

# Importance of Waisali Reserve, Vanua Levu for herpetofauna conservation in Fiji

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## ABSTRACT

A two day herpetofauna survey of Waisali Reserve was conducted between 4-6<sup>th</sup> March, 2004. The survey consisted of timed active diurnal surveys for lizards and nocturnal surveys for frogs. Seven herpetofauna species were found during the survey including four endemic species. The most significant find was the confirmation of a population of the endangered Fiji ground frog (*Platymantis vitianus*), a species previously thought to be extirpated from mainland Fiji due to the presence of mongoose. The other significant finding was that of *Emoia mokosariniveikau*, only the third location known for this species. Our survey results identify Waisali Reserve as an important site for herpetofauna conservation in Fiji and we propose several management actions to facilitate conservation of herpetofauna in this area.

**Keywords:** herpetofauna, frogs, skinks, lizards, mongoose, Waisali Reserve, conservation, *Platymantis*, *Emoia*

## 1 INTRODUCTION

The known terrestrial herpetofauna of Fiji consists of 30 species: 3 frogs, 2 iguanas, 3 snakes, 10 geckos and 12 skinks. Forty per cent (12/30) of these species are endemic to Fiji (Morrison, 2003). Many of these species have undergone severe population declines or reductions in their geographic ranges due to habitat destruction and introduced predators (e.g. mongoose). Consequently some species (particularly terrestrial species e.g. ground frogs, and skinks) have been extirpated from much of their original range (Watling and Zug, 1998; Morrison, 2003). Despite these dramatic declines there has been very little interest in terrestrial Fijian herpetofauna including their conservation (the Fijian crested iguana *Brachylophus vitiensis* is a notable exception).

In September 2003 a single individual Fiji ground frog (*Platymantis vitianus*) was collected from Waisali Reserve (Naikatini pers comm.). This potentially represented a very significant discovery as this endangered species (listed as Endangered under IUCN 2002 criteria) was thought to have been extirpated from the parts of its range on mainland Fiji (Viti Levu and Vanua Levu) due to the presence of mongoose (Morrison, 2003; Watling pers comm.). Consequently, the first aim of the survey was to confirm the presence of the Fiji ground frog in Waisali Reserve. Additional aims were to (a) determine the herpetofauna species present in the area, (b) identify potential threats to herpetofauna in Waisali Reserve and (c) determine the conservation importance of Waisali Reserve for herpetofauna and to propose management actions to aid conservation of the area.

## 2 METHODS

### 2.1 WAISALI RESERVE

Waisali Reserve is a 120ha reserve on the windward side of Vanua Levu, Fiji (Figure 1). The traditional landowners are the people of the Waisali Mataqali, Waisali Village, Cakaudrove Province, Vanua Levu however, since a lease agreement signed in 1996, the legal custodian of the area is the National Trust of Fiji.

The reserve is a catchment surrounded by steep slopes to the north and east near the summit ridge of the main Vanua Levu mountain range at elevations ranging from 350-650m above sea level. Rainfall in the area is between 3000-5000mm per annum. The small creeks and tributaries in the reserve join to form the Savuqoro stream which is the main stream flowing through the reserve. The Savuqoro stream then joins the Waisali River.

The forest system within the area is typical of a low-mid elevation tropical rainforest. Most forest in the reserve is intact and undisturbed however, disturbance is common along the main Savusavu-Labasa highway on the south and western boundary of the reserve (Figure 1). The forest is dominated by dakua makadre (*Agathis macrophylla*) and dakua salusalu (*Decussocarpus vitiensis*). Several other large timber trees are also common in the area including yaka (*Dacrydium nidulum*), damanu (*Calophyllum sp.*), kaudamu (*Myristica sp.*) and buabua (*Fagraea berteriana*).

### 2.2 SURVEY SITE DESCRIPTION

The Savuqoro stream within the reserve is 2-3km long and surveys were carried out along the lower 1km stretch and associated tributaries starting at the camp site (Figure 1, 16 38°19.8'S, 179 13°19.7'E).

Vegetation along the stream is dominated by tree species including kuluva (*Dillenia biflora*), mimila (*Sauraurai rubicunda*), yasiyasi (*Syzygium sp.*) and mako (*Trichospermum sp.*). Dominant shrubs in the area were lolo (*Ficus vitiense*) and vadra (*Pandanus sp.*). *Angiopteris* and *Cyanthea* ferns were also common along the streams. There were several areas dominated by para-grass (*Barachiara mutica* and *Piper aduncum*), the result of landslides from the road.

### 2.3 SURVEY METHODS

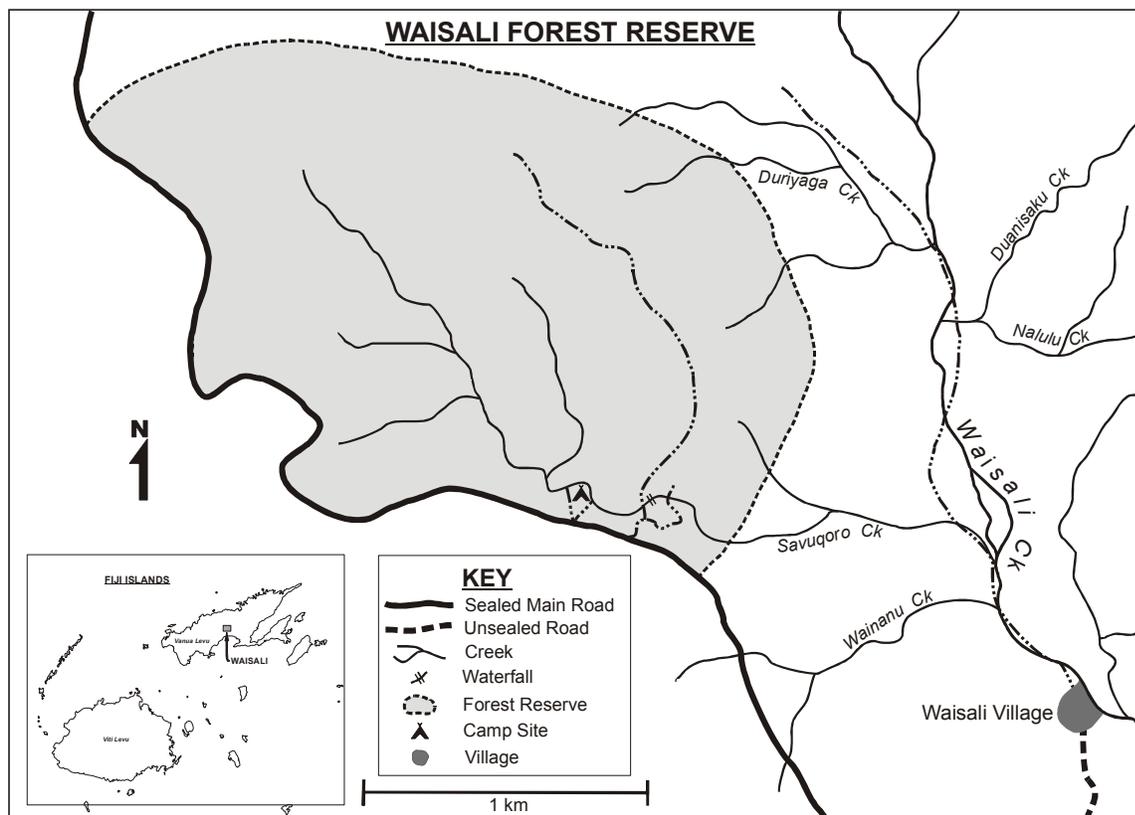
Nocturnal surveys for frogs and geckos were carried out between 2000-2200 on the 4<sup>th</sup> and 5<sup>th</sup> of March, 2004 for a total of 11 person hours. Acoustic surveys and active visual searches in and on plants, between rocks along the stream and on the forest floor were conducted along a 300m section of stream with a 5m buffer on either side.

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**Table 1.** Herpetofauna species found in Waisali Forest Reserve, March 4-6, 2004.

Species	Common name	# individuals	Other
<b>Amphibians</b>			
<i>Platymantis vitianus</i> <sup>*1</sup>	Fiji ground frog	9 caught, 20 heard	Mainly juveniles
<i>P. vitiensis</i> *	Fiji tree frog	>20 caught, >80 heard	Seven clutches found in pandanus, juveniles
<i>Bufo marinus</i>	Cane toad	2 caught	Both adult females
<b>Reptiles</b>			
<i>Emoia concolor</i> *	Fiji green tree skink	2 observed	
<i>E. cyanura</i>	Brown-tailed, copper-striped skink	8 observed	
<i>E. mokosariniveikau</i> *	Fiji forest skink	1 observed	
<i>Nactus pelagicus</i>	Pacific slender-toed gecko	4 caught	

\*denotes endemic species, <sup>1</sup> listed as Endangered under IUCN (2002) criteria.



**Figure 1** Location of Waisali Reserve on Vanua Levu and geographic layout of the reserve.

Several forays were also made into the forest to search the forest floor in relatively flat areas.

Diurnal surveys were restricted to 6 person hours on the 5<sup>th</sup> of March between 0900-1200. Active searches were carried out in forested habitats for skinks (basking in open areas), geckos (under bark and in crevices) and frogs (and eggs, in pandanus and birds nest ferns). Opportunistic surveys were also conducted whilst carrying out surveys of other taxa (plants and fish).

### 3 RESULTS

Seven herpetofauna species were found during the survey (Table 1) including four endemic species - two frogs and two skinks. With the exception of the Fiji tree frog (*Platymantis vitiensis*), the encounter frequency of these species in the area is relatively low when compared to other areas within Fiji.

Waisali is the only site on mainland Fiji (Viti Levu and Vanua Levu) where the Fiji ground frog (*P. vitianus*) has been found and the only known site with all three

amphibian species co-occurring (2 native and 1 introduced). The population density of Fiji tree frogs in Waisali Reserve is one of the largest recorded in Fiji, being far more frequently encountered than both the ground frog and the cane toad (ratio of roughly 15:1 for ground frogs and 30:1 for cane toads). Encounter rates of ground frogs in the area (9 individuals seen, a further 20 heard) is much lower than that on other islands recently surveyed (40-150+, Kuruyawa *et al.* 2004).

Most of the tree frogs found were reproductively active (gravid females, calling males and females, yellow colouration in the groin). All ground frogs found were juveniles, although adults were heard calling. Both cane toads found were adult females.

Seven clutches of Fiji tree frog eggs were also found during the survey. Most of these were found in pandanus plants (5) while the remaining two were found in birds nest ferns (*Asplenium australasicum*). These clutches were at various stages of development ranging from recently laid to hatching. No clutches of the Fiji ground frog nor tadpoles of the cane toad were found.

Four species of lizards were found during the surveys including the endemic widespread Fiji green tree skink (*Emoia concolor*) and the far more restricted Fiji forest skink (*Emoia mokosariniveikau*). The brown-tailed, copper-striped skink (*Emoia cyanura*) and the slender-toed gecko (*Nactus pelagicus*) are common, introduced species found throughout Fiji.

Several individual small Indian mongoose (*Herpestes javanicus*) and bush rats (*Rattus rattus*) were observed in the survey area. Signs of the wild pig (*Sus scrofa*) including tracks, wallow areas and dug up earth were found throughout the area.

## 4 DISCUSSION

### 4.1 SPECIES RICHNESS AND ABUNDANCE

Herpetofauna species richness in Waisali Reserve is relatively high compared to other sites on mainland Fiji however, the encounter rates of species other than Fiji tree frogs are very low (Morrison pers. obs.) This low frequency may be due to predation and habitat disturbance or may be an artifact of survey effort, reflecting the relatively short duration of two days and nights. Surveys of similar duration and using equivalent methods elsewhere in Fiji however, have demonstrated higher encounter rates of herpetofauna (Morrison pers. obs.). The relatively high species richness in Waisali Reserve is encouraging and is likely to be an underestimate of the number of species in the area. As the abundance of herpetofauna in the area is low, it is feasible that we may not have found all species present in Waisali (especially geckos and snakes). Further surveys of a longer duration and covering a larger part of the reserve will be needed to detect additional species and to make reliable estimates of population abundance.

Waisali Reserve is the only known site where all three amphibian species co-exist. Tree frogs are by far the most abundant of the three species with all stages of the life-cycle being represented i.e. reproductively active adults, juveniles, metamorphs and eggs. The scarcity of cane toads probably reflects the steep terrain and the absence of

temporary pools in the forest or near the stream as breeding sites.

The presence of *Emoia mokosariniveikau* is important for Waisali Reserve given that the species is only known from one female specimen found in Saivou on Vanua Levu (Zug and Ineich, 1995) and one other unconfirmed sighting on Viti Levu. The presence of the more widespread *E. concolor* is also an important record for the reserve.

### 4.2 GROUND FROGS

The confirmation of the Fiji ground frog in Waisali Reserve is an important result for the distribution and conservation of this species. The ground frog was once found on the wetter, eastern sides of Viti Levu and Vanua Levu along with Taveuni, Ovalau, Gau and Viwa (Tailevu). After the mongoose was introduced to Fiji, the ground frogs became far more scarce and were eventually thought to be extirpated from mainland Fiji (Morrison, 2003). The discovery of this population not only demonstrates that they can co-exist with mongoose but that the ground frog may persist elsewhere on mainland Fiji

The ground frogs in Waisali were more rarely encountered than on mongoose-free islands (Kuruyawa *et al.* 2004). Ground frogs in Waisali Reserve were however, more evasive and cryptic compared with those in naïve populations that have never been exposed to the mongoose and have limited exposure to other predators. Ground frogs in Waisali are very elusive and tend to jump or swim away when approached within 5-7m. Ground frogs on mongoose-free islands however, rarely flee when approached and tend to remain immobile, pressed down into the soil or leaf litter relying on crypsis to remain undetected thereby allowing easy capture.

### 4.3 THREATS

There are several potential threats to the herpetofauna of Waisali Reserve, the most significant of these being predation by mongoose and rats. Mongoose and rats have been associated with the decimation of herpetofauna in Fiji (Gorman, 1975; Gorman, 1977; Ryan, 2000), whilst rats have been linked to herpetofauna declines in a number of areas in the Pacific including Hawaii (Lever, 1985), Tokelau (Mosby and Wodzicki, 1973), and New Zealand (Crook, 1973; Cree and Butler, 1993).

Feral pigs could also affect ground frogs, which by sheltering during the day on the ground under leaf-litter would be vulnerable to the digging actions of the pigs either through direct mortality or through habitat destruction.

### 4.4 IMPORTANCE OF WAISALI RESERVE FOR HERPETOFAUNA CONSERVATION

Waisali Reserve is an important site in terms of herpetofauna conservation in Fiji for several reasons including;

- 1) A high proportion of endemic species (4/7)
- 2) The only known population of endangered Fiji ground frog on mainland Fiji and potentially the smallest population recorded for Fiji
- 3) One of the largest known populations of Fiji tree frogs
- 4) The only known site with all three amphibian species

- 5) Only the third known location of *Emoia mokosariniveikau* in Fiji

To aid the conservation of the herpetofauna of Waisali Reserve the following management actions are proposed:

- 1) Identify the threats: then control or remove mongoose, rats and pigs where possible and where justified.
- 2) Minimize habitat clearing, logging and any other activities leading to habitat destruction and erosion
- 3) Monitor *P. vitianus* and *Emoia mokosariniveikau* populations throughout the year and between years to determine current population size and temporal variation in abundance
- 4) Conduct further surveys for additional herpetofauna species
- 5) Highlight importance of this site for *P. vitianus* conservation on both a national and regional scale

amphibians. Fiji Biodiversity Strategy and Action Plan, 11pp.

13. Zug, G. R. and Ineich, I. 1995. A new skink (*Emoia*: Lacertilia: Reptilia) from the forests of Fiji. *Proceedings of the Biological Society of Washington* **108**(3), 395-400.

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## REFERENCES

1. Cree, A. and Butler, D. 1993. *Tuatara Recovery Plan. Threatened species recovery plan 9*. Department of Conservation, Wellington.
2. Crook, I. G. 1973. The tuatara, *Sphenodon punctatus* Gray on islands with and without populations of the Polynesian rat *Rattus exulans* (Peale). *Proceedings of the New Zealand Ecological Society* **20**, 115-120.
3. Gorman, M.L. 1975. The diet of feral *Herpestes auropunctatus* (Carnivora: Viverridae) in the Fijian Islands. *Journal of Zoology* (London), **175**, 275-278.
4. Gorman, M. L. 1977. *The mongoose*. Department of Biology, University of Aberdeen, United Kingdom.
5. Kuruyawa, J., Osborne, T., Thomas, N., Rounds, I., Morrison, C. and Morley, C. 2004. Distribution, abundance and conservation status of the Fijian Ground Frog (*Platymantis vitianus*). Unpublished Report for the BP Conservation Program.
6. Lever, C. 1985. *Naturalized mammals of the world*. Longman Inc., New York.
7. Lowe, S. J., Brown, M. and Boudjelas, S. 2000. *100 of the world's most invasive species*. IUCN/SSC Invasive Species Specialist Group (ISSG), Auckland.
8. Morrison, C. 2003. *A field guide to the herpetofauna of Fiji*. Institute of Applied Sciences, University of the South Pacific.
9. Mosby, J. M. and Wodzicki, K, 1973. Food of the Kimoa *Rattus exulans* in the Tokelau Islands and other habitats in the Pacific. *New Zealand Journal of Science* **16**, 809-810.
10. Ryan, P. A. 2000. *Fiji's Natural Heritage*. Exisle Publishing, New Zealand.
11. Watling, D. W. Personal communication. Environmental Consultants Fiji, Suva, Fiji.
12. Watling, D. and Zug, G. R., 1998. Annotated list and conservation status of Fijian terrestrial reptiles and