26th and 27th of November, 2008. The team had a minimum of two searchers at any one time.

Frogs and geckoes are active and more visible at night. Standardized 2-hour nocturnal surveys with a minimum of three observers at any one time were

conducted along the two major streams (Nabiya Stream and Vuniqesa Stream – two surveys) and their tributaries (Toluwalu Stream and a dried up tributary - two surveys) over four nights: 19th – 20th; 22nd – 23rd November, 2008 (Map 3). The standardized surveys usually commenced at around 20:00, ending two hours later. Captured ground and tree frogs were given a frog number (NT#) and toe-clipped. The toe-clips were stored in ethanol vials for future DNA analysis.

Environmental variables such as air temperature (°C), water temperature (°C), weather conditions (rain) and cloud cover (%) were taken at the beginning and end of each survey. Habitat characteristics and other basic ecological and biological information of herpetofauna found were recorded. Observations on possible threats

to herpetofauna species and populations were also noted.

RESULTS

Environmental Variables

Weather conditions were fine with occasional showers and heavy downpour during the last three days of the expedition. Average air and water temperatures recorded for the nocturnal surveys were both 22.5 °C.

Species Diversity and Abundance

General herpetofauna

Eleven species were observed throughout the survey

Table 2.1: List of herpetofauna species observed in the Nakauvadra Range from 18 – 27th November, 2008.

Latin Name	Common Name	Fijian Name	Status
Frogs			
<i>Bufo marinus</i>	Cane toad	Boto ni valagi, Boto karokaro	Introduced and invasive
<i>Platymantis vitianus</i>	Fiji ground frog * ^a	Boto ni Viti, Dreli	Endemic
<i>Platymantis vitiensis</i>	Fiji tree frog * ^a	Ula	Endemic
Reptiles			
<i>Emoia concolor</i>	Fiji green tree skink	Mokosari	Endemic
<i>Emoia cyanura</i>	Brown-tailed copper-striped skink	Mokosari	Native
<i>Emoia impar</i>	Blue-tailed copper-tailed skink	Mokosari	Native
<i>Emoia parkeri</i>	Fiji copper headed skink ^a	Mokosari	Endemic
<i>Gehyra vorax</i>	Giant forest gecko	Moko kabi, Boliti	Native
<i>Gehyra oceanica</i>	Oceanic gecko	Moko kabi	Native
<i>Lepidodactylus lugubris</i>	Mourning gecko	Moko kabi	Introduced and invasive
<i>Nactus pelagicus</i>	Skink-toed gecko		Native

* Denotes species listed as threatened under IUCN (2006)

^a Denotes species listed as endangered under Fiji's list of 50 endangered species (2008) (NatureFiji- MareqetiViti, www.naturefiji.org).

(Table 2.1), including two frogs, one toad, four skinks, and four geckoes (captured and identified). Two shed snake skins (possibly *Candoia bibroni*) were also observed.

Four of these are endemic to Fiji: Fiji ground frog (*Platymantis vitianus*), Fiji tree frog (*P. vitiensis*), Fiji copper headed skink (*Emoia parkeri*) and the Fiji green tree skink (*E. concolor*); five are native: Blue-tailed copper-striped skink (*E. impar*), Brown-tailed copper-striped skink (*E. cyanura*), Giant forest

gecko (*Gehyra vorax*), Oceanic gecko (*G. oceanica*) and Skink-toed gecko (*Nactus pelagicus*); and two are introduced and invasive species: Cane toad (*Bufo marinus*) and Mourning gecko (*Lepidodactylus lugubris*).

Herpetofauna species were present at all the sites (Table 2.2). Almost all species were found at both major river systems: Volivoli and Vuniqesa, except for the introduced gecko *L. lugubris* which was only found on Wainibe Stream, about 20 minutes from

Table 2.2: List of herpetofauna species observed in the Nakauvadra Range, Fiji, from 18 – 27th November, 2008.

Species	Site								Total	
	1	2	3	3	4	5	6	7		8
	Track 1: Vatukaceveva to Base Camp 1	Va'ava'a Ridge	Volivoli/ Nabiya/ Toluwalu	Nabiya	Wainibe	Vuniqesa	Track 2: Base camp 2 to Narara	Track 3: Base camp 2 to Upstream Vuniqesa	Uluisuvani	
<i>B. marinus</i>			3	1		2				6
<i>E. concolor</i>	2		1	1					1	5
<i>E. cyanura/ E. impar</i>	2									2
<i>E. impar</i>						12				12
<i>E. parkeri</i>			1	2						3
<i>G. oceanica</i>						2				2
<i>G. vorax</i>			1	1						2
<i>N. pelagicus</i>			2			1		1		4
<i>L. lugubris</i>					1					1
<i>P. vitianus</i>			9	6		3				18
<i>P. vitiensis</i>			2	1		5	2			10
Total	4	2	18	11	1	25	2	1	1	65

Vunisea Village. The lizards *E. cyanura*, *E. parkeri* and *G. vorax* were only found around Volivoli but not at Vuniqesa; *E. impar* and *G. oceanica* were only found around Vuniqesa but not at Volivoli.

Despite having an equal number of standard survey nights, more frogs were found around Volivoli Stream (Sites 3b and 3d) than around Vuniqesa Stream (Sites 5a and 5c). There were more *P. vitianus*

found around Volivoli Creek (Nabiya Stream and Toluwalu Stream); but more *P. vitiensis* encountered around Vuniqesa Stream, particularly along the ridges, during the day.

ANNOTATED LIST OF HERPETOFAUNA SPECIES

Frogs

Eighteen *P. vitianus* and three *P. vitiensis* were observed during the standard 2-hour surveys. Five out of the ten *P. vitiensis* captured during the diurnal surveys were not measured.

Snout-vent lengths (SVL) for the twenty three *P. vitianus* and *P. vitiensis* measured were variable, ranging from 26.8 - 76.9 mm and 18.7 - 33.7 mm,

respectively (Appendix 4). Frog weights ranged from 2 - 41.9 g for *P. vitianus* and from <0.5 - 2.5 g for *P. vitiensis*. One gravid female *P. vitianus* was captured (NT# 22).

All three species of anurans (Plate 5a-c) were only active at night, with occasional encounters of tree frogs (*P. vitiensis*) and cane toads (*B. marinus*) during the day. The ground frogs, *P. vitianus*, were observed on all four of the survey nights (Table 2.2); tree frogs and cane toads were observed on only two of these

Table 2.3. Number of individuals observed or captured for each species at different times of the day in the Nakauvadra Range, Fiji.

Species	7am - 9am	10am - 12pm	1pm - 3pm	7pm - 9pm	9pm - 11pm	Total
<i>B. marinus</i>		1	1	2	2	6
<i>E. concolor</i>	3	1	1			5
<i>E. cyanura/E. impar</i>	2					2
<i>E. impar</i>		11	1			12
<i>E. parkeri</i>		2	1			3
<i>G. oceanica</i>				2		2
<i>G. vorax</i>	1	1				2
<i>L. lugubris</i>						1
<i>N. pelagicus</i>		1		3		4
<i>P. vitianus</i>				16	2	18
<i>P. vitiensis</i>		5	2	3		10
Total	7	22	6	26	4	65

nights.

The ground frogs (*P. vitianus*) and *B. marinus* were only observed within and along the stream banks and their tributaries whilst *P. vitiensis* were found both along streams and further inland along the ridges.

Platymantis vitianus. The first captured *P. vitianus* was found after it responded to calls by the observer (whistle) over a period of five minutes on the first night of survey. Hereafter this method, in addition to looking for eyeshine in frogs, was used. The (small) calling *P. vitianus* were found on tree roots or sapling branches with dense vegetation cover whilst the larger *P. vitianus* found via eyeshine were sitting on rocks and boulders along the stream bank.

Calls of the *P. vitianus* were heard every night,

particularly along the dry sections of the stream bed and further inland from the stream where the sound of the water flow could not drown out the calls.

Platymantis vitiensis. There were no *P. vitiensis* calls heard during the surveys. Fiji tree frogs (*P. vitiensis*) encountered during the day were captured from their diurnal retreats (in leaf axils of epiphytes: climbing pandanus [*Freycinetia* sp.]; birds nest ferns and orchids). Individuals captured at night were usually found on the leaves of epiphytes and tree saplings.

Bufo marinus. Cane toads (*B. marinus*) encountered during the day was also found in their diurnal retreats: beneath boulders along the river

banks. There was a notably low encounter of adult cane toads; however, several pools along the major streams were laden with strings of eggs and tadpoles.

Reptiles

Skinks. Skink encounter rates were quite low (Table 2.2), and were only observed during the day, particularly between 10am and 12pm (Table 2.3). Ground skinks *E. cyanura* and *E. impar* (Plate 6) were mainly found foraging on the ground, on boulders, and fallen tree branches. The high number of *E. impar* observed at Site 5b was simply due to a change in the search effort, when the observer opted to sit along the stream bank for two hours. It was only then that this species could be observed in relatively higher abundance (11 individuals).

The arboreal skinks, *E. parkeri* (Plate 7) and *E. concolor* were mainly encountered from 0.2-15 m above the ground on tree trunks, and branches after sitting in ideal skink habitat within forested areas for more than 20 minutes.

Geckoes. The Giant forest gecko (*G. vorax* – Plate 8) and the introduced and invasive *L. lugubris* were encountered during the day, at Site 3c and Site 4 (near Vunisea Village) respectively. They were both found beneath tree bark whilst *G. oceanica* and *N. pelagicus* were found on bedrock along the stream bank at night. A *G. vorax* was found within Camp 1 on the first day of survey.

DISCUSSION

All the herpetofauna species found in this expedition are new records for the Nakauvadra Range, and have been recorded from sites of similar altitude within Viti Levu (e.g., Wabu Forest Reserve, Monasavu).

Both Volivoli and Vuniqesa Streams, and their surrounding habitats appear to support a healthy herpetofauna population, and possibly more species than encountered during this survey.

The relatively low encounter rates of herpetofauna observed in this survey is, as the results suggest, a reflection of the search method used. Two alternative methods of diurnal surveys were used:

1. Sitting and observing at one site over a certain period of time; and
2. Conducting opportunistic surveys and accompanying other taxa survey teams.

The former method produced a higher abundance of one species only (*E. impar*) but low diversity whilst the latter produced a higher diversity of species, but low abundance. A combination of these two methods in future surveys would undoubtedly provide a more realistic indication of the diversity and abundance of herpetofauna in the Nakauvadra Range.

Interesting Species or Genera

Fiji Ground Frogs (*P. vitianus*)

The discovery of the endemic ground frog, *P. vitianus*, [listed as Endangered (EN) under IUCN criteria (IUCN 2006)] during this survey is the first record on Viti Levu in over 20 years. Naturalists working in Fiji over the past 20 years had widely accepted that two species: the Fiji ground frog (*P. vitianus*) and the megabotoniviti (*P. megabotoniviti*) had been consumed to extinction by the introduced mongoose (*Herpestes javanicus*) and humans on Vanua Levu and Viti Levu (Watling and Pernetta 1979, Ryan 2000, Morley et al. 2004, Morrison et al. 2004, Morrison 2005).

Local herpetologists have in the past five years searched for surviving populations of the ground frogs in likely frog habitats on both Vanua Levu and Viti Levu. Whilst surveys on Vanua Levu had proved successful with discoveries of ground frog populations (Morrison et al. 2004), the Viti Levu surveys into the Savura, Sovi Basin, Wabu and Tomaniivi Forest reserves suggested that these frogs had indeed perished on Viti Levu (Morrison 2003a, 2003b, 2003c, 2004, 2006, Thomas 2006).

The discovery of this species in the Nakauvadra Range, and its absence from other less disturbed sites previously surveyed within Viti Levu (e.g., Wabu Forest Reserve, Sovi Basin), suggests that in addition to being able to co-exist with cane toads, mongoose and tree frogs, *P. vitianus* can also survive in habitats that have been historically modified or significantly impacted by humans (mainly early Fiji settlers). Another contributing factor that could be further investigated is the vegetation and flora of the Nakauvadra Range in comparison other current Fiji ground frog sites in Fiji.

The behaviour of the ground frogs in the Nakauvadra Range is similar to that of the ground frogs on Viwa Island (Tailevu), Gau Island and Taveuni Island, in being slightly more naïve and easier to capture than the ground frogs on Vanua Levu. The ground frogs on Vanua Levu (Waisali

Forest Reserve) are evasive and cryptic; usually jumping away as soon as they have been spotlighted.

The village guides also informed the team that they do not differentiate between ground frogs and tree frogs, using the general term *ula*. The word *ula* means 'to jump' in the dialect of the villages around the Nakauvadra Range. Other villages within the province of Naitasiri also use this name.

More research will need to be done within the Nakauvadra Range and in other parts of Viti Levu to determine why this species persists in the area. It would be interesting to follow the forest systems to which Nakauvadra is/ was connected to; previous records of Fiji ground frogs within Viti Levu have been made from Naitasiri (1862) and Namosi (1898) (Graeffe 1986, de Marzan 1987).

Fiji Tree Frog (*P. vitiensis*)

The Fiji tree frog is known to only occur on Ovalau, Viti Levu and Vanua Levu in Fiji (Osborne 2007). Its macro- and microhabitat distribution within the Nakauvadra Range is similar to its distribution in other parts of Fiji (e.g., Wabu Forest Reserve, Sovi Basin, Savura Forest Reserve) where they are usually found along streams, and further inland along ridges. The Nakauvadra Range and certain parts of Ovalau and Vanua Levu are the only sites in which tree frogs and ground frogs co-exist. A comparison of sites on Vanua Levu, Ovalau and Viti Levu may reveal the interactions between these two species.

Endemic Skinks (*E. concolor* and *E. parkeri*)

The presence of the two arboreal endemic skinks, *E. concolor* and *E. parkeri* is encouraging. The main difficulty faced when searching for these two skinks was their distance from the ground – two specimens were observed up to 15 m above the ground, in a tree. Their arboreal nature and the dense epiphytes on the trees often made it difficult to identify them. Identification was only possible when using a pair of binoculars. Using sticky board traps in trees may help with their capture in future surveys.

Cane toads (*B. marinus*)

The cane toad (*B. marinus*) is listed in the Invasive Species Specialist Group's (2004) list of 100 of the world's worst invasive species (Lowe et al. 2004). Few adults were encountered during the survey however, some stagnant pools were filled with numerous tadpoles and strings of cane toad eggs. The cane

toads may not be a direct threat to the herpetofauna populations in Nakauvadra, however, it would be interesting to study their interactions with the ground frogs and compare with the ground frog-cane toad interactions on Viwa Island (Tailevu, Thomas 2007).

CONCLUSIONS AND RECOMMENDATIONS

Identified threats to herpetofauna in the Nakauvadra Range

Several threats were identified during the survey:

1. Destruction of both the tree and ground frog breeding habitats by feral pigs and horses brought in by pig hunters.
2. The presence of the introduced mongoose *Herpestes fuscus* (Plate 9) and rats pose a potential threat. There is no evidence as yet on the direct impacts of the mongoose and rats on herpetofauna populations in the Nakauvadra Range; and the rediscovery of the ground frog questions the previously hypothesized negative impacts of mongoose on the frogs. A more detailed survey is needed to address this issue.
3. Ground frogs have been consumed by Fijians in the past. There is a possibility this is still the case; a traditional knowledge interview with pig hunters from the surrounding villages could confirm this.

General recommendations

1. There is a need for more specialized research on the herpetofauna of the Nakauvadra Range; particularly to study their ecological role within the Nakauvadra Range and how this compares with populations in other parts of Fiji.
2. Improve/increase field survey methods and effort. In particular for frog surveys:
 - a. Establish several long term monitoring plots or transects to survey the different species, both along the stream banks and inland.
 - b. Find out range of frog distribution along the stream:

- i. Distance from villages;
- ii. Distance along head waters of the streams;
- iii. Perpendicular distance from the stream bank to determine the range of overlap between the three species;
- c. Interview nearby villages to find out if frogs have any significant traditional roles; or if there are any folklore that mentions frogs.
- d. Record and document frog calls; find out if females also call as reported in the frogs on Viwa Island (Tailevu) and Taveuni (Kuruyawa et al. 2004).
- e. Find out where females ground frogs are laying their eggs.
- f. Document the phenology of frogs in the Nakauvadra Range and compare with other sites in Fiji.
- g. Collect DNA tissue and compare with other sites in Fiji.

For reptile surveys:

- h. As above (a-c, e-g).
 - i. Surveys to be conducted in areas undisturbed by survey teams of other taxa. Skinks can be quite evasive, scrambling away to hide under leaf litter or boulders and rocks at the slightest disturbance.
 - j. The Giant forest gecko (*G. vorax*) is more likely to be found under the bark of live trees rather than dead trees and therefore future surveys should place more emphasis on live trees.
 - k. Binoculars and sticky board traps should be used for surveying arboreal skinks (and snakes).
3. Awareness of the importance of the Nakauvadra Range as a refuge for the Fiji ground frog (*P. vitianus*) will also need to be carried out to local pig hunters and villagers who frequent the Nakauvadra forest.

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