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Chapter 2

Herpetofauna of the Nakorotubu Range, Ra and Tailevu Provinces, Viti Levu, Fiji.

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SUMMARY

A total of ten frog and reptile species were documented from the Nakorotubu Range, Ra and Tailevu Provinces, Fiji representing approximately 24% of Fiji's 33 presently known terrestrial herpetofauna. This included one frog species, one toad, five skinks, two geckoes and one snake. All species were observed in relatively low abundances.

Three of the species are endemic to Fiji (*Platymantis vitiensis*, *Emoia concolor* and *E. parkeri*). With the exception of the introduced cane toad (Bufo marinus), all remaining species are native to Fiji and the Pacific.

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

INTRODUCTION

Fiji is home to 33 species of terrestrial herpetofauna: three frogs (two endemic species), four iguanas (two endemic species), four snakes (two endemic species), 10 geckoes (two endemic species) and 10 skinks (six endemic species) (Morrison 2003, Watling et al. 2010). Over forty percent of these are endemic, with possibly more (new) endemic species to be described in 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; Thomas 2008; Watling 2010). To date, no specific herpetofauna surveys have been conducted in the Nakorotubu Range and consequently, its herpetofauna diversity is poorly known.

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

METHODS AND SITE DESCRIPTIONS

Site descriptions

Base Camp 1: Olou, Nabavatu Stream, Ridge (Map 2, Appendix 4)

The section of Wailoa stream known to the people of Matuku as Olou (between Matuku Village and Rest Spot 1 on Map 2; Plate 5) was at least 20 m in width with large boulders both within the stream and along the stream bank. Riparian vegetation was severely disturbed with intermittent agricultural areas and patches of bamboo. Cattle hoof prints were obvious along

the trail.

Nabavatu Stream (between night transect 2 [T2] and sticky trap transect 1 [ST1] in Map 3) was on average 10 m in width, with big boulders within the stream and on stream banks. Riparian vegetation was again severely disturbed with cattle hoof prints obvious along the river bank and along the trails.

The slope extending from T2 to day transect 1 (DT1), though densely vegetated by trees with high canopy cover, was quite disturbed with obvious feral cattle and feral pig presence. Undergrowth was sparse particularly in areas with cattle hoof prints.

Despite the obvious disturbance, the trees and stream vegetation displayed good frog, gecko and skink habitats.

Base Camp 2: Matuku Village, Look out, Base camp 2, Montane forest. (Map 3, Appendix 4)

The track from Matuku Village to the look-out point enroute to Base camp 2 was dominated by agricultural land and cattle pasture land. Streams around Base camp 2 were slow flowing with dense vegetation cover. Stream widths were relatively similar, averaging 2 m. Stream vegetation was relatively undisturbed being dominated by pandanus and native riparian plants. The most disturbed part of the forest surrounding Base camp 2 was the main track. Epiphyte cover on trees was high. There were no signs of feral cattle presence. The area displayed ideal habitats for native tree skinks, geckoes and frogs.

Base Camp 3: (Map 4, Appendix 4)

Base camp 3 was located within an abandoned cattle pasture field and banana plantation. The stream and riparian vegetation were relatively disturbed and open with intermittent stands of native riparian plants such as Pandanus and *Inocarpus fagifer*. Stream width averaged at 10 m, with rare encounters of riffles and pools. Stream vegetation displayed ideal habitats for Fiji's native frogs, geckoes and skinks in some places.

Survey methods

Opportunistic diurnal surveys (OS), standardized diurnal visual encounter surveys with a pair of binoculars (DT), standardized nocturnal visual encounter surveys (T) and sticky traps (ST) methods were used to assess herpetofauna biodiversity and potential threats in the survey sites.

Skinks are more likely to be seen during day, particularly during hot and sunny conditions. Diurnal transect surveys were thus conducted along trails enroute to Camps 1, 2 and along stream edges – particularly amongst boulders and exposed trees, and in forest habitats surveyed by other survey teams in the expedition: vegetation and flora survey sites and freshwater fauna survey sites (1_DT1 in Map 2; 2_DT1, 2, 3 in Map 3; 3_DT1, 2, 3 in Map 4). The opportunistic diurnal surveys (OST) began at 08:00 and ended at 17:00 each day from the 30th November – 03rd December and 05th – 10th December, 2009. 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 (T) with a minimum of two observers at any one time were conducted along the major streams: Nabavatu Stream and its tributaries (1_T1, 1_T2 in Map 2), at Base camp 2 (2_T1 and 2_T2 in Map 3); and along the riparian vegetation along the Wailotua Creek at Base camp 3 (3_T1 and 3_T2 in Map 4). These were conducted over five nights (Appendix 5). The standardized surveys usually commenced at around 20:00, ending two hours later. Captured ground and tree frogs were given a frog number (M #) and toe-clipped. The toe-clips were stored in ethanol vials for future DNA analysis.

Surveys using sticky traps to capture skinks and geckoes were also conducted at ideal locations around Base camp 1 (1_ST1 in Map 2), Base camp 2 (2_ST1 in Map 3), and Base camp 3 (3_ST1 in Map 4). The traps were left out for 2 hours during hot days; or in shady areas overnight (Table 1) and collected early the next morning.

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. Moon phase was also recorded for nocturnal surveys. Habitat characteristics and other basic ecological and biological information of herpetofauna found were recorded. Observations on possible threats to herpetofauna species and populations were noted.

RESULTS

Environmental Variables

Weather during the expedition was predominantly cloudy with light drizzles with only two days of strong sunshine. Average air and water temperature were 23°C and 22°C respectively.

Species Diversity and Abundance

General herpetofauna

Nine species were observed encountered the survey (Table 2.1), including one frog, one toad, three skinks, and two geckoes (captured and identified). The eggs of one unconfirmed species of skink were encountered – it would most likely have been the eggs of the endemic *Cryptoblepharus eximus*.

Three of the nine species observed are endemic to Fiji: Fiji tree frog (*Platymantis 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*), Skink-toed gecko (*Nactus pelagicus*) and Pacific boa (*Candoia bibroni*); and one introduced and invasive species: Cane toad (*Bufo marinus*).

Table 2.1: List of herpetofauna species observed or reported in the Nakorotubu Range from 30th November – 10th December, 2009.

Latin Name	Common Name	Fijian name	Status
Frogs			
Bufo marinus	Cane toad	Boto ni valagi, Boto karokaro	Introduced and invasive
Platymantis vitiensis	Fiji tree frog*[a]	Ula	Endemic
Reptiles			
Candoia bibroni	Pacific Boa	Gata, Balei	Native
Cryptoblepharus eximus	Pygmy snake-eyed skink		Endemic
Emoia concolor	Fiji green tree skink	Mokosari	Endemic
Emoia cyanura	Brown-tailed copper-striped skink	Mokosari	Native
Emoia impar	Blue-tailed copper-striped skink	Mokosari	Native
Emoia parkeri	Fiji copper headed skink a	Mokosari	Endemic
Gehyra vorax	Giant forest gecko	Moko kabi, Boliti	Native
Nactus pelagicus	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).

Herpetofauna species were present at all three camp sites (Table 2.2), but representation of species at each camp site differed. Base camp 1 yielded the highest species diversity (8 species): only four species were encountered at Base camps 2 and 3. Abundance of each species was low at each site. The Fiji tree frog *P. vitiensis* was the most commonly encountered species (24 individuals) followed by *E. cyanura* (6) and *B. marinus* (6).

Table 2.2: Number of individuals encountered at each site in the Nakauvadra Range. 1 = Base camp 1; 2 = Base camp 2; 3 = Base camp 3. T = Nocturnal transect; DT = Diurnal transect; OS = Opportunistic survey.

Latin Name	Common Name					Fijian name						Status				
	1_T1	1_T2	1_DT1	1_DT2	1_ST1	2_OS1	2_T1	2_DT1	2_DT2	2_DT3	2_DT4	3_T1	3_DT1	3_T2	3_ST1	TOTAL
B. marinus				1								5				6
C. bibroni									1							1
C. eximus			1													1
E. concolor			1	1					1		1					4
E. cyanura					5										1	6
E. impar															1	1
E. parkeri			1								1					2
G. vorax				1												1
N. pelagicus	1															1
P. vitiensis	1	8	2			5					1	6	1			24
Total	**2**	**8**	**5**	**3**	**5**	**5**	**0**	**0**	**2**	**0**	**3**	**11**	**1**	**0**	**2**	**41**

Frogs

Fifteen of the twenty four *P. vitiensis* encountered were captured during the standard 2-hour surveys. The remaining nine were captured during opportunistic diurnal surveys and diurnal standard transect surveys. Frog eggs were encountered only once during Base camp site 3's opportunistic survey (3_OS1 in Map 4).

All twenty four frogs were measured. Snout-vent lengths (SVL) and weights of the twenty four *P. vitiensis* measured were variable, ranging from 21.8-49 mm and 0.5-13 g. (Appendix 5).

Cane toads were encountered on both nocturnal and diurnal surveys, but not in high numbers.

Platymantis vitiensis

The low calls of *P. vitiensis* were heard during the surveys. Frogs encountered during the day were captured from their diurnal retreats [in axils of climbing pandanus (*Freycinetia* sp.); and Pandanus trees]. Individuals captured at night were usually found on the leaves of tree saplings. All individuals captured were encountered less than 5 mm from the stream edge. The highest abundance of frogs in a given time (2_OS1 in Table 2.2) was encountered in a field of Pandanus trees in a swampy area during an opportunistic survey with the vegetation team.

Bufo marinus

Cane toads (*B. marinus*) encountered during the day were also found in their diurnal retreats. There was a notably low encounter of adult cane toads, and no tadpoles observed.

Reptiles

Skinks

Skink encounter rates were quite low (Table 2.2), and were only observed during the day. Ground skinks E. cyanura (Plate 6) and *E. impar* were mainly found foraging on the ground and on boulders. The high number of skinks observed in base camps 1 (5 individuals) and 2 (2 individuals) were due to the use of sticky traps (ST in Table 2.2). 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 during opportunistic surveys (OS) and diurnal transects (DT) on the two days of good sunshine.

Geckoes

The Giant Forest Gecko (*G. vorax*) was encountered after clearing of vegetation for Base camp 1 while *N. pelagicus* was found during a nocturnal survey (1_T1 in Table 2.2) along a stream.

Snakes

The Pacific Boa *C. bibroni* was encountered by the vegetation survey team along a trail, in a tree at more than 20 m height.

DISCUSSION

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

Only two of the three sites (Base camps 1 and 2) appear to generally support a healthy population of native herpetofauna; however, all three sites appear to support healthy populations of the endemic Fiji tree frog. The frogs were even found in agricultural areas which could be attributed to the fact that they had intact native riparian vegetation at the edge of the plantations.

Based on lessons learnt from a previous similar survey (Thomas 2008), several herpetofauna search methods were employed in this survey. All four methods of survey (diurnal opportunistic surveys, diurnal transect surveys with a pair of binoculars, nocturnal transect surveys and sticky trap surveys) contributed to the encounter rate of herpetofauna at all sites.

The ground skinks (*E. cyanura* and *E. impar*) are usually evasive animals and were only encountered due to the use of the sticky traps. No other species of skinks, geckoes or frogs were captured by the sticky traps, and these have proven to be an effective method for surveying for the usually evasive ground skinks.

The tree skinks (*E. concolor* and *E. parkeri*) on the other hand remain elusive and were only observed at a distance through a good pair of binoculars on a good sunny day. Additional targeted diurnal transect surveys to the usual opportunistic surveys had to be conducted in the search for these two species. There were possibly more individuals present in the three sites, but they were only observed on days of good sunshine. Sticky traps were also placed on tree trunks during the survey, but the average height at which these species were observed suggests that sticky traps ought to be placed at about 3 m or more above the ground.

Surveying during ideal weather conditions using all four methods of searching for herpetofauna would undoubtedly yield higher abundance and diversity of species in the Nakorotubu range.

Interesting Species or Genera

Pygmy snake-eyed skink *(Cryptoblepharus eximus)*

The probable encounter of the endemic pygmy snake-eyed skink is significant. This endemic species was thought to be a predominantly lowland coastal species until it was recorded from Marou Settlement (Tikina Savatu, Ba) in the interior of Viti Levu (Thomas 2004). Previous inland records of this species on Viti Levu have only been recorded once – in the upper Sigatoka catchment (Morrison 2003). The occurrence of this species in Nakorotubu Range is only the third record of its inland occurrence on Viti Levu. The discovery of its eggs beneath a large boulder along the stream bank is the first record of its eggs deposition site (Plate 8).

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 Nakorotubu Range is similar to its distribution in other parts of Fiji (e.g., Wabu Forest Reserve, Sovi Basin, Savura Forest Reserve, Nakauvadra Range) where they are usually found along streams. It was interesting to note that despite the high occurrence of the climbing pandanus within the ridges at 1_DT1, no frogs were encountered. The presence of feral cattle in forest at 1_DT1 poses a threat to the persistence of the Fiji tree frog and other herpetofauna as the cows are good dispersers of invasive and weedy plants (Plates 9 and 10).

The geographic position of the Nakorotubu Range suggests that the recently rediscovered population of the endangered sister species of the tree frog – the Fiji ground frog (*P. vitianus*) (Thomas, 2008), should also occur here. The Nakorotubu Range lies between the Nakauvadra range, Viwa Island and Ovalau Island – all of which have the Fiji ground frog. The absence of the Fiji ground from the Nakorotubu Range is indeed interesting.

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. Closely observed individuals (2 m above the ground) were only observed in relatively disturbed sites.

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. It was encouraging to note that there were no tadpoles found. The cane toads may not be a direct threat to the herpetofauna populations in the Nakorotubu range. The absence of tadpoles in likely egg deposition sites in Base camp sites 1 and 3 are notable, and should be compared against the freshwater fauna data.

CONCLUSIONS AND CONSERVATION RECOMMENDATIONS

Identified threats to herpetofauna in the Nakorotubu Range

Several threats were identified during the survey:

1. The presence and seemingly high abundance of feral cattle in the forest at Base camp 1 and their apparent preference of the ridge top trails poses a potential threat to frog breeding sites and to tree and ground skinks and geckoes. The effect of cattle trampling on the ridge tops is already showing in the presence of invasive and weedy plants in along the ridges and the landslides and state of the tributaries of Nabavatu stream (Plate 11). The feral cattle, if they persist, could have a significant negative impact on the herpetofauna population at the forest around Base camp 1.

2. The presence of the introduced mongoose *Herpestes fuscus* 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 Nakorotubu range. A more detailed survey is needed to document this relationship.

General recommendations

1. The herpetofauna of the Nakorotubu range is a relatively unknown group. A study of the tree skink diversity will be interesting because of the varying levels of disturbance and types of habitat at the site. The Nakorotubu Range has potential to support rare endemic species such as *E. campbelli* and new undiscovered species.
2. Any detailed surveys in the future should employ all three methods of survey used in this survey and also conduct the following:
   a. Document the phenology of frogs in the Nakorotubu Range and compare with other sites in Fiji.
   b. Collect DNA tissue and compare with other sites in Fiji.

   For reptile surveys:
   c. As above (a-b).
   d. Continue the use of sticky traps. The ground skinks were only captured through the use of the sticky traps.
   e. 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.
2. The absence of the Fiji ground frog from the Nakorotubu Range is interesting. Future herpetofauna surveys should extend to parts of the Nakorotubu Range closest to the Nakauvadra range (North-western portion of the Nakorotubu Range) and Viwa Island and Ovalau Island (South-eastern portion of the Nakorotubu Range) to confirm if the Fiji ground is indeed absent.
3. Awareness on the impact of feral cattle should also be conducted. The feral cattle and their easy access to streams not only pose threats to the herpetofauna, but also to the quality of water sources of Matuku Village.

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