The Red-throated Lorikeet
Charmosyna amabilis
in the Fiji Islands

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CONTENTS

SUMMARY

The red-throated lorikeet is an endangered small parrot endemic to Fiji, and is a priority species for conservation both globally and locally. Historically, its distribution included the islands of Viti Levu, Taveuni and Ovalau and it is characteristically associated with mature old-growth native forest at altitudes above 500 m. Evidence from historical records suggest that the population has declined. There have been few sightings since the 1970s, most of which have been in Viti levu on the Nadrau plateau and around Mt. Tomaniivi, where the last confirmed sighting occurred in 1993. It is not known if the species still survives on Ovalau and Taveuni, and its historical and current presence on Vanua Levu is uncertain. Predation by introduced black rats has been identified as one possible cause of decline, which has contributed to the decline of other Pacific island small parrots. More recently, habitat loss and degradation may have contributed, and will increasingly threaten forest bird populations.

Between November 2001 and April 2002, we conducted a field survey to assess the status and distribution of the red-throated lorikeet in the wild. The survey was funded by the World Parrot Trust and was supported by the National Trust for Fiji and Environment Consultants (Fiji) Ltd. No birds were observed during three months of field observations in Viti Levu and Taveuni, suggesting that the species may be more rare than previously believed. The number of black rats trapped in montane native forest was similar to numbers known in forests on other tropical islands where rats threaten endemic bird populations. Evidence collected of mongoose and feral cats suggested that they have penetrated into the forest interior, and may be a contributing factor to bird population declines.

Conservation actions cannot be initiated for the red-throated lorikeet until more information is obtained. However, an assessment of the threats facing other forest-dependent birds will contribute towards developing a conservation strategy for this species. Although large areas of forest still remain in Fiji, logging activities will increasingly threaten forest bird populations by reducing habitat availability. The legal protection of forests at Wabu and the Sovi Basin in Viti Levu, and the Bouma National Heritage Park in Taveuni would contribute to the conservation of the red-throated lorikeet.

RECOMMENDATIONS

Further information about the red-throated lorikeet is urgently needed, and few recommendations can be made until more is known about the species. However, research to assess the general threats to birdlife in Fiji will contribute towards building a conservation strategy for the red-throated lorikeet. The implementation of research priorities for threatened birdlife in Fiji, identified in the Melanesian and Nauru avifauna conservation workshop (Sherley 2000), will strengthen conservation efforts for the lorikeet. These are:

- Conduct forest surveys and threat assessments for rare birds.
- Develop a monitoring programme for forest birds.
- Develop local expertise in bird survey methodology.
- Develop field training in bird monitoring techniques.
- Identify suitable areas for conservation.

These priorities fulfill recommendations from the Fiji Biodiversity Strategy and Action Plan. *Objective 2.4, Action 36: achieve a detailed knowledge of the occurrence and status over time of Fiji's biodiversity resources, in particular, the threatened endemic forms. Objective 4.1, Actions 60, 61, 63: effectively manage threatened species.*

Recommendations specific to the red-throated lorikeet

- Continue surveys on Viti Levu, Taveuni, Ovalau and Vanua Levu, and identify sites important to the species.
- Gather ecological information to identify key factors important to the lorikeet.
- Conduct research on introduced rats, mongoose and cats and their effect on native birds.
- Encourage the legal protection of forest at Wabu, Sovi Basin and Bouma National Heritage Park.

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INTRODUCTION

Over 17% of the world's birds are confined to islands and of these, 23% are threatened representing 39% of threatened birds worldwide. Island birds have suffered 93% of recent bird extinctions, mainly due to introduced species, direct persecution and habitat destruction. Habitat destruction and degradation is the most important factor threatening island birds today, affecting over 50% of island species (King 1985, Johnson & Stattersfield 1990). By virtue of their simple ecosystems and discrete boundaries, islands provide excellent opportunities for effective bird recovery and management actions and it is on small islands that some solutions, e.g. permanent eradication of cats and rats, can be successful.

Grouped together, the Pacific islands rank high in the world for bird biodiversity yet around 30% of Pacific birds are currently threatened with extinction. The Fiji Islands has 57 breeding land birds, of which 26 (46%) are endemic and 12 (21%) are globally threatened (Stattersfield & Capper 2000, Watling 2001).

Parrots are one of the most endangered groups of birds in the world and at least 95 species (28%) are threatened (Snyder *et al*. 2000). The red-throated lorikeet *Charmosyna amabilis* is an endangered (IUCN 2000) small parrot endemic to the Fiji Islands and is a priority species for conservation both globally and locally (Watling 1998, Snyder *et al.* 2000).

THE SURVEY

The aim of the survey was to assess the status and distribution of the red-throated lorikeet.

This was achieved by:

- a field survey of Viti Levu and Taveuni for the species
- a field investigation of introduced mammalian predators as a potential threat to the species
- a review of historical and recent literature and sightings

The survey fulfilled Objective 2.4, Action 36 of the Fiji Biodiversity and Action Plan: *achieve a detailed knowledge of the occurrence and status over time of Fiji's biodiversity resources, in particular, the threatened, endemic forms* and Objective 4.1, Actions 60, 61 and 63: e*ffectively manage threatened species, encourage research on threatened species and include links with international expertise.*

FIELD SURVEY LOGISTICS AND PERSONNEL

PERSONNEL

The survey was funded by the World Parrot Trust (WPT) and carried out jointly with the National Trust for Fiji (NTF), our institutional base, and Dr. Dick Watling (Environment Consultants (Fiji) Ltd.). Both groups gave logistical and administrative support, and Dr. Watling advised us throughout the survey. Kirsty Swinnerton, who headed the project, was supported by the World Parrot Trust and Aleksandra Maljkovic was a British volunteer. K. Swinnerton and A. Malkjovic remained in Fiji between 10th November 2001 and 30th April 2002.

Alifereti Bogiva, from the Fijian Affairs Board, informed and briefed the necessary Provincial Administrators in whose province we were to be working. Alifereti Naikatini, from the University of the South Pacific, worked with us at Monasavu between 22/11/01 and 22/12/01 and contributed significantly to fieldwork and organisation of field trips. We also worked with Apisai Tinakoro in Wainimala (15/01/02 to 24/01/02) and Jone Niukula in Monasavu (29/03/02 to 05/04/02), both of whom are NTF staff. Dr. Dick Watling accompanied us in the field in Taveuni (27/02/02 to 02/03/02) and in Monasavu (12/04/02 to 15/04/02).

LOGISTICS

We used two 125cc off-road motorbikes to travel between field sites, and to Taveuni by boat. At Monasavu, the bikes were essential to survey a larger area. At Monasavu and Wainimala, the NTF provided a 4WD truck to carry field equipment and local staff between Suva and our study sites (or nearest point to study sites). At other times, we used local trucks, buses and taxis.

PROTOCOL

Nearly all land in Fiji is communally owned and permission was needed to survey it. Permission to visit the site was initially obtained in Suva from the Provincial Administrator for that region. Permission to survey the land was obtained from the Tui (Chief) of the main land-owning village. We were usually introduced to the Tui by the Turaga-ni-koro (administrative head). We presented some kava, a letter of introduction from the NTF, showed pictures of the lorikeet and other parrots and discussed our study with the Chief and a group of between 10 and 20 villagers. The meetings drinking kava were a good way of obtaining local knowledge about the lorikeet, about parrots and wildlife in general and to find out about campsites and trails. We paid for local guides, and villagers who helped transport equipment.

STUDY SITES

A description of the Fiji environment and vegetation types is given in Appendix I. Surveys were carried out on two islands, Viti Levu and Taveuni (Figure 1). Study sites were chosen using one or more of the following criteria:

- the lorikeet had been previously recorded in the area
- presence of mature, good quality native forest
- high altitude (≥ 500 m)
- accessibility
- local knowledge of the area

Six study areas were chosen, four on Viti Levu and two on Taveuni (Figures 2*b* and 3). Descriptions of the study sites are in Appendix II.

Table 1. Study sites and dates visited. Highlighted dates are periods in the field. Coordinates for Fiji Map Series 31, read the alphanumeric identifier followed by vertical grid line and horizontal grid line with tenths. A grid square reference is given for the Wabu camp. The inland point of the Qeleni road is given.

Island	Site	Camp Coordinates	Altitude (m)	Dates visited	No. days
VITI LEVU	**Monasavu / Nadrau plateau**			**22/11/01 – 22/12/01**	**31**
	• FEA Headquarters (Monasavu dam)	N27/260,175	720 – 1080	22/11/01 – 02/12/01	12
	• Tomaniivi Reserve and Wabu forest	N27/220,340	700 – 1100	03/12/01 – 08/12/01	6
	• FEA Power Project 3 dam	N28/229,070	800 – 1200	10/12/01 – 15/12/01	6
	• FEA Headquarters (Monasavu dam)	N27/260,175	760 – 1200	16/12/01 – 22/12/01	7
	Narokorokoyawa, Wainimala	N28/328,047	500 – 844	**15/01/02 – 25/01/02**	**11**
TAVEUNI				03/02/02 – 10/03/02	36
	• Des Voeux Peak	S24/369,171	900 – 1192	**05/02/02 – 11/02/02**	**7**
	• Qeleni Road	S24/433,267	20 – 420	**14/02/02**	**1**
	• Mt. Koroturaga (Bouma NHP)	S24/200,430	500 – 700	**18/02/02 – 21/02/02**	**4**
	• Mt. Koroturaga (Bouma NHP)	S24/200,430	500 – 700	**27/02/02 – 02/03/02**	**4**
	• Soqulu Estate	S24/311,152	360 – 440	**05/03/02 – 07/03/02**	**3**
VITI LEVU	**Monasavu / Nadrau plateau**			**29/03/02 – 15/04/02**	**18**
	• FEA Headquarters (Monasavu dam)	N27/260,175	800 – 1200	29/03/02 – 15/04/02	17
	• Tomaniivi Reserve	N27/224,319	700 – 1323	09/04/02	1

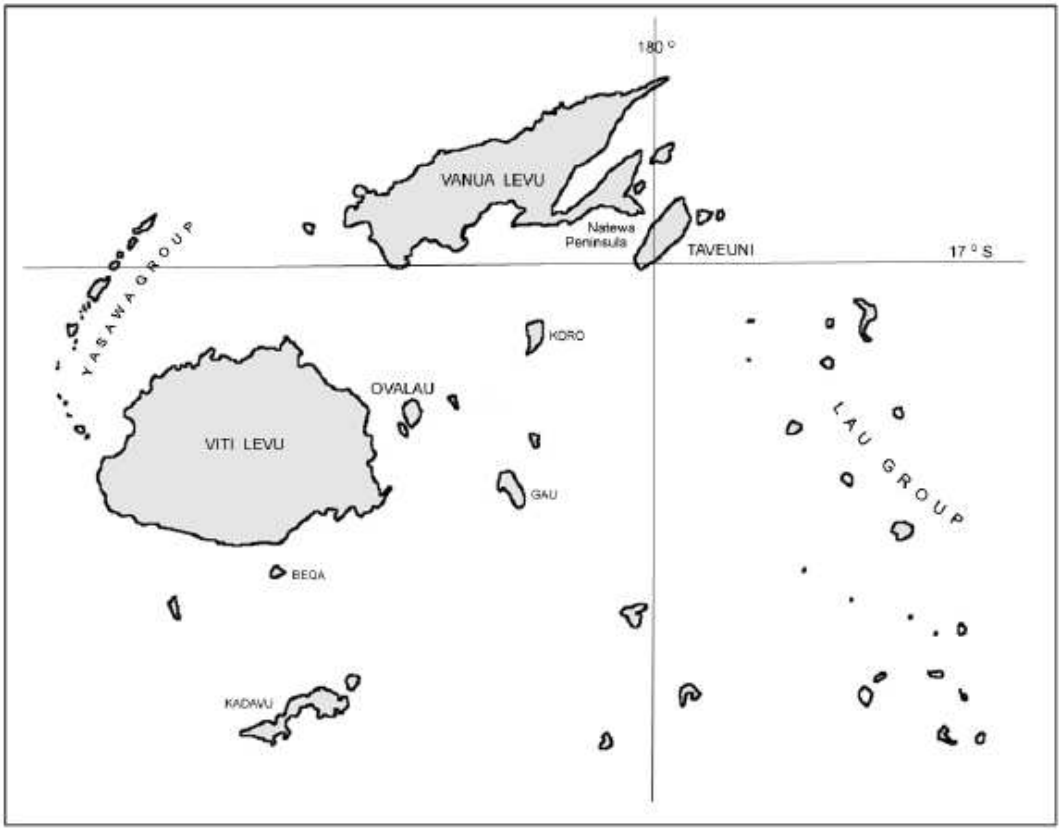


Figure 1. Map of the main islands of the Fiji Group

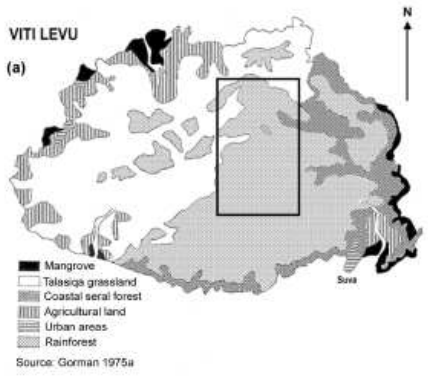
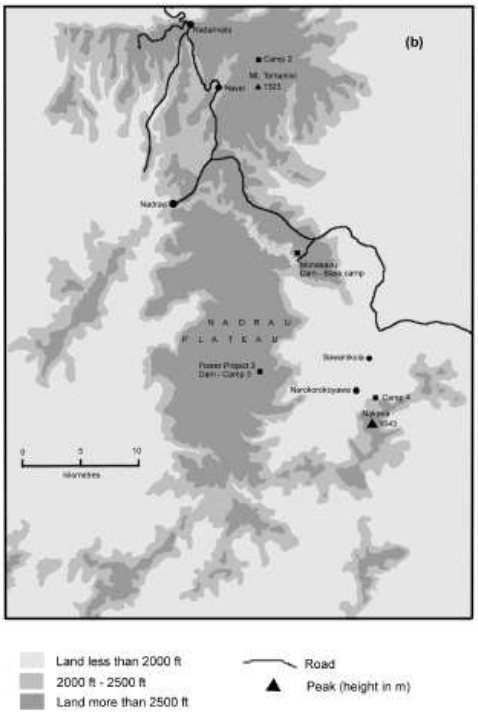


Figure 2 Map of Viti Levu (a) vegetation types (b) insert of the Monasavu area



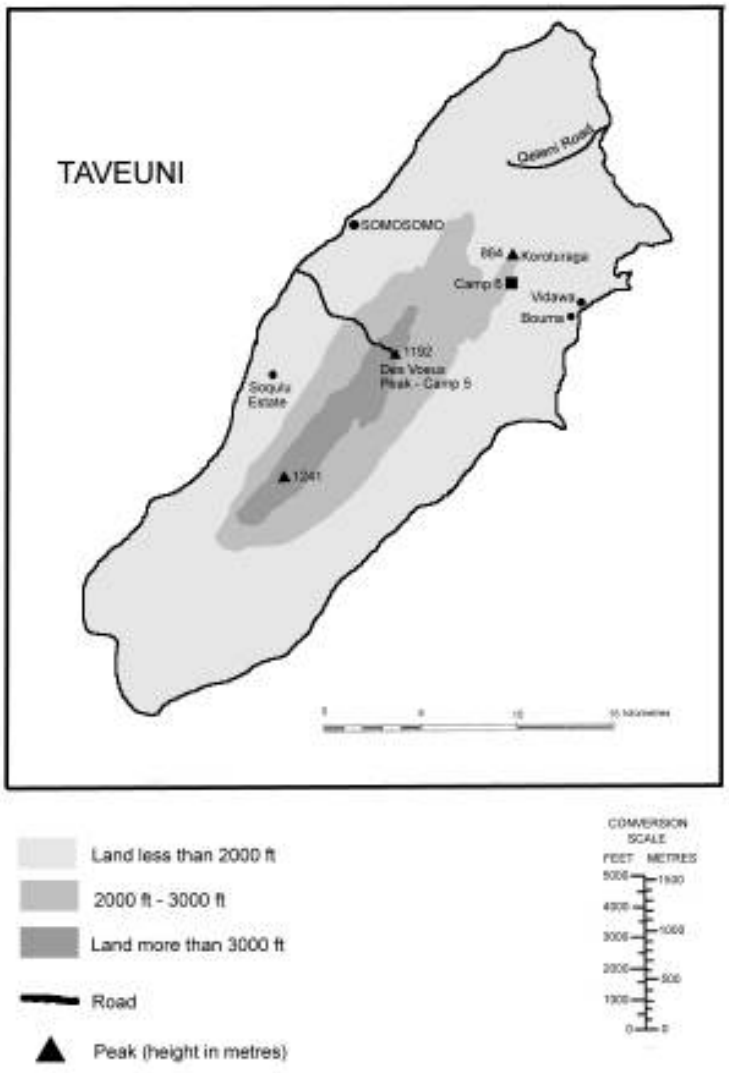


Figure 3. Map of Taveuni island showing study sites and places mentioned in the text.

SURVEY METHODS

SUMMARY

We surveyed selected forest on Viti Levu and Taveuni, and searched for the red-throated lorikeet. We collected sightings of collared lorys *Phigys solitarius* and recorded feeding and unusual behavioural observations. We met with villagers to obtain local knowledge of the lorikeet and discussed general parrot issues, particularly where relevant to their conservation. We trapped and identified rats and collected evidence of feral cat and mongoose in forest.

PARROT OBSERVATIONS

Searching for the red-throated lorikeet

The lorikeet was most likely to be seen flying fast above the canopy, or feeding in the canopy. We watched from high points that gave an open view of the canopy and from which we could scan a large area. Viewpoints included roads and tracks along ridges, clearings created by tree-fall, forest clearance or landslips and views from up trees. Sometimes a small area was cleared to create a viewpoint. Viewpoints usually overlooked a small valley, side of a valley or lower-lying area. The quality of viewpoints, and hence quality of observations, varied between sites with the best views achieved at Monasavu.

Slow walks along trails were also used where viewpoints were difficult to find, for example in the Wainimala area. This technique relied heavily on identifying birds by their call and even then, subsequent observation of birds in the canopy was difficult.

We focussed on flowering trees, in particular vuga *Metrosideros collina* and other species being used by nectarivorous birds such as wattled honeyeater *Foulehaio carunculata*, orange-breasted honeyeater *Myzomela jugularis*, giant forest honeyeater *Gymnomyza viridis* and collared lory.

Observations focussed on collared lorys, as a means of finding red-throated lorikeets. By observing lorys, there was a reasonable chance of finding lorikeets as the two species exploit similar food plants and are known to fly and feed together. The calls from the two species are similar enough that collared lory calls had to be traced to the source bird (or group of birds), in order to eliminate the possibility of a lorikeet. Once collared lory calls became more familiar, unfamiliar 'small parrot' calls were listened for.

Observations of collared lorys

Each collared lory sighting and call was recorded to measure the encounter rate. This provided a base-line measurement of how frequently we might *expect* to encounter a small parrot with a similar ecology. Behavioural and feeding observations were also recorded for collared lorys. The lory and lorikeet are believed to be sympatric, exploiting similar resources in different ways. Observing lorys provided an insight into why the lorikeet should be so rare, and how the two species could co-exist.

Fieldwork

Observations were focussed early morning and late afternoon, between 06:00 hrs and 11:00 hrs and between 15:00 hrs and 19:00 hrs. Timed three-hour canopy watches enabled a quantitative assessment of effort at each site. Timed forest walks resulted in more qualitative observations. Searches for the lorikeet were also maintained during hours spent in the field walking between viewpoints and camp, finding suitable trails, rat-trapping and at field camps.

INTRODUCED MAMMALS

Rat trapping

Rat trapping was carried out at Monasavu and Wainimala on Viti Levu and Des Voeux Peak on Taveuni, to establish what species of rat were present (see Appendix III for site descriptions). Snap-traps were laid in pairs, 10 m apart along a 250 m transect through native forest. Traps were baited with peanut butter and fish oil, and later with burnt coconut and trapping was carried out for between three and seven consecutive nights. Each trap was covered in a black polythene cloche-style roof to prevent rain diluting the bait or springing the trap.

An index of rat abundance was calculated for each site as follows:

Index of abundance = (# of captures ÷ corrected trap nights) x 100

Where index of abundance is rats per 100 corrected trap nights
Corrected trap nights = (# of trap nights – trap nights lost)
Trap nights lost = (# of traps with captures + traps sprung) ÷2

Owing to weak, poor quality traps, some rats escaped from the traps. Rat fur in sprung traps were treated as captures. A maximum index was calculated where all sprung traps were treated as a capture.

Observations of cat and mongoose and collection of scats

Any cat or mongoose sighting was recorded. Cat and mongoose scats were collected and a gross identification of content made (rat, bird, insect), primarily looking for feathers. The location of scats found was recorded to provide evidence of cat and mongoose presence in remote, forest locations.

RESULTS

SEARCHES FOR THE RED-THROATED LORIKEET

No sighting of the red-throated lorikeet was made and no call was heard that could be definitely attributed to the lorikeet, despite 79 days or part-days in the field (Table 1) involving 373 man-hours of timed observations. Canopy watches on suitable flowering trees, on which collared lorys and honeyeaters were feeding, did not result in any sightings.

ENCOUNTER RATES OF COLLARED LORYS

Mean encounter rates with collared lorys are shown in Appendix IV. Sightings peaked early morning (between 06:00 and 09:00 hrs) and late afternoon (between 15:00 and 18:00 hrs) when they averaged about two encounters per hour. The maximum number of times that a group of parrots was seen or heard within any one hour was nine. Encounter rates varied with site, and birds were less frequently encountered at higher altitudes in stunted mossy cloud forest. If the viewpoint was close to a flowering tree, birds were more frequently encountered and if several trees were close to the viewpoint, birds could often be seen or heard almost continuously.

Feeding observations from collared lorys included vuga *Metrosideros collina,* vure *Geissois superba, Medinilla spectabilis*, *Medinilla archboldiana*, *Syzigium* sp. and *Psychotria* sp. (*confertilobia*).

INTRODUCED MAMMALS

Rat trapping

Only black rats were caught in native forest. Trapping in and around the FEA buildings at Monasavu caught both black and Norway rats. Table 2 shows indices of rat abundance in native forest in Viti Levu and Taveuni. The overall index of abundance in native forest was between 3.7 and 7.6 rats per 100 corrected trap nights. These indices fall between those known for rats in tropical native forest in Mauritius (means between 2.4 and 10.6, overall mean 4.4) (D. Hall *pers. comm.*) and are lower than indices known from native montane forest in Maui (Hawaii) (means 7.8 ± 2.3 to 16.3 ± 5.0) (Sugihara 1997).

Maximum weight of *R. rattus* was a male at 226 g. Four immature individuals measured between 43 g and 59 g (Table 3). Two colour forms of *R. rattus* were caught; a creamy white/white belly (17 individuals) and a grey belly (11 individuals). Both were trapped in the same transect line and both at all sites. The dorsal pelage of both forms ranged between shades of grey, brown, and black.

Table 2. Index of rat abundance per 100 corrected trap nights, in upland native forest on Viti Levu and Taveuni, November 2001 - April 2002. [ ] = number of traps with evidence of rat (fur, blood) and assigned as a capture.

Site	Monasavu	Monasavu	Wainimala	Des Voeux Peak	Monasavu	Monasavu	All sites
Site number	1	2	3	4	5	6	-
No. nights	4	5	7	5	7	3	31
No. traps sprung	8	10	3	5	18	12	56
No. captures	1	7[3]	7[1]	8[5]	17[9]	13[8]	53[26]
Minimum index	0.5	2.9	2.4	3.3	5.1	9.4	3.7
Maximum index	4.6	7.0	3.5	5.3	10.5	18.2	7.6

Table 3. Means of morphometric data for *R. rattus* and *R. norvegicus* caught in upland native forest and in the FEA buildings, November 2001 - April 2002. Adult and immature animals are included.

Species	N	Sex	Weight (g)	Total length (mm)	Tail length (mm)	Hind foot (mm)	Ear (mm)
R. rattus	13	Female	118.4	360.0	192.0	32.1	23.4
		± SD	52.8	54.0	26.9	3.2	2.3
	16	Male	141.7	388.9	209.0	34.1	24.0
		± SD	52.4	46.3	22.6	1.3	1.6
R. norvegicus	4	Female	148.5	323.5	142.5	35.0	17.5
		± SD	64.2	50.8	24.8	2.7	1.7
	4	Male	226.7	376.7	167.0	38.5	19.2
		± SD	92.3	62.0	31.4	3.3	1.0

Cats and mongoose

Mongooses were seen at all three sites on Viti Levu. At Narokorokoyawa, the villagers told us they caught them as food in native forest by our camp. Mongoose scats were collected from roads and tracks, but also found at Mt. Tomaniivi peak. Cats were seen along the road between Monasavu and Navai, and were probably semi-wild. Cat scats were collected from Viti Levu and Taveuni, from Mt. Tomaniivi peak, Wabu Reserve and Des Voeux peak, suggesting that cats had penetrated far into native forest. It would be surprising if these populations were not feral. Feral cat populations are known from native forest on Mauritius, in areas much closer to habitation than in Fiji.

Mongoose scats indicated a diet of mostly rats and invertebrates. However, some scats contained bird remains, skulls and feathers, including one scat that was entirely collared lory feathers and bones. Other feathers were possibly from a white-eye *Zosterops* sp., an island thrush *Turdus poliocephalus*, one of the large pigeons and a medium-sized passerine. No identifiable bird remains were found in cat scats, which comprised mostly rat fur.

LOCAL KNOWLEDGE OF THE RED-THROATED LORIKEET

Identification of local birds by villagers was generally poor and information about the red-throated lorikeet was confused. As an example, villagers at Sawanikula (Wainimala) said that it was common around the village but only two kilometers down river at Narokorokoyawa, villagers had never seen it. Villagers did not distinguish it from the collared lory, and both were called “kula”. Villagers frequently confused the lorikeet with the red-headed parrotfinch *Erythrura pealii* which is also known as “kula, kulakula and Qïqïkula” (kula meaning ‘red’). Elderly villagers and those who worked in the forest, such as pig hunters and tour guides, did not know the bird neither in Viti Levu nor Taveuni.

The historical name for the lorikeet “kulawai” (Layard 1876) is unknown today. The fact that villagers have no local name for the lorikeet suggests that it is not known well enough seen to warrant individual identification. Villagers at Navai and Nadrau all suggested that the birds are only seen when the vuga and drala are flowering around the villages, and historical information also suggests this (Clunie 1979).

In Taveuni, locals would have less exposure to forest birdlife as there are no villages in the central mountain range. We met a local amateur ornithologist who distinguished the lorikeet as a 'forest kula', a local birdwatching tour guide and an ex-patriate amateur ornithologist, all of whom claimed to have seen it on the Des Voeux peak road, but if true, these sightings could have been up to 10 years ago.

Flowering seasons for vuga *Metrosideros collina* and drala *Erythrina* sp.

Individual vuga trees may have flowers and fruits year round and in Viti Levu, we found some flowers on individual trees during the whole study period. Two peak flowering seasons may occur between April and July and between September and November, but which may vary according to altitude, aspect and regional climate. At higher elevations on the plateau between Monasavu dam and Power Project 3 site, more trees were coming into flower in April but which had finished by July (Watling *pers. comm.)*. On a visit to Mt. Tomaniivi on 9th April, large numbers of trees were in flower around the peak, but none around the village. At the village flowering apparently occurs between May and August. In Nadrau, villagers suggested there were two seasons, around October/November and starting in April. Clunie (1979) suggested that both vuga and drala were in flower around Nadrau in October. No flowering was seen in the Sovi Basin in August 2001 (Watling *pers. comm.*).

In Taveuni, several large trees were in full flower just below Des Voeux peak in early February but below Mt. Koroturaga in mid to late February, only one tree in flower was seen. Large numbers of vuga trees were observed from the trail to Mt. Koroturaga, which apparently come into flower in May. Vuga trees are used for timber and decoration, are more common in forest edge, along roads and around villages where they may be planted.

Two species of *Erythrina* occur, *E. variegata* (*indica*) and *E. subumbrans*, both of which are called drala. *E. variegata* has large orange/red flowers usually in August, although two trees at Navai had flowers in April. A large group of *E. subumbrans* is found just outside Nadrau village, where red-throated lorikeets have previously been observed (Watling *pers. comm.*), and usually flowers in October. *Eucalyptus*, *Syzigium* sp. and *Eugenia* species (particularly *E. jambos*) may also be important food sources for red-throated lorikeets.

SPECIES PROFILE

CHARMOSYNA LORIKEETS

The genus *Charmosyna* comprises 14 species distributed from Buru Island (Indonesia) in the west through Irian Jaya, Papua New Guinea, Bismark Archipelago, Solomon Islands, Vanuatu, Santa Cruz islands and New Caledonia. The red-throated lorikeet in Fiji represents the eastern-most range of this genus. There is little information on most species of *Charmosyna*, they are notoriously difficult to find (Beehler *et. al* 1986) and characteristically inhabit mountainous regions with high rainfall (Juniper 1998). Seven species are in the IUCN Red List (2000) (Table 4). The New Caledonian lorikeet is known only from two specimens collected in 1859 and an observation in 1913 (Forshaw 1989) and recent attempts to locate it have failed (Ekstrom *et. al* 2000). The blue-fronted lorikeet *C. toxopei* is only definitively known from seven specimens collected in the 1920s. Recent attempts to locate it failed and recent sightings are considered uncertain (Snyder *et. al* 2000). Reasons for the decline and rarity of *Charmosyna* lorikeets are cited variously as small populations and restricted range, habitat destruction and degradation, avian malaria, cyclones and invasive species (Stattersfield & Capper 2000).

Table 4. IUCN Red List (2000) status of *Charmosyna* species. Watling (1998) defined the IUCN criteria B1, B2 and C2 for the red-throated lorikeet.

Scientific name	Common name	IUCN status	Criteria
C. diadema	New Caledonian lorikeet	Critical	D1
C. toxopei	Blue-fronted lorikeet	Critical / Endangered	C2b / D1
C. amabilis	Red-throated lorikeet	Endangered	C1; C2b
C. palmarum	Palm lorikeet	Vulnerable	B2c,e + 3b,c
C. meeki	Meek's lorikeet	Low risk / near threatened	
C. multistriata	Striated lorikeet	Low risk / near threatened	
C. margarethe	Duchess lorikeet	Low risk / near threatened	

THE RED-THROATED LORIKEET

The red-throated lorikeet *Charmosyna amabilis* is an endangered (IUCN 2000) small parrot endemic to the Fiji Islands. It is fully protected under the Fijian Birds and Game Act 1923 and is an Appendix II (CITES) species. Historically, it is known from the islands of Viti Levu, Taveuni and Ovalau and is associated with mature old-growth native forest at altitudes above 500 m. The current population estimate of less than 2500 birds, limited to less than 500 km^2 is based on IUCN category thresholds for threatened species.

Historical accounts between 1875 and 1926

The red-throated lorikeet (*Trichoglossus amabilis*) was first described by Edward Pierson Ramsay in 1875, from two type specimens collected by Charles Pearce in Ovalau on 17th June 1875. (Ramsay 1875, 1877*a*)[1]. Edgar Layard also published a description under the synonym *Trichoglossus aureicinctus*, from a single specimen also collected by Charles Pearce in Ovalau on 15th June 1875 (Layard 1875).

Between 1875 and 1926, further specimens were collected from Viti Levu, Taveuni and Ovalau (Appendix V). The historical literature provides conflicting accounts about how easily the species was found. Eduard Gräffe made trips to Fiji in 1862 and between 1864 and 1865, collecting for the Godeffroy Museum in Hamburg, but made no mention of the lorikeet (Gräffe 1868). Ramsay (1875) recorded that the flock from which his specimens were obtained consisted of about 30 individuals. Layard (1876) suggested that they were difficult to procure from Viti Levu, but also observed them 'flying in considerable numbers in company (but not mingling) with the kulu (sic) (*Lorius solitarius* Lath.)' (collared lory). They were 'known to the natives of Fiji under the name of "kula-wai" and to the Laconi boys by that of "Vuni-as"'[2]. Baron A. von Hugel collected in the central highlands of Viti Levu in 1875 but made no record of nor collected the species (Roth & Hooper 1990). The 'Challenger' Expedition collected shining parrots and collared lorys, but not the red-throated lorikeet (Finsch 1877). Bahr (1912) collected collared lorys and shining parrots for export to captive collections, noted that he did not see the lorikeet but 'was told by a planter that it is still common in the mountain forest of Taviuni'.

By the early 1900s, Wood and Wetmore (1926) were already concerned for its survival, noting it could still be seen occasionally on Viti Levu and Taveuni but 'rarely seen away from the high mountains of the interior' (of Taveuni). They suggested it 'is now probably extinct on Ovalau' and noted 'this charming little species is vanishing from Fiji'. The Whitney South Sea Expedition collected extensively in Fiji between 1924 and 1925, but found the species only on Viti Levu (Watling 1985). However, Chapman (1934*a*) maintained that the species was by no means rare, since 12 specimens were collected for the Whitney Expedition in one week (see Discussion).

Accounts and sightings between 1965 and 2002

In the 1970s, the lorikeet was observed and collected in the central highlands of Viti Levu (Nadarivatu/Nadrau plateau) and the southern end of the Sovi Basin (Gorman 1975*a*, Clunie 1979). Clunie (1972) recovered a bird leg from a peregine eyrie at Joske's Thumb, apparently belonging to the red-throated lorikeet although he never saw the species there, but analysis of fossil bones excavated from the eyrie did not confirm the species presence (Worthy 1999). W. Beckon observed, photographed and filmed the bird between 1975 and 1978, in the central highlands of Viti Levu on the Nadarivatu plateau. Between 1965 and 1991, D. Watling recorded eight sightings, also in the central highlands. The last confirmed sighting was on the slopes of Mt. Tomaniivi in 1993 (Appendix VII).

During this period, there have been other published sightings (Blackburn 1971, Holyoak 1979, Lees 1990), and personal observations (J. Kretzschmar 1993, G. Allport 1998, P. Hayman 2002) made in Viti Levu, Taveuni and Ovalau (Appendix VII). Unsubstantiated reports from individuals met during our survey included sightings in the 1990s from Mt. Tomaniivi in Viti Levu and in Taveuni. Sightings made by an individual, by an individual with little experience of the species and in an unusual area are treated here with caution, particularly owing to confusion with the collared lory.

[1] Ramsay presented the description to the Linnean Society of New South Wales on 26 July 1875, but the proceedings were not published until 1877 (Ramsay 1877*a*). The description was published on 28 July 1875 in the Sydney Morning Herald, and both events confirmed by Ramsay to the Society in December 1875 (Ramsay 1877*b*).

[2] Laconi, from Taveuni. Vuni-as may be mis-interpreted. "Vuniyasi" means 'yasi tree' and it is probable that Layard was given the name in which the birds were perched, rather than the local name for the lorikeet (Geraghty *pers. comm.*).

Presence on Vanua Levu

The red-throated lorikeet was never collected from the island of Vanua Levu. Clunie (1984) first included Vanua Levu in the species' range, although he made no positive sightings of the species on the island (Clunie *pers. comm.*). This has been reiterated in most subsequent literature (Pratt *et. al* 1987, Collar *et. al* 1994, Juniper & Parr 1998, Clunie 1999, Stattersfield & Capper 2000, Watling 2001). Although there seems no reason why the lorikeet should *not* exist on Vanua Levu, the only evidence so far is a sighting on the Natewa peninsula in 1993 by J. Kretzschmar[3].

Species description

Descriptions can be found in Amadon (1942), Forshaw (1989), Clunie (1984, 1999) and Watling (2001). A delicate, long-tailed green lorikeet with a red throat bordered below with yellow, red thighs and a yellow-tipped tail. Some tail feathers have inner webs marked with crimson patches. The sexes are similar and have an orange bill and legs. Immature birds have purplish-brown thighs and the plumage and red throat is duller. The species' call of squeaky, creaking cries (Clunie 1999) or a brief, high-pitched monosyllabic squeak (Watling 2001) is given in flight or when feeding. Morphometric measurements of specimens are given in Appendix VI.

The red-throated lorikeet is most easily confused in the wild with the collared lory *Phigys solitarius*, with which it may be sympatric (Juniper 1998). Although the birds are of similar length (18-19 cms), the two birds are surprisingly different. In addition to plumage colour, the 'thumb-sized' body and long tail of the delicate lorikeet contrast strongly with the chunky short-tailed lory.

Habitat

The red-throated lorikeet is found in mature old-growth forest, usually at altitudes above 500 m (Clunie 1999, Watling 2001). Recent sightings have been clustered around the Nadarivatu / Nadrau plateau (above 700 m) and Mt. Tomaniivi (up to 1325 m). Early records of birds at lower altitudes have been made in Suva (Wood & Wetmore 1926), in mangroves on Ovalau (J. Kretzschmar *pers. comm.*) and at Joske's Thumb (Clunie 1979). A specimen collected by Tarte probably came from the south of Taveuni, which is mostly below 200 m but does include steep peaks up to 800 m.

Ecology and behaviour

The little information there is about the species' ecology is gleaned from early accounts (Ramsay 1875, Layard 1876, Wood & Wetmore 1926), recent publications (Clunie 1979, 1984, Watling 2001) and observations (Watling *pers. comm.*). Some habits may be inferred from the ecology of other *Charmosyna* species. The species is a nectar and pollen feeder, and may suddenly appear at a flowering tree, in a small flock (recently two to eight birds) and making a lot of noise. Birds restlessly move between flowers in the canopy, hanging upside down or in any position to get at the nectar, and have a preference for brightly coloured (red, yellow or white) flowers with filamentous pistils, such as vuga *Metrosideros collina,* and drala *Erythrina* sp.. They may feed alongside wattled honeyeaters *Foulehaio carunculata* and collared lorys, and which they may variously chase or be chased by. There is no evidence to support "nomadic" behaviour and there are no breeding records.

DISCUSSION

THE SURVEY

Why did we not find the red-throated lorikeet ?

Lorikeets of the *Charmosyna* genus are well known for their elusiveness and even the more common species can be inconspicuous. Nomadic behaviour and sudden appearances in small flocks at flowering trees are characteristic of some species. Most species are more common in mountainous regions in wet, upland forest that receives high annual rainfall (up to 10,000 mm) and is often covered in cloud. The Papuan lorikeet *C. papou* has been recorded as high as 3,500 m elevation. Eleven of the 14 species are largely green and confusion with other small parrots living alongside them makes identification difficult.

[3] Although sightings by individuals are treated with caution, Kretzschmar was an experienced ornithologist with considerable Fijian experience.

Bad weather was the main factor that affected our ability to find the lorikeet and we lost many days and part-days to heavy rain. Low cloud over forest was normal during rainstorms, in early morning and late afternoon – the best time to search – and reduced visibility. Accessing forest was our second problem. Only at Monasavu could we cover a large area, although even here we mostly viewed forest from the roadsides. Elsewhere, few usable trails existed and fieldwork was often limited close to camps. Time was lost finding trails and good viewpoints, and the quality of viewpoints varied.

Why we should have found the lorikeet ?

Effort was focussed at Monasavu where recent sightings have been made. Habitat was not limiting at our study sites and the hours spent in good habitat should have resulted in some observations. Observations were made at flowering vuga trees, a quality food resource for the lorikeet, but only resulted in sightings of other nectarivorous species. Encounter rates with the similar-sized collared lory reflected our ability to detect a small parrot with relative ease. Although the lorikeet call was not known, it is probably fairly distinctive as a 'small parrot' call. Bird calls were quickly learnt and eliminated as belonging to other species.

HAS THERE BEEN A DECLINE IN THE RED-THROATED LORIKEET POPULATION ?

Historical specimens and observations suggest that there has been a decline in the red-throated lorikeet population, even though some early accounts suggested it was difficult to find. Layard collected nine birds in a period of 18 days and Beck collected 12 specimens in only 13 days, suggesting that they were relatively easy to obtain. Ramsay (1875) recorded a flock of thirty birds, and Layard (1875) recorded 'considerable numbers'. In recent times flocks have rarely numbered more than between three and five individuals.

A population decline can also be inferred from: habitat loss and changes in habitat quality, particularly in the last 30 years; the introduction of black rats, cats and mongoose and their known effect on island faunas; the rarity and decline in other Fijian birds reliant on mature old-growth forest (such as the black-faced shrikebill *Clytorhynchus nigrogularis* and pink billed parrotfinch *Erythrura kleinschmidtii*) and the rarity and decline of other small parrots from the Pacific Islands, including other *Charmosyna* species.

Causes of decline

Introduced species
The black rat *Rattus rattus* has been identified as one of the possible causes of decline and rarity of the red-throated lorikeet. Nest predation by *R. rattus* has caused local extinctions of *Vini* lorikeets on small islands in the Pacific. *R. rattus* is particularly implicated, being more arboreal and forest-living than other species. In tropical forests in Mauritius, density of *R. rattus* may average 3.2 rats per hectare (range 0.7 - 6.1 rats per hectare) (D. Hall *pers. comm.*). Pacific lorikeets may increase their vulnerability to rat predation when nesting in open or partially exposed sites, such as in coconut palms (*Vini kuhlii*) or fern-bases, moss-growths and epiphytes (*Charmosyna pulchella*, *C. papou*, *C. meeki*, *C. josephinae* and *C. placentis*) (Juniper & Parr 1998, Low 1998). An observation from a villager in Fiji suggested that the red-throated lorikeet (or collared lory) may sometimes nest in fern-bases.

The impact of introduced mongooses and cats on island birds is well known, and has already contributed to the disappearance from Fiji of rails, junglefowl, swamphen and seabirds. Ground-living species are at greatest risk, but arboreal species can also be affected. In Mauritius, cats are the greatest threat to the endemic pink pigeon *Columba mayeri*, and both cats and mongooses have contributed to the decline of the Mauritius kestrel (Jones 1987). In Fiji, Gorman (1975*b*) found 26% of mongoose scats to contain bird remains. Logging activities and infrastructure development will encourage the spread of introduced species further into native forest.

Habitat
It is difficult to see how current habitat availability could be a limiting factor for the red-throated lorikeet. Most habitat loss in Fiji has occurred in the lowlands and large areas of upland forest remain intact. On the islands of Viti Levu, Vanua Levu, Taveuni and Ovalau, about 51% (8,332 km^2) of land is natural forest. The red-throated lorikeet is reliant on mature old-growth forest, which currently accounts for about 25% (1,273 km^2) of natural forest on Viti Levu, 47% (1,402 km^2) of natural forest on Vanua Levu and 37% (30 km^2) of natural forest on Ovalau. On Taveuni (435 km^2) about 50% is forest (Watling 1998).

Human persecution

There is no record of red-throated lorikeets being hunted on a scale large-enough to cause population decline. In the Pacific islands, the historical trade in red feathers from red shining parrots and collared lorys, used for mats and clothing, probably did not affect the red-throated lorikeet as the amount of red-feathers available was too small. However, it is worth documenting details of the claim that the decline of several species, including the red-throated lorikeet and the masked shining parrot *Prosopeia personata*, was due to 'excessive collection' by the Whitney South Seas Expedition, which visited Fiji between 1924 and 1925. Porter (1934), supported by Tavistock (1934*a*, 1934*b*), claimed that 47 red-throated lorikeets were shot for collection, when a permit was given for only five, and that the expedition had 'apparently exterminated' the species as a result. This claim was refuted by Chapman (1934*a*, 1934*b*), Curator of birds at the American Museum of Natural History, who maintained that only 12 specimens were obtained, and the ease with which these birds were obtained suggested that the species was not rare. I have been able to trace only 12 specimens from the Whitney Expedition (Appendix VI) suggesting that the original claim was untrue.

CONCLUSIONS

The red-throated lorikeet may be more rare than previously believed, as no birds were observed during a three-month field survey. Current population estimates are based on IUCN category thresholds and there is no supporting field data. The population has probably declined since the last century and most recent sightings have been clustered in the central highlands of Viti Levu. It is not known if the species still survives on other islands. The only identifiable factor that may have contributed to this decline is predation by introduced black rats. More recently, habitat loss and degradation may have contributed, and will increasingly threaten forest bird populations. Further information about the species is urgently needed so that conservation measures can be initiated. The legal protection of forests at Wabu and the Sovi Basin in Viti Levu, and the Bouma National Heritage Park in Taveuni would contribute to the conservation of this species.

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APPENDIX I: THE FIJI ENVIRONMENT

The Fiji Islands are located in the subequatorial tropics, about 3000 km east of Australia and 850 km east of Vanuatu. Most islands lie between longitudes 177° W and 177° E and latitudes 15° and 22° S (Figure 1). Fiji forms a cluster of more than 300 islands, occupying an ocean territory of about 650,000 km^2. The total land area of 18,333 km^2 (less than 3% of the ocean territory) is occupied mostly by two large islands, Viti Levu (10,390 km^2) and Vanua Levu (5,538 km^2), and two mid-sized islands, Taveuni (434 km^2) and Kadavu (408 km^2). Viti Levu is the second largest island in the Tropical Pacific, closely comparable in size to the island of Hawaii.

The larger and intermediate-sized islands are mostly volcanic in origin. The larger islands have mountainous interiors rising to elevations of 1323 m (Mt. Tomaniivi) on Viti Levu, 1241 m (Uluiqalau) on Taveuni, 1032 m on Vanua Levu and 838 m on Kadavu. On Viti Levu, a mountain chain runs north-south across the island, dividing the island into a wet (windward) and dry (leeward) zone. Taveuni has a mountain range along the spine of the island with scoria cones, craters, surface ash layers and Holocene lava flows.

CLIMATE

The climate is oceanic, with a warmer season between November and April and a slightly cooler season between June and October. Mean coastal air temperatures range from 26°C in January to 22°C in July, but this falls to a mean annual temperature between 19°C and 20°C in the upland interior of Viti Levu, Taveuni and Vanua Levu (Wright 1958). The south-east trade winds, that dominate the wind pattern, and the mountainous topography of Fiji have marked effects on rainfall and vegetation. Annual rainfall rises from between 2000 mm and 3000 mm on the windward south east coasts up to between 5000 mm and 10,000 mm on mountain ranges, and declines to 1500 mm on the leeward north west coasts. Cyclones occur every few years (Ash 1992).

VEGETATION

Descriptions of the principal vegetation types of Fiji can be found in Twyford and Wright (1965), Cochrane (1969), Parham (1972), Berry and Howard (1973), Smith (1951, 1979), Ash (1992) and Mueller-Dombois and Fosberg (1998). Climate, topography and historical human activities have influenced the vegetation types. Prior to the arrival of Polynesian, and later Melanesian, settlers 4000 years ago, the islands were mostly forested with some relatively small areas of native grassland in the dry zone. The aboriginal population practised a shifting, clearance type of agriculture around the coast and inland along river valleys creating a mozaic of secondary habitats and extensive areas of grassland using fire. A large industrious population in the inland parts of major islands suggests that secondary habitats have been present for a long period in prehistory and have been an important habitat for native species. European forestry and agriculture and the development of large-scale cash crops further increased secondary habitats, changed the floral composition through the introduction of weeds and increased the land under permanent cultivation (Pernetta and Watling 1978).

Rainforest is the predominant native terrestrial vegetation type in Fiji but species composition and structure varies in response to landform, geology, climate and the prevailing winds (Figure 2*a*). Upland rainforest principally lies above 600 m altitude. The vegetation of the wet mountain zone is principally made up of two conifers, *Agathis vitiensis* and *Podocarpus vitiensis*, mixed with dominant broad-leaved species also found in lowland rainforest. The myrtaceous species *Metrosideros collina* is significantly more abundant in the montane environment. Canopy height is between 20 m and 30 m, and there are many small trees, epiphytes, climbers, ferns and herbs.

With increasing altitude, there is a decline in species diversity and in canopy height. Inland the cloud base is reached at between 900 m and 1100 m, giving rise to mountain ridges supporting stunted mossy cloud forests with a reduced canopy height of between 3 m and 7 m and dominated by climbing *Freycinetia*, epiphytes and bryophytes. Good examples were seen at Mt. Tomaniivi in Viti Levu and Mt. Koroturaga in Taveuni, where mean annual rainfall was recorded as 9970 mm (average daily rainfall 27 mm) (see Ash 1988).

Deforestation

Loss of native forest and reduction in forest quality are the most important threats to Fiji's endemic birds. Deforestation is ongoing but the rate is unknown. The principal causes of deforestation and reduction in forest quality in Fiji are clearing of forests associated with large and small scale agriculture and rural development projects, spread of small settlements, urban growth and infrastructure (roads, dams), fire, logging and conversion to mahogany plantation. Poor logging practices affect the ability of forest to regenerate and enrichment with mahogany *Swietenia*

macrophyla will gradually convert natural forest into hardwood plantations, with a major effect on biodiversity. Fire is the single most damaging causative agent of deforestation and works in conjunction with, or is facilitated by, logging and cyclones (Watling 1998).

PROTECTED AREAS

The Fiji Government has no wildlife management or conservation department and the few legally protected areas (comprising 5,647 ha or 0.3% of land area) are not actively managed. Mt. Tomaniivi in Viti Levu (1,323 ha) and Ravilevu in Taveuni (4,018 ha) are legally gazetted Nature Reserves that could be important to the conservation of the red-throated lorikeet. The Bouma National Heritage Park (Taveuni) is currently in a transitional stage to legal status (Watling 2001). The Wabu Forest in Viti Levu (c. 500 ha) is an informal protected area, leased by the Department of Forestry. The Sovi Basin (19,600 ha) has also been proposed for protection (Cabaniuk *et. al*). The permanent protection of these three sites would contribute to the conservation of the red-throated lorikeet and many other forest-dependent species.

INTRODUCED SPECIES

It is well known that rats have contributed to the decline and extinction of island birds (Atkinson 1985). Three species of rat have been introduced to Fiji. The Polynesian rat or kiore *Rattus exulans* was an aboriginal introduction, the earliest estimate of which is between 3000 B.P. and 2700 B.P. (Roberts 1991, Nowak 1999). Europeans introduced black and Norway rats in the 19th century (Pernetta & Watling 1978) and both are typically commensal with man. The black rat is more common and widespread in the tropics than the Norway rat, and is an agile climber. In parts of Asia and the south Pacific including Fiji, two forms of black rat have been identified through morphological and physiological differences, predominantly grey or white underparts (Corbet and Hill 1991), one of which may be a distinct species *R. tanezumi*, (Wilson & Reeder 1993, Nowak 1999). When all three species are found in forest, black rats may exclude Norway and Polynesian rats, with the latter often becoming extinct. Polynesian rats are only known to coexist with the other two species in two areas of New Zealand (Thorsen *pers. comm.*). In Fiji, Polynesian, black and Norway rats have been recorded in agricultural, urban, suburban, plantation and coastal areas (Pernetta & Watling 1978), but no previous studies had been made in native forest.

The lesser Indian mongoose *Herpestes auropunctatus* was introduced to Fiji in 1883 to control rats in cane fields (Gorman 1975*b*), but is absent from some large islands notably Taveuni and Kadavu. It has been implicated in the decline of native birds in Mauritius, Hawaii and Fiji (Pernetta & Watling 1978, Jones 1987, Stone 1994). Domestic cats may have only been introduced by Europeans (Pernetta & Watling 1978) and it is probable that truly feral populations exist.

APPENDIX II: Description of study sites

VITI LEVU

Monasavu Dam / Nadrau Plateau

Base camp	Fiji Electricity Authority hydro-electric power station headquarters at Monasavu dam.
Second camp	Power Project 3 Dam.
Access	Public road up to Navai and Nadrau villages, and FEA roads around the dam.
Permission	Naitasiri Provincial Office, Tui Nadrau, FEA and military officers stationed there.
Forest type	Large areas of unlogged, upland rain forest. Some cleared and disturbed areas from dam construction and maintenance. Forest stunted at high exposed elevations. Patchy around villages, mixed with agricultural and forestry plantations and secondary forest.
Protected areas	The entire watershed against woodcutting, but not a designated reserve, managed by FEA.

Mt. Tomaniivi and Wabu Nature Reserve

Camp	At Navai village (with Turaga-ni-koro Eliki Namatalau) and at Wabu Reserve boundary
Access	From Navai village along trails
Permission	Naitasiri Provincial Office and Tui Navai
Forest type	Mostly upland rain forest. At high elevations in Mt. Tomaniivi and Wabu Reserves, stunted mossy cloud forest. Wabu and Mt. Tomaniivi Reserve unlogged but east of Wabu and outside the Reserve logged and enriched with mahogany. Patchy around village with agricultural and forestry plantations and secondary forest. Trail along lower slopes of Mt. Tomaniivi heavily invaded with *Lantana camara*.
Protected areas	The Department of Forestry manage Mt. Tomaniivi Nature Reserve (1,323 ha) and lease the Wabu protected area (c. 500 ha).

Narokorokoyawa, Wainimala

Camp	South-east of Narokorokoyawa village. Highest point on north-west boundary of Sovi Basin.
Access	From Sawanikula village where road ends. Cross Wainimala river to Narokorokoyawa village. Guided to campsite via a ridge trail towards Nakeva peak, used fairly regularly by villagers.
Permission	Naitasiri Provincial Office and Tui Narokorokoyawa.
Forest type	Camp at about 500 m, transition between upland and lowland rainforest. Patchy, forest edge, some agricultural plantations and secondary forest. High elevation unlogged upland rainforest, stunted on exposed slopes.
Protected areas	Adjacent Sovi Basin is being proposed as a protected area.

TAVEUNI

Des Voeux Peak

Camp	Des Voeux Peak adjacent to Fiji Telecoms station.
Access	4WD private Telecoms track from Wairiki village (8 kms) on coast.
Permission	Taveuni Provincial Office (at Somosomo) and Fiji Telecoms.
Forest type	Unlogged upland rain forest. At exposed peak, stunted, wet, mossy cloud forest.
Protected areas	None.

Mt. Koroturaga, Bouma National Heritage Park

Camp	On trail, below Mt. Koroturaga peak.
Access	From Vidawa, guided by Isake Delai.
Permission	Taveuni Provinicial Office. Also contacted Bouma National Heritage Park Visitor Centre at Tavoro., and Isake Delai at Vidawa.
Forest type	Unlogged, upland rainforest. Cloud forest on exposed ridge above camp.
Protected areas	Bouma National Heritage Park proposed. A landowner-managed initiative established in 1990, with assistance from the New Zealand Government and Fiji Native Lands Trust Board.

APPENDIX II (continued)

Qeleni Road

Access	From Vunidawa on coast.
Permission	Taveuni Provincial Office. Visits can be organised through Garden Island Resort at Waiyevo (guide Paul Labela).
Forest type	Secondary forest, coconut plantations, agricultural plantations.
Protected area	None.

Soqulu Estate

Access	Soqulu (Taveuni) Estates.
Contact	Soqulu Estates and Pete Hilton (resident bird enthusiast).
Forest type	Mostly secondary forest with patches of native trees. Cleared for farming and housing, much of it recently. Above the estate, slopes up to better quality rainforest but access only with guides.
Protected area	None.

APPENDIX III: Site descriptions at rat transects

1. Monasavu, Viti Levu

TRANSECT 1: 28/11/01 –1/12/01

Located 15m from road, near stream. Vegetation dominated by tree ferns and *Piper* sp. Trees are stunted (possibly due to waterlogging), canopy maximum 12m. Undergrowth dense with regeneration evident. Rat line avoided the road and stream. Terrain: undulating slopes, vegetation shorter at top of slope with more ground cover (mainly Zingibraceae).

TRANSECT 2: 17/12/01 –21/12/01

Located on forested ridge 300m-350m from FEA buildings at Monasavu Dam site, along ridge following small path used by pig hunters. Canopy of native species, stands at 20m-25m. Undergrowth light/medium density, of fern species and saplings of canopy species. Invasive *Piper* sp. absent , very little Zingibraceae.

2. Wainimala, **Viti Levu**

TRANSECT 3: 17/01/02 – 23/01/02

Located on small spur, 50% flat, 50% on steep slope, followed old path for the most part, final 75m cut down slope. Tall forest at 20m-23m with emergents at 25m-30m. Understory vegetation sparse, some ferns, tree ferns, but mainly saplings.

3. Des Voeux Peak, Taveuni

TRANSECT 4: 06/02/02 – 10/2/02

Located in shallow basin at summit of Des Voeux Peak. Palm-rich forest with canopy at 18m-22m. Very wet substrate, many small creeks appearing with rain. Understory, ferns, tree ferns and saplings, dense in places.

4. Monasavu, Viti Levu

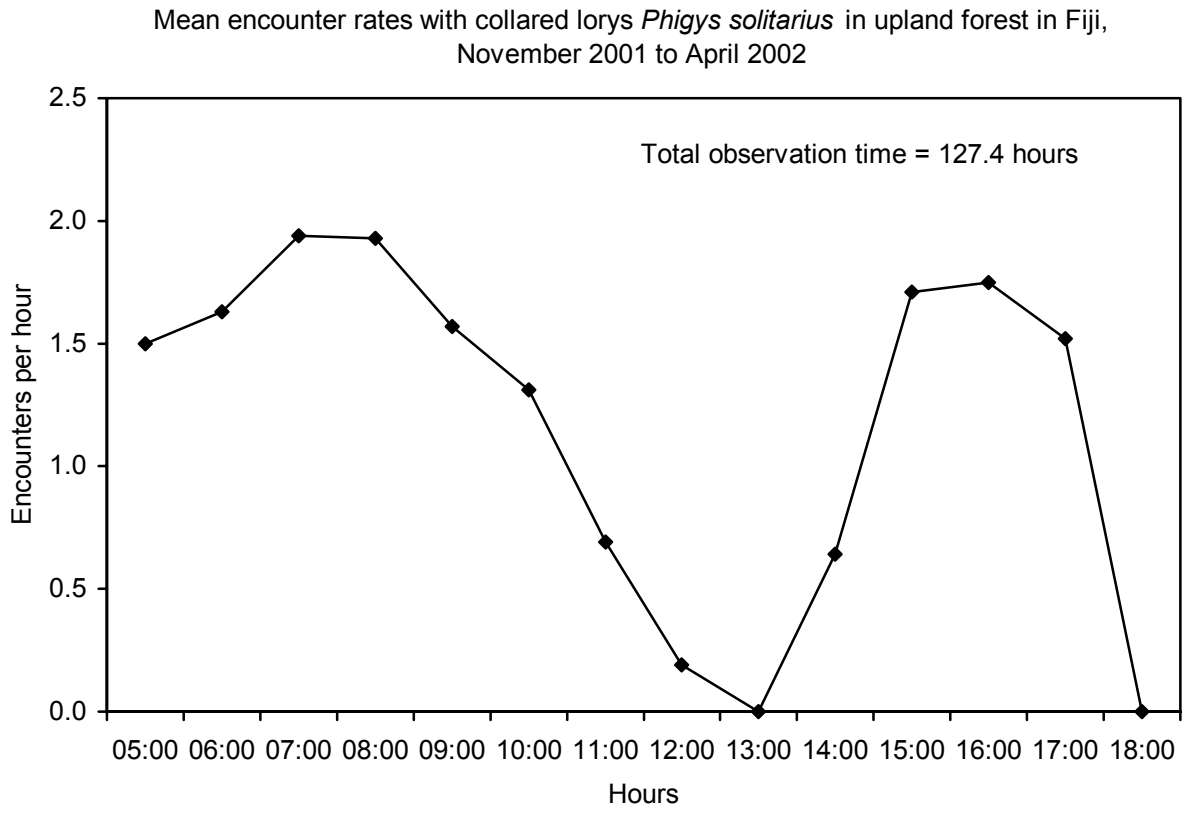
TRANSECT 5: 01/04/02 – 07/04/02

As for transect 2.

TRANSECT 6: 11/04/02 – 13/4/02

Located along grassy track (3m-4m wide) near dam. Forested on each side, with banana plants along track edge.

APPENDIX IV: Mean encounter rates with collared lorys in upland forest.



An encounter was defined as a sighting or a call of one or more birds in a group. Usually birds were seen or heard when flying rapidly above the canopy and each encounter was easily defined. When feeding, birds rarely remained on a tree for longer than one or two minutes. An encounter when feeding was defined as each time they reappeared at the tree. Where birds remained in view constantly, for example when feeding, their presence was recorded every five minutes. Data is combined from different sites on Viti Levu and Taveuni and was obtained during timed watches, and some timed walks.

APPENDIX V: Red-throated lorikeet specimens in museum collections.

Museums are: Macleay (Sydney), Liverpool (UK), British Museum of Natural History (Tring, UK), Australian Museum (Sydney), Philadelphia Academy of Sciences (USA), Natural History Museum Vienna (Austria), American Museum of Natural History (Washington), Delaware Museum of Natural History (USA), Fiji Museum (Suva Fiji), Victoria Museum (Melbourne).

Collection	Collection No.	Collector	Date collected	Locality	Sex	Comments
n/a	n/a	C. Pearce	17 June 1875	Ovalau	Male	TYPE, description only (Ramsay 1875)
n/a	n/a	C. Pearce	17 June 1875	Ovalau	Female	TYPE, description only (Ramsay 1875)
n/a	n/a	C. Pearce	15 June 1875	Ovalau	Unknown	TYPE for *aureicinctus*, description only (Layard 1875)
Macleay	B.1797	C. Pearce	Unknown	Ovalau	Male	Paralectotype (Fisher & Longmore 1995)
Macleay	B.1798	C. Pearce	Unknown	Ovalau	Male	Lectotype (Fisher & Longmore 1995)
Macleay	B.1799	C. Pearce	Unknown	Ovalau	Female	Paralectotype (Fisher & Longmore 1995)
Macleay	B.1799a	C. Pearce	Unknown	Ovalau	Female	Paralectotype (Fisher & Longmore 1995)
Liverpool	T.2774	C. Pearce	15 June 1875	Ovalau	Unknown	TYPE, Syntype *aureicinctus* (Fisher & Longmore 1995)
Liverpool	T.2773	E.L. Layard	August 1875	Taveuni	Unknown	
BM-Tring	89.1.20.106	E.L. Layard	1 Aug 1875	N'Gila, Taveuni	Male	Food: flowers. Beak: orange, legs: orange, iris: buff
BM-Tring	89.1.20.107	E.L. Layard	2 Aug 1875	N'Gila, Taveuni	Female	Food: flowers. Beak: orange, legs: orange, iris: buff
BM-Tring	89.1.20.108	E.L. Layard	22 July 1875	N'Gila, Taveuni	Female	Food: flowers. Beak: coral, legs: coral, iris: pale scarlet
BM-Tring	89.1.20.146	E.L. Layard	22 July 1875	Taveuni	Male	Food: flowers. Beak: coral, legs: coral, iris: pale scarlet
BM-Tring	89.1.20.178	E.L. Layard	2 Aug 1875	N'Gila, Taveuni	Male	Food: flowers. Beak: orange, legs: orange, iris: buff
BM-Tring	98.12.2.167	E.L. Layard	18 Aug 1875	N'Gila, Taveuni	Juvenile	Food: flowers. Beak: orange, legs: orange, iris: buff
BM-Tring	98.12.2.168	E.L. Layard	1 Aug 1875	N'Gila, Taveuni	Male	Food: flowers. Beak: orange, legs: orange, iris: buff
BM-Tring	98.12.2.169	E.L. Layard	2 Aug 1875	N'Gila, Taveuni	Female	Food: flowers. Beak: orange, legs: orange, iris: buff
BM-Tring	1912.6.14.8	A.R. Tarte	24 Jan 1912	Taveuni	Female	(Juvenile)."Lived in confinement for 4 months"
Australian	A2646	J.A. Boyde	Sept 1878[1]	Fiji	Female	
Australian	30595	Grant	1902[1]	Fiji	Unknown	
Australian	A836	W.J. Abbott[2]	Nov 1877[1]	Levuka, Ovalau	Female	"kulawai"
Australian	Unknown	W.J. Abbott	Unknown	Levuka, Ovalau	Unknown	No details, on loan to J. Forshaw
Philadelphia	50571	E.L. Layard[3]	1877	Unknown	Male	Obtained from Australian Museum
Vienna	49.948	Th. Kleinschmidt	mid Dec 1875	Taveuni	Male	Obtained from Museum Godeffroy (No. 12809) in 1877
AMNH	618263	Th. Kleinschmidt[4]	Unknown	Viti Levu	Male	Native name: Thula Wai
AMNH	618264	Th. Kleinschmidt	Unknown	Viti Levu	Unknown	Native name: Thula Wai
AMNH	618265	Th. Kleinschmidt	Unknown	Viti Levu	Male	Native name: Thula Wai
AMNH	618266	Th. Kleinschmidt	Unknown	Viti Levu	Male	Native name: Thula Wai
AMNH	618267	Th. Kleinschmidt	Unknown	Viti Levu	Male	Native name: Thula Wai
AMNH	618268	Th. Kleinschmidt	Unknown	Viti Levu	Unknown	

APPENDIX V: (continued)

Collection	Collection No.	Collector	Date collected	Locality	Sex	Comments
AMNH	618269	Th. Kleinschmidt	Unknown	Viti Levu	Unknown	
AMNH	221440	R.H. Beck	5 May 1925	Viti Levu	Female	Iris/legs/bill: yellow. Sex organs: swelling
AMNH	249464	R.H. Beck	5 May 1925	Viti Levu	Female	Iris/legs/bill: yellow. Sex organs: swelling
AMNH	249465	R.H. Beck	5 May 1925	Viti Levu	Female	Iris/legs/bill: yellow. Sex organs: swelling
AMNH	249466	R.H. Beck	6 May 1925	Viti Levu	Female	Iris/legs/bill: yellow. Sex organs: swelling
AMNH	249468	R.H. Beck	7 May 1925	Viti Levu	Female	Iris/legs/bill: yellow. Sex organs: small
AMNH	249469	R.H. Beck	8 May 1925	Viti Levu	Female	Iris/legs/bill: yellow. Sex organs: small
AMNH	249470	R.H. Beck	8 May 1925	Viti Levu	Female	Iris/legs/bill: yellow. Sex organs: small
AMNH	249471	R.H. Beck	13 May 1925	Viti Levu	Female	Iris/legs/bill: yellow. Sex organs: swelling
AMNH	249472	R.H. Beck	13 May 1925[5]	Viti Levu	Female	Iris/legs/bill: yellow
Ex-AMNH	249473	R.H. Beck	13 May 1925	Viti Levu	Male	Given to Dr. Streseman in Berlin, 1927
DMNH [AMNH]	39670 [249463][6]	R.H. Beck	1 May 1925	Viti Levu	Female	Iris: orange, bill & feet: yellow, sexual organs swelling
DMNH [AMNH]	39671 [249467][6]	R.H. Beck	6 May 1925	Viti Levu	Male	Iris, bill & feet: yellow, sexual organs small
Fiji, Suva	Unknown	F. Clunie	17 Sep 1977	Nadarivatu, Viti Levu	Female	Caught in a mist net
Victoria	57589	Unknown	Unknown	Unknown	Unknown	Mounted. No details, on loan to J. Forshaw
Victoria	57590	Unknown	Unknown	Unknown	Unknown	Mounted. No details, on loan to J. Forshaw

Notes:

[1] Date registered with the museum.

[2] Also on museum's records as donated by Abbott: one specimen exchanged to Walter Chamberlain (see note [3]) and two missing from the collection.

[3] Specimen obtained from the Walter Chamberlain collection in exchange with the Australian Museum, and is probably the same specimen as detailed in note [2].

[4] Kleinschmidt collected for the Godeffroy Museum, Hamburg, between 1850 and 1880 (Watling 1982). Wood & Wetmore (1926) state 'five skins in the Tring Museum were collected by T. Kleinschmidt in the interior of Viti Levu about 1872' (but not currently at Tring).

[5] Date not recorded but assumed same as specimen before and after.

[6] Acquired from AMNH, [ ] = AMNH old collection number.

APPENDIX VI: Morphometric measurements of historical specimens of the red-throated lorikeet.

(a) Type descriptions and type relevance of specimens in the Macleay Museum (Sydney) and Liverpool Museum (UK). (Fisher & Longmore 1995). Measurements in inches.

Collection	Collection number	Sex	Total length	Wing	Tail	Tarsus	Bill	Culmen	Comments
n/a	n/a	Male	6.70	3.60	3.25	0.46	0.50	0.35	TYPE description (Ramsey 1875)
n/a	n/a	Female	6.50	3.60	3.05	-	-	-	TYPE description (Ramsey 1875)
Macleay	B.1797	Male	6.40	3.50	2.80	0.50	0.60	0.45	Paralectotype
Macleay	B.1798	Male	6.70	3.50	3.10	0.55	0.55	0.40	Lectotype
Macleay	B.1799	Female	6.60	3.60	3.00	0.55	0.55	0.40	Paralectotype
Macleay	B.1799a	Female	6.00	3.30	2.80	0.50	0.60	0.40	Paralectotype
n/a	n/a	Unknown	6.50	3.50	3.25	0.35	0.50	-	TYPE description for *aureicinctus* (Layard 1875)
Liverpool	T. 2774	Unknown	6.50	3.65	3.00	0.50	0.45	-	TYPE (Layard 1875). Syntype for *aureicinctus*

(b) Published morphometric measurements of red-throated lorikeet specimens. Measurements in mms. Sample mean given in brackets.

Sex	No. birds	Wing	Tail	Tarsus	Exposed culmen	Source
Male	4	93, 94, 96, 96	75, 77, 79?, 83	-	-	Amadon (1942)
Female	6	92, 92?, 93, 93?, 96, 97	75?, 77, 78, 80, 82, 84	-	-	Amadon (1942)
Male	10	94-100 (96.3)	69-79 (72.8)	12-13 (12.5)	10-11 (10.8)	Forshaw (1989)
Female	8	91-96 (93.9)	68-80 (74)	12-13 (12.4)	10-11 (10.8)	Forshaw (1989)

APPENDIX VI (continued)

(c) Morphometric measurements from museum specimens of red-throated lorikeets. Measurements are in millimetres. Specimens in Table (a) re-measured. Collections are Australian Museum (Sydney), Macleay Museum (Sydney) and British Museum of Natural History (Tring, UK).

Collection	Collection Number	Sex	Total length	Wing	Tail	Culmen -feathers	Culmen -skull	Culmen -gape	Comments
Australian	A2646	Female	162.0	92.0	74.0	11.8	-	10.3	
Australian	A836	Female	153.0	89.0	72.0	12.6	-	10.2	
Tring	89.1.20.107	Female	160.0	98.0	78.0	12.0	14.5	13.0	
Tring	89.1.20.108	Female	154.0	98.0	72.0	-	-	-	
Tring	98.12.2.169	Female	167.0	93.0	85.0	11.7	14.2	12.1	Paralectotype (Fisher & Longmore 1995).
Macleay	B.1799	Female	165.0	91.0	86.0	12.2	-	11.5	Paralectotype (Fisher & Longmore 1995).
Macleay	B.1799a	Female	155.0	86.0	69.0	11.9	-	11.3	
Tring	89.1.20.106	Male	158.0	98.0	86.0	13.3	17.0	12.2	
Tring	89.1.20.146	Male	165.0	-	85.0	11.8	14.0	12.4	
Tring	89.1.20.178	Male	160.0	99.0	75.0	11.9	14.1	13.2	
Tring	98.12.2.168	Male	163.0	100.0	85.0	12.6	15.2	12.6	Lectotype (Fisher & Longmore 1995).
Macleay	B.1798	Male	170.0	95.0	89.0	12.1	-	11.2	Paralectotype (Fisher & Longmore 1995).
Macleay	B.1797	Male	160.0	92.0	79.0	13.6	-	10.8	
Australian	30595	Unknown	169.0	92.0	90.0	12.8	-	11.9	
Tring	98.12.2.167	Juvenile	158.0	93.0	83.0	-	15.2	12.3	
Tring	1912.6.14.8	Juvenile female	155.0	92.0	77.0	-	15.6	14.0	

APPENDIX VII: Red-throated lorikeet sightings from 1965

Observer	Date seen	Location		Altitude (m)[1]	Comments	Reference
		Island	Locality			
Watling	1965 - 1973	Viti Levu	Nadarivatu/Nadrau	> 800	Two observations at Lomalagi and one near Navai. No more than three birds[2].	Pers. obs.
Clunie	1972	Viti Levu	Joske's Thumb	433	In fresh peregrine prey remains, feathers & contents of pellets. Not confirmed by fossil bone material from the eyrie.	Clunie (1972). Worthy (1999).
Gorman	Nov 1970 - May 1973	Viti Levu	Nabukulevu	120-180	78 hours observation at 150m–610m. Seen infrequently, rare.	Gorman (1975*a*)
Gorman	Nov 1970 - May 1973	Viti Levu	Nadarivatu plateau: Navai to Nadrau	760-910	25 hours observation. Seen infrequently, rare.	Gorman (1975*a*)
Gorman	Nov 1970 - May 1973	Viti Levu	Mt. Tomaniivi	610-910	26 hours observation.	Gorman (1975*a*)
Blackburn	Aug / Sept 1970	Viti Levu	Nausori Highlands	< 550	Two birds by P. Crombie (unconfirmed)[3]. Not on Taveuni.	Blackburn (1971)
Holyoak	28 June – 6 July 1973	Viti Levu	Waisa, Vunidawa	200-250	Not uncommon on a forested ridge, seen twice and heard repeatedly (unconfirmed)[3].	Holyoak (1979)
Holyoak	28 June – 6 July 1973	Viti Levu	Naitaradamu	800	Several seen (unconfirmed)[3].	Holyoak (1979)
Holyoak	12 – 21 July 1973	Taveuni	Not stated	510-1000	Widespread in the rainforest, seen or heard on 5 days. Two feeding in canopy of a tall tree at 700m, with collared lory and wattled honeyeater (unconfirmed)[3].	Holyoak (1979)
Watling	Aug 1975	Viti Levu	Nadrau plateau	> 700	Small flock (4 or 5) seen feeding in a white flowered tree on path from Nadrau to Monasavu dam site along Nanuku Creek.	Pers. obs.
Beckon	1975 – 1978	Viti Levu	Nadarivatu/Nadrau Plateau	700-800	Photographs and video footage.	
Clunie	6 – 21 Oct 1979	Viti Levu	Nadrau plateau	730-820	Well known to everyone at Nadrau, saw 1 group of 3 and lone individual feeding in vuga, alongside kula. Said to be seen when vuga flowers, in small groups with kula in same tree.	Clunie (1979)
Watling	28 Sept 1981	Viti Levu	Road to Nadrau	c. 800	Three seen feeding in a white flowered tree, filamentous flower. Also present, collared lory, wattled honeyeater, orange-breasted honeyeater.	Pers. obs.
Watling	13 May 1985	Viti Levu	Mt. Tomaniivi	c. 800	Pair seen flying overhead at base of mountain.	Pers. obs.
Watling	22 Oct 1986	Viti Levu	Mt. Tomaniivi	> 800	Two or three seen briefly, flying and then visiting a vuga tree.	Pers. obs.
Watling	24 July 1991	Viti Levu	Mt. Tomaniivi (base)	c. 800	Pair in vuga with collared lory and wattled honeyeaters, for c. 15 minutes coming and going around the tree. At one point chased off a wattled honeyeater.	Pers. obs.

APPENDIX VII (continued)

Observer	Date seen	Location		Altitude (m)[1]	Comments	Reference
		Island	Locality			
Kretzschmar	Jan 1993	Vanua Levu	Natewa Peninsula, Navonu Forest Station	Unknown	Two in flight in secondary forest (unconfirmed)[4]. After Cyclone Kina.	Pers. obs.
Kretzschmar	c. 1993	Ovalau	Near airport	< 150	In flight[4].	Pers. obs.
Watling	12 Aug 1993	Viti Levu	Road to Nadrau	c. 800	Three seen on a flowering drala. Distant view for c. 10 minutes, feeding on flowers with collared lory.	Pers. obs.
Allport	Sept 1998	Viti Levu	Nausori Highlands	< 550	A single and a group of four or five. Observation was in dry conditions in the middle of an El Nino (unconfirmed)[3].	Pers. obs.
Hayman	10 June 2002	Viti Levu	Mt. Tomaniivi	800-1000	Two or three, visiting a red-flowered tree (unconfirmed)[3].	Pers. obs.

Notes:

[1] Altitudes recorded in feet have been converted to metres.

[2] Visited site 3-4 times a year for about two days.

[3] Observations are treated with caution if made: by an individual; an individual with no or little experience of Fijian birds; in an area in which they have not previously been recorded.

[4] Kretzschmar was an experienced ornithologist with considerable Fijian experience (but see note [3]).

A reference in the Appendix in Lees (1990) to a sighting in Taveuni has no supporting field data and is not included here.

APPENDIX VIII: Recommendations for further surveys

(a) Additional sites to survey for the red-throated lorikeet

Searches for the lorikeet should continue to focus on the Nadarivatu and Nadrau Plateaus, in particular around Mt. Tomaniivi. Sites additional to those detailed in this report include:

VITI LEVU

1. *Sovi Basin*: Access from Nadakuni village, but also possible from Delailasakau over the Waidina river.
2. *Wainimakutu to Nasava track*: this track, from the upper reaches of the Waidina to the Wainimala river, goes through good forest and could be surveyed in conjunction with the area around Narokorokoyawa village.
3. *Nabukelevu Village, upper Navua river*: focussing on the Navutulevu Forest concession area over the river. Logging roads could be used for access.

TAVEUNI

4. *Ravilevu Nature Reserve*: access from Lavena Village, which has a tourist lodge as a useful base.

VANUA LEVU

Areas in the north-east, centre and south-west need surveying, cross-island logging roads could provide access.

5. *Delaikoro Road*: the road, leading up to a transmitter, might be useful for access to forest from the road.
6. *Nakorotari*: accessible from Labasa.
7. *Drawa Village*: the village is embarking on a Sustainable Forest Management project with GTZ and the Forestry Department. Some good unlogged forest in an important area on Vanua Levu. Access could be arranged through the Chairman of the Landowner's Committee (Niko Vonokula) who works for FSC. Providing them with some information on birds would be useful.

OVALAU

8. Any area of good forest, in particular at higher elevations. Guided walks around Lovoni village can be organised.

(a) Recommendations for fieldwork

1. Consideration must be given to the organisation required prior to accessing forest, the physical difficulties of accessing forest and the weather. Field trips of at least one week per site is recommended.
2. Where the survey team is international, employ and train at least one local fieldworker for the duration of the survey (approximate cost FJ$ 20,000 per year).
3. A minimum of two people are needed to remain in the field during the survey, to support observations made by an individual, and to facilitate camp life. Villagers were reluctant to camp in the forest.
4. Use of a 4WD vehicle to transport fieldworkers, guides and equipment (approximate cost new £20,000). This would also enable more staff and/or volunteers to be recruited to the project.
5. Use of good quality, lightweight camping equipment, in particular stoves, tents and tarpaulins, to reduce baggage loads and to improve camp life in bad weather.
6. It is difficult to recommend optimum months in which to search. During the wet season, field trips may be delayed, observation time reduced and access across rivers restricted. Coinciding a field trip with vuga and drala flowering may increase chances of observing birds, but equally, the birds may disperse between trees.

Red-throated lorikeet specimens

Red-throated lorikeet (above) and collared lory (below) specimens

Collared lorys

A. Maljkovic, A. Naikatini, K. Swinnerton

Camp 2 Wabu Reserve

Vuga *Metrosideros collina*

Mt. Tomaniivi

Mossy cloud forest, Wabu Reserve

Montane forest at Monasavu. In the distance, Mt. Nakeva and camp 4.

North-west slopes of Des Voeux Peak, looking to Vanua Levu.

Tagimaucia lake from Des Voeux Peak

Talasiqa grasslands, Nausori Highlands