FIJI FLYING FOX *MIRIMIRI ACRODONTA* SPECIES RECOVERY PLAN

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Table of Contents

List of Tables

List of Figures

ABBREVIATIONS AND ACRONYMS

asl	Above Sea Level
NFMV	NatureFiji-MareqetiViti

1 INTRODUCTION

1.1 BACKGROUND TO THE FIJI FLYING FOX PROJECT

This Species Recovery Plan for the Fiji flying fox *Mirimiri acrodonta* has been prepared by NatureFiji-MareqetiViti as a component of its "Conservation of the Critically Endangered Fiji flying fox *Mirimiri acrodonta* on Taveuni Island, Fiji" project. The project was funded by the Critical Ecosystem Partnership Fund (CEPF) and was undertaken between January 1st 2009 and 31st December 2009. The principal project components were:

- Fieldwork to learn about the status, ecology and behaviour of the Fiji flying fox, and how it may be distinguished in the field from the two other large flying foxes found on Taveuni (*Pteropus tonganus, P.samoensis*) ;
- To undertake a major island-wide awareness programme among Taveuni forest landowners to raise the profile of Taveuni's unique biodiversity using the Fiji flying fox as an iconic flagship species;
- Preparation of a Species Recovery Plan for the Fiji flying fox; and,
- Initiation of a conservation 'Site Support Group' for Taveuni.

The project was identified and undertaken as a component of NFMV's 2007-2112 Strategic Plan – Programme 4: Extinction risk reduced for Fiji's priority threatened species.

1.2 PROJECT METHODS & PERSONNEL

The project was managed by Nunia Thomas, NFMV Conservation Coordinator and directed by Dick Watling NFMV Trustee-Director.

Fieldwork on the Fiji flying fox was undertaken by Ms Annette Scanlon (Ph.D. student from the University of South Australia) and Guy Botroff. Four surveys for the Fiji flying fox were conducted during April, May-June, August, and November 2009 on Des Voeux Peak, Taveuni – the only area for which this species is recorded. The four surveys consisted of 7-10 trap nights using 3-8 mist nets, set at varying altitudes in forest and flyway areas. A total of 35 trap nights and 68,265 mist net hours were completed at and around the summit, (Scanlon 2009). Waisale Mataitoga coordinated the Taveuni landowner awareness programme in conjunction with with the Cakaudrove Provincial Office in Taveuni. Two rounds of open forums were conducted on Taveuni at the district level (3 venues) for traditional villages and at 4 venues for non-traditional settlements. Nine government departments and three non-governmental organisations participated in the awareness campaign (Thomas 2009).

2 FIJI FLYING FOX

2.1 COLLECTION AND SURVEY INFORMATION - 1977 TO 2008

The species was first described by Hill and Beckon in 1978, the holotype collected 300 m north east of Des Voeux Peak radio tower (the TFL station and access track to Des Voeux Peak were constructed in 1977). Just two individuals were trapped and collected during May and November 1977 (and subsequently deposited at the British Museum, Hill and Beckon 1978). The species was not encountered again until an Australian Museum expedition in 1990-91 (headed by P. German). During May 1990, after 12 days with 10 mist nets in the Des Voeux Peak region, three more individuals were captured and deposited in the Australian Museum (Flannery 1995; Scanlon 2009). A bat survey in Fiji in 2000-01 did not cover high altitude forest areas of Taveuni because of time constraints, poor weather conditions, and vehicle problems and so did not attempt to locate this species in its known habitat (Palmeirim *et al*. 2005).

Incidental observations of what were believed to be *Mirimiri acrodonta* were made by Linda Farley and Jorg Kretzchmar at c.850 m asl on the Des Voeux peak road in November 2002 (*in litt.* to Dick Watling).

2.2 SURVEY INFORMATION - 2009

The most thorough survey to date for the Fiji flying fox was undertaken in 2009 by Annette Scanlon with Guy Bottroff for NFMV (Scanlon 2009).

A total of 35 trap nights and 68,265 mist net hours was completed at Des Voeux Peak in 2009. Bats were captured with nylon mist nets set in flight paths and in the sub canopy. A single female *M. acrodonta* was captured on 31 May in a sub-canopy net at 5:30 am at 815 m asl. Detailed mensural and other information was gathered from this bat and a transponder implanted before it was released unharmed.

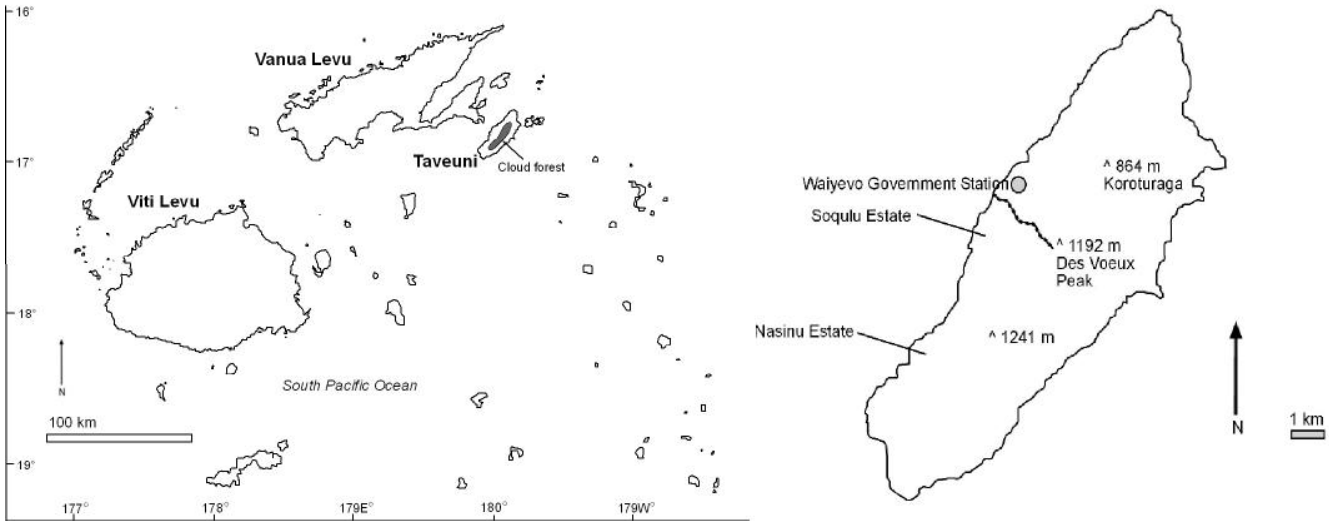

Figure 1: Fiji flying fox field research study site in cloud forest between 800-1,200 m asl at Des Voeux Peak on Taveuni (source: Scanlon 2009)

2.3 NAME AND TAXONOMY

The Fiji flying fox was formerly placed in the monkey-faced bat genus *Pteralopex* (Hill 1978) and called the Fiji monkey-faced bat (Flannery 1995). It was recently reclassified into the monotypic genus *Mirimiri* based on genetic and morphological distinctions (Helgen 2005), and the English name Fiji flying fox has since been adopted.

2.4 ECOLOGY OF THE FIJI FLYING FOX *MIRIMIRI ACRODONTA*

The Fiji flying fox remains one of the most rare and poorly understood bats. Because it is so rare very little information is known of its ecology. It has been recorded as lactating in May in both 1990 and 2009; the diet is probably tough because they have highly cuspidate teeth (Flannery 1995), and they may roost in pairs in fern clumps 6-10 m from the ground on larger trees (Hill and Beckon 1978) and as observed by Farley & Kretzschmar 2004 (*in. litt.* Dick Watling). This is clearly a cryptic species. In nearly 40 days/nights at Des Voeux peak, Scanlon (2009), never saw or heard a bat which may have been this species, other than the one caught in a net (section 2.2).

2.5 DISTINGUISHING THE FIJI FLYING FOX FROM OTHER FRUIT BATS

Distinguishing the Fiji Flying Fox from Fiji's three other fruit bats in the field is the first essential requirement to enabling distributional, ecological and behavioural data to be readily collected. Scanlon (2009) provides comparative information on the identification of the Fiji flying fox and other fruit bats in the hand and in the field (Table 1).

Table 1: Comparison of attributes among Fijian fruit bat species. Mass and forearm (FA) measurements (range) from adult animals captured during Taveuni surveys and from captures on Vanua Levu; measures for *M. acrodonta* supplemented from Flannery (1995). *P.t. = Pteropus tonganus*, *P.s.n. = P. samoensis nawaiensis*, *M.a. = Mirimiri acrodonta*, *N.m. = Notopteris macdonaldi*. Source: Scanlon (2009)

	P. t	***P. s. n***	***M. a***	***N. m***
Mass, g (maximum)	399-570	300-438	222-362	60-87
FA, mm (maximum)	141-161	126-138	120	64-70
Pelage	Dark body with distinct cream- yellow mantle	No distinct mantle; hoary appearance over whole body, some white or ginger patches on head/body	Uniform tan; ears may be obscured by thick hair	Uniform pale gray/khaki
Flight/wing shape	Wings narrower than *P.s.n.*; with deep indentations	wings broader than *P.t.*; no deep indentation	Wings broad, similar to *P.s.n.*	Manoeuvrable flyers with large wing area; Wings meet in midline of back, lower back is bare (hairless); tail extends past wing membrane
Habitat use/distribution	On most islands in Fiji; lowland & high altitude forest, coastal, &	Many islands; predominately forest habitats (lowland &	High altitude (>800 m) cloud forest, Taveuni only	Main islands in Fiji; sub canopy cloud & lowland forest & gardens

	cultivated habitats	high altitude)		
Other/general	Most frequently encountered bat species	Often bright red eyes contrasting against pale white head	Distinct orange (not red) eyes – no pale white head	Small blossom bat with mouse-like tail, roosts in caves

Scanlon (2009) summaries the differences between the species as follows (edited extract):

2.5.1 Pacific or Polynesian Flying Fox *Pteropus tonganus*

The Pacific or Polynesian flying fox *Pteropus tonganus* is the most common and well known bat species in Fiji. It forms large raucous colonies of many hundreds (or occasionally thousands) of individuals, including an apparently semi-permanent camp at the Garden Island Resort on Taveuni. It exploits forest and urban resources (such as cultivated fruits), and is occasionally hunted and eaten by villagers. Identifying this species in the field is relatively straightforward: it is high flying, often observed above the canopy at forested sites, and it has a distinct pale cream/yellow mantle that contrasts against dark brown/black body hair (see Fig. 2 and Fig. 3). This species has not been observed flying in sub-canopy areas; it is only caught in the highest mist nets (usually greater than 12 m), and then rarely are adults captured. *P. tonganus* tends to "crash land" into vegetation from above then climb to food resources further down; hence these bats are sometimes observed feeding in sub-canopy areas. The rostrum is more elongate and the wings narrower in *P. tonganus* than in the similar-sized species, *P. s. samoensis* (Wilson and Engbring 1992, Banack 1996); however, caution should be applied when using these traits alone because wing and rostrum shape may appear to vary (e.g. with flight mode and angle of observer relative to bat). Ideally, several cues should be used to discern species confidently. Comparisons with *P. s. nawaiensis* are presented in Table 1; Fig. 2 and 3.

2.5.2 Samoan Flying Fox *Pteropus samoensis nawaiensis*

The Samoan Flying Fox *Pteropus samoensis* subspecies *nawaiensis* is similar in size to P. tonganus, but differs in habits and (less obviously so during field observations) in morphology. Many villagers know the difference between "beka" and "beka lulu" – beka lulu relates to the pale colouring in *P. s. nawaiensis*; it is understood that *P. S. nawaiensis* is less conspicuous (less gregarious, for example), more dependent on forest habitats, and has a strong odour compared to that of *P. tonganus* (Wilson and Engbring 1992, Banack 1996, and personal obs.). *P. tonganus* is favoured for eating to *P. s. nawaiensis* because it is larger and smells better (it may also be more commonly encountered and/or easier to kill with rocks/sticks). Wing shape and pelage vary between the species, and should be used with other attributes (such as habitat and vocalisations) if differentiating from far away (see Table 2). In Fiji *P. s. nawaiensis* is rarely encountered outside forest habitats, which contrasts to the *P. tonganus* habits of using many different environments, including urban. Notably, *P. s. nawaiensis* roosts solitarily, in pairs, or small groups (sometimes within larger camps of P. tonganus), and the vocalisations are less boisterous and more "chatter-like" between a few or two individuals (Banack 1996, and personal obs.). In terms of separating *P. s. nawaiensis* from *M. acrodonta, P. s. nawaiensis* is larger, has hoary colouration (white, ginger, brown mottling) hair, and brown-red eyes, which may contrast against a white head in some individuals; it is also many times more common than is *M. acrodonta*. The two species may

occupy similar habitats, in sub-canopy areas of cloud forest on Taveuni for example. The bright orange eyes of *M. acrodonta* against the regularly-coloured tan/fawn hair on a round face are very obvious at close range.

2.5.3 Fiji Flying Fox *Mirimiri acrodonta*

Few generalisations can be made from a single capture; however, our observations were consistent with other records of the species. Obvious physical attributes include a regular tan-fawn pelage and brilliant bright orange eyes (see Table 2; Fig. 2 and 3). The species is smaller than *P. s. nawaiensis*, but the difference is not obvious for field identification purposes. The bat was captured at about 815 m a.s.l., which extends the range slightly for the species, but its distribution remains very restricted, and this species is unlikely to be observed elsewhere. Once released at the site of capture, the animal made short flights of a few meters from tree to tree, and eventually crawled into an epiphytic clump on a large tree (*Palaquium* species). This observation supports earlier reports of use of epiphytes by Hill and Beckon (1978), yet an inspection of the clump (>20 m from ground, accessed with abseiling by G. Bottroff) did not reveal any signs (odour, "nesting" area, guano or ejecta) that the area was used regularly.

Figure 2: Portraits of Fiji's megachiropteran: a) *P. tonganus*, b) *P. s. nawaiensis*, c) *M. acrodonta*, and d) *N. macdonaldi* (note more prominent ears and elongate rostrum on *P. tonganus* than on *P. samoensis* and *M. acrodonta*; photos by G. Bottroff; Source Scanlon 2009).

Figure 3: Images showing traits of Fiji's megachiropteran bats: a) and b) *P. tonganus* in flight, a) shows deep indentations in wings, b) shows distinct cream/yellow mantle; c) *P. s. nawaiensis* in flight with broad wings and little wing indentations, the rostrum also appears smaller, d) *M. acrodonta* broad winds, little indentation flying sub canopy, and e) *N. macdonaldi* showing wings meeting at midline on back, creating a "bare back" (Photos by G. Bottroff; Source: Scanlon 2009).

2.6 DISTRIBUTION

The Fiji flying fox is currently known from six captured bats all from above 800 m asl around or below Des Voeux peak on Taveuni. There is one possible observation at a lower altitude (c.400m) on the road leading to Des Vouex peak. A possible record of this bat on Delaikoro, Vanua Levu by P. German (in Scanlon 2009) is regarded as unconfirmed.

Thus, the Fiji flying fox has only been positively encountered in one part of the high altitude cloud forest (> 800 m asl) on the island of Taveuni. There has not, however, been any significant search for it at other locations in similar locations over 800 m asl on Taveuni (of which there is approximately 70 km^2), or in lower altitude forest (of which there is approximately 100 km^2).

2.7 TAVEUNI'S MONTANE CLOUD FOREST

Taveuni's montane cloud forest occurs quite extensively on ridges along the central upland area within the Taveuni Forest Reserve. It is not known to what degree the characteristic forest descends into the Ravilevu Nature Reserve. The cloud forest is best characterised as being comprised of stunted trees with a canopy height of between 3-7 m, leaves with drip tips and stems heavily covered with bryophytes and the area having high precipitation. The area is almost always shrouded in clouds especially the ridges and mountaintops. The thick soggy layer of partially decayed organic matter on the forest floor is also a very common feature.

Ash (1987) noted that although a few species occured in the canopy in the cloud forest as well as at lower altitudes, e.g. *Dysoxylum gillespianum, Macaranga seemannii* and *Syzygium* spp., most species are apparently restricted in altitudinal range. The ridge-top cloud-forest includes trees such as *Spireanthemum serratum* and *Ascarina swamyana* which are rarely observed in other habitats. Several epiphytes are similarly restricted to cloud-forests, e.g. *Medinilla waterhousei* and ferns such as *Antrophyum smithii, Grammitis hookeri, Hymenophyllum flabellatum* and *H.javanicum*. Epiphytic bryophytes were abundant at the ridge top. Climbing *Freycinetia* spp occur at all sites, and on the upper windward slopes and ridge top *F. urvilleana* forms about 40% of the upper leaf canopy and their stems form a dense tangle.

Tree canopy height and trunk diameter decline with altitude between species and it is apparent that this trend also occurs within species. The reduction in canopy height is greater than the reduction in maximum stem diameters, giving the ridgetop trees a stunted appearance.

Parris (1994) recorded 18 new fern records from Des Voeux peak including three species new to Fiji, *Asplenium lobulatum, Pseudophegopteris paludosa* (a new genus for Fiji) and *Chingia longissima*.

2.8 CONSERVATION

2.8.1 Status

The IUCN Red List categorised the Fiji flying fox as Endangered in 1994, this was subsequently upgraded to Critically Endangered in 1996.
The population size is unknown but it is estimated as likely to be a few hundred individuals certainly under 1,000 (Helgen *et al* 2008). They determine the Critically Endangered status on the basis of:

- Extent of occurrence is less than 100 km^2;
- It occurs at only one location; and,
- There is a continuing decline in habitat.

Confirmed information is that the species is known from only one general location around Des Voeux Peak in montane cloud forest on Taveuni. To date it is assumed that it occurs in the remaining montane cloud forest on the island, of which there is approximately 70 km^2.

The Fiji flying fox has been presumed not to occur in forest below 800 m asl, though there have been no significant surveys to provide any evidence for this. Although it is stated that there is a continuing decline in habitat, there has, in fact, been no decline in the montane cloud forest habitat on Taveuni except on a limited scale in the Des Voeux Peak area to accommodate the expansion of telecommunication structures. However, there has been loss of forest and encroachment into the Taveuni Forest Reserve at lower altitudes.

2.8.2 Conservation Planning & Legislative Support

The Fiji flying fox is listed as *Pteralopex acrodonta* Taveuni flying fox in the Endangered and Protected Species Act 2002.

The Des Voeux peak area is within the Taveuni Forest Reserve, there have been no surveys to determine if the Fiji flying fox occurs in the adjacent Ravilevu Nature Reserve.

Under the Forest Decree 1992, the management objectives of Forest Reserves clearly indicated that forest protection have equal weight to production dependent on capability. (refer Box 1).

Management of forest reserves and nature reserves

7.—(1) Forest reserves shall be managed as permanent forest in order to provide on a permanent basis the optimum combination of benefits of protection and production of which they are capable.

Box 1: Forest Decree 1992 – Management of Forest Reserves

However, the history of Forest Reserve management to date provides no indication that Forest Reserves serve this purpose. The vast majority of Fiji's Forest Reserves have been converted to Mahogany Plantations and/or dereserved. As such the forest protection function of Forest Reserves has been largely, if not completely neglected. Given this management style and precedent of Forest Reserves, it is not surprising that other stakeholders in forest management (specifically conservation agencies, both Government and Non-government) have little confidence in the designation of unique upland areas of Taveuni as a Forest Reserve. Fiji's National Biodiversity Strategy and Action Plan identify the Taveuni Forest Reserve in combination with the adjacent Ravilevu Nature Reserve and the Bouma-Lavena Forest Park as a national priority for full protection status.

There have been no previous conservation plans for this species. Helgen *et al* (2008) recommended "More study needed regarding threats, population size, and to assess its possible presence on Vanua Levu." Scanlon (2009) recommended "future surveys could explore more mild fringe areas of the Taveuni forests, as well as Delaikoro Peak on Vanua Levu".

3 RECOVERY PLAN

3.1 IS KNOWLEDGE ABOUT SPECIES ADEQUATE FOR OBJECTIVES AND ACTIONS TO BE DEFINED ACCURATELY?

Very little is known about the Fiji flying fox and it is clearly insufficient to enable objectives to be drawn up other than to acquire more basic information about the species.

3.2 RECOVERY OBJECTIVES FOR THE FIJI FLYING FOX

The following are the immediate objectives for the Fiji Flying Fox recovery plan, they are focused primarily on determining more basic information about the bat on which conservation management measures could be drawn up:

1. Determine the Fiji flying fox's distribution and landscape use on Taveuni;
2. Determine Fiji flying fox's presence or otherwise at other potential sites in Fiji;
3. Attain a good understanding of the ecology and behaviour of the Fiji flying fox;
4. Ensure good public awareness amongst the Taveuni island community about this unique bat; and,
5. Secure full protection for the Taveuni Forest Reserve.

3.3 RECOVERY ACTIONS

3.3.1 Determine the Fiji flying fox's distribution and landscape use on Taveuni

It is not yet proven that the Fiji flying fox is confined to high altitude forests on Taveuni, surveys are need elsewhere to determine its habitat needs and landscape use.

Priority Actions:

- Undertake mist net trapping surveys at a representative number of lower altitude (< 800 m asl) forest sites on Taveuni.

When feasible – if and where the bat can be quite readily observed or trapped:

- detailed ecological observations should be made, e.g. on diet and roosts, to assess "habitat needs"; radio/satellite-tracking for "landscape use" – or GIS mapping

3.3.2 Determine its presence or otherwise at other potential sites in Fiji

It is possible that this cryptic bat is found at other sites in Fiji. As a first action, surveys should be planned for high altitude forests similar to the one on Taveuni where it is known from.

Priority Actions:

- Undertake mist net trapping surveys at Delaikoro, Vanua Levu (selected because of an unconfirmed record there by an experienced bat biologist, P.German);
- Undertake mist net trapping surveys at similar high altitude habitats on Viti Levu and elsewhere on Vanua Levu, using predictive measures from 3.3.1 e.g. habitat associations;

3.3.3 Attain a good understanding of the ecology and behaviour of the Fiji flying fox

Distinguishing the Fiji Flying Fox from Fiji's three other fruit bats in the field is the first essential requirement to enabling distributional, ecological and behavioural data to be readily collected.

Priority Action:

- Experienced bat biologists to undertake observational surveys and mist net trapping surveys at Des Voeux Peak and any other sites where the Fiji flying fox is found.

3.3.4 Ensure good public awareness amongst the Taveuni island community about this unique bat

The support of the Taveuni community for forest habitat conservation and conservation of the Fiji flying fox is essential to its long term survival. This will not be provided unless there is a good level of awareness in the community about the significance of this unique bat. Its potential as a flagship species for the conservation of Taveuni's highly significant forest biodiversity resource needs to be realised.

Priority Actions:

- Prepare materials on the Fiji flying fox in the vernacular;
- Undertake awareness campaigns in schools, communities and the tourism sector.

3.3.5 Secure full protection for the Taveuni Forest Reserve

Forest Reserve is an inadequate designation under the Forest Decree for permanent forest protection. The existing proposals to upgrade the Taveuni Forest Reserve and combine it with the Ravilevu Nature Reserve and Bouma-Lavena Forest Park as a single "National Park" equivalent[1] needs to be kept alive and encouraged.

Priority Actions:

- Advocate for the Taveuni "National Park" ;
- Advocate for Taveuni's forests to be placed on Fiji's World Heritage Tentative List[2]

[1] Integrated Development Plan for Taveuni (NEMP 1993); National Biodiversity Strategy and Action Plan (2003)

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