Status, distribution and conservation of the Ultramarine lorikeet *Vini ultramarina* in the Marquesas Islands, French Polynesia

Photo: Peter Odekerken

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SUMMARY

Island birds are particularly susceptible to human-induced changes because of their naturally small population sizes, their vulnerability to small environmental changes and their ecological naivety with respect to introduced species. The Ultramarine lorikeet of the Marquesas Islands, French Polynesia, is representative of the plight of a large suite of South Pacific island birds having undergone significant declines since the arrival of humans and is regarded as one of the most threatened of insular lorikeets. The decline in lorikeet numbers has closely parallelled the establishment of black rats on islands within its historic range. Black rats, as nest predators, are considered the main threat to the lorikeet's survival.

In an effort to establish the current status of Ultramarine lorikeet populations and to address the threat posed by introduced rats in the Marquesas Islands we initiated the first stage in a research and conservation program designed to increase our understanding of the species' biology and conservation requirements and to reverse or at least stabilise the species population decline. All islands within the species range were visited and surveyed for lorikeets. The small island of Ua Huka supports the only robust population of the lorikeet, estimated at 2375 (±612) individuals. Owing to its rat-free status this island is the only secure refuge for the species. Despite intensive efforts only a single individual was sighted on the island of Ua Pou while no lorikeets were found on Nuku Hiva. A population translocated to the island of Fatu Iva in the 1990s has undergone a drastic decline following the recent establishment of black rats on the island and is now on the brink of local extinction.

A study of the basic ecology of the species on Ua Huka and Fatu Iva revealed that the lorikeet utilises a large range of food resources, including nectar, fruit, seeds and insects from native species and a range of introduced plants. On Ua Huka lorikeets were found in all habitat types from sea level to cloudforest above 800m, however, highest concentrations occurred in coconut and fruit tree plantations at 100-200m altitude. Potential and actual nesting sites were noted in tree hollows of the species *Artocarpus altilis, Hibiscus tiliaceus, Pandanus tectorius, Pometia pinnata* and *Cocos nucifera.*

Conservation efforts focussed on reducing the threat posed by black rats on the islands of Ua Huka and Fatu Iva. Our efforts on Ua Huka concentrated on minimising the chances of establishment of rats on the island by introducing traps in the wharf area, studying the biology of the species and testing the use of artificial nest boxes by lorikeets. Our focus on Fatu Iva was to protect nest trees from rats, provide supplementary artificial rat-proof nest boxes and to identify and initiate rat control programs in favourable areas. Further urgent and more intensive efforts are required to save the Ua Pou and Fatu Iva populations from extinction while preventing the establishment of black rats on Ua Huka is of the highest priority.

RÉSUME

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1. INTRODUCTION

The South Pacific islands are recognised as having one of the highest rates of bird endemism in the world. This uniqueness is attributable to the isolation over long periods of time of the many small islands and archipelagos in the region. Paradoxically, this isolation also makes the region's birds among the most threatened. In historic times, the Pacific Islands claim the unenviable record of the highest rate of bird extinction as a proportion of total species of any region on the planet. Indeed, since the arrival of humans to the islands of eastern Polynesia more land birds have become extinct than currently exist (Steadman 1989). The susceptibility of the Pacific Islands' avifauna is a function of naturally small population sizes, confinement to islands that may be subject to rapid environmental changes and the relative inability of the islands' birds to cope with introduced predators or competitors of continental origin.

1.4 Status and distribution of the *Vini* genus in the South Pacific

The situation facing the South Pacific's avifauna is highlighted by the plight of its parrot species, particularly the *Vini* genus of lorikeets. The *Vini* are a group of small, colourful lorikeets consisting of five species ranging from Fiji in the west to Henderson Island in the south-east (Figure 1). Four species are considered endangered or vulnerable to extinction (IUCN 2000) while two species, *V. sinotoi* and *V. vidivici* have become extinct since human occupation of the region began (Steadman 1989) (Table 1).

Blue lorikeet *Vini peruviana*

The Blue lorikeet, although relatively widespread occurring from the Society Islands, the Tuamotu archipelago and the Cook Islands (to where it was probably introduced), is considered vulnerable having disappeared from 15 of the 23 islands it was once known to occur on. This species has been the subject of a captive breeding effort by the San Diego Zoo that has unfortunately been unsuccessful in establishing a healthy breeding population. There is a need for determining the current distribution and status of the species within the Society Islands and the Tuamotu archipelago which is currently poorly known.

Kuhl's lorikeet *Vini kuhlii*

The only surviving population within its natural range of Kuhl's lorikeet occurs on Rimatara in the central Pacific islands. Recent surveys of the island indicate that the population is stable there (Blanvillain 2002). Other introduced populations exist in the Austral Islands and on islands of Kiribati where the species occurs on only a few islands (Watling 1995).

Stephen's lorikeet *Vini stepheni*

This species inhabits Henderson Island, an uninhabited raised-reef island in the Pitcairn Group in the south-central Pacific. Its population size was estimated in 1987 to be between 720 and 1820 individuals (Graves 1992) and in 1992 around 1200 pairs (Trevelyan 1995). Its confinement to this one isolated island of 37 km² qualifies it as vulnerable.

Blue-crowned lorikeet *Vini australis*

Of all the *Vini* the status of the Blue-crowned lorikeet is considered most secure. It is common throughout much of its range and is endemic to islands in the Fiji group, Tonga, Samoa and parts of central Polynesia. It has nonetheless, declined in parts of its range and become locally extinct on some islands following the arrival of black rats.

TABLE 1: Conservation status and distribution of the *Vini* lorikeets in the South Pacific

Species	Common name	Distribution	IUCN status	CITES listing
Vini ultramarina	Ultramarine lorikeet	Marquesas Islands	EN	I
Vini kuhlii	Kuhl's lorikeet	Rimatara, Line Islands, Kiribati	EN	II
Vini peruviana	Blue (Tahitian) lorikeet	Some islands in Tuamotu, Society and Cook Islands	VU	II
Vini stepheni	Stephen's lorikeet	Henderson Island	VU	II
Vini australis	Blue-crowned lorikeet	Fiji, Tonga, Samoa, Niue Wallis & Futuna, American Samoa	Not listed	II
Vini vidivici	Conquered lorikeet	Extinct	-	-
Vini sinotoi	Sinoto's lorikeet	Extinct	-	-

1.5 Key threats

Throughout their respective ranges the *Vini* lorikeets are found in numerous habitats and seem to have adapted to small-scale changes in habitat as a result of agriculture and the establishment of cultivated gardens and plantations without adverse effects. In many cases they appear to have benefited from a greater range and more consistently available food resources and are commonly observed in village gardens and plantations (Holyoak and Thibault 1984; Seitre and Seitre 1991). This situation is analogous to that of other lorikeet species, for example, the adaptation and increase of musk and rainbow lorikeet populations in suburban Australian towns and cities as a result of a more consistent food supply (Paton et al. 1994). However, habitat loss and degradation due to high levels of grazing by introduced herbivores, sporadic fires and tropical storms have converted large areas of dry woodland and forest to grasslands or infestations of introduced invasive weeds such as *Leucaena leucocephala*. Loss of habitat over such broader scales (particularly on islands) inevitably results in population declines of susceptible species and results in habitat fragmentation that may amplify the potential effects of introduced predators and competitors in remaining favourable habitats.

In the past hunting for food and feathers was considered a serious threat to some species. For example, the use of feathers from Kuhl's lorikeet for adornment was a common occurrence that is believed to have been responsible for the demise of the species in parts of its original range, especially within the Cook Islands (Watling 1995). Poaching for the pet trade is also a potential threat, however, is probably negligible compared to the relative effects of other threats the genus faces.

Introduced avian diseases, including avian malaria and birdpox, have been considered as significant factors responsible for the decline of forest birds in Hawaii (Munro 1944), and may also be a threat to birds in the Marquesas. There is no information at this stage regarding the presence of disease in the islands, however, the relative proximity and

natural, cultural and historical connections between the island archipelagos suggest disease may be a significant threat warranting further investigation.

Whilst the lorikeets seem able to tolerate some degree of habitat change and poaching may have a comparatively limited impact, nest predation by rats, particularly by the black rat *Rattus rattus,* is considered the main threat to the species survival. Black rats have decimated populations of various birds, including the *Vini*, on many islands throughout the Pacific and beyond (Atkinson 1985; Hay 1985; Seitre and Seitre 1991). The decline of the Ultramarine lorikeet in the recent past has closely paralleled the progressive establishment of black rats on islands within its range. Lorikeets are particularly susceptible to nest predation because they nest in tree hollows which black rats also readily use as nesting and roosting sites. The effects of black rats on avifauna compared with other introduced rat species are generally more pervasive because of their agility and ability to climb trees. Nest predation and competition for hollows is of particular concern where hollows are in short supply or in areas where black rat populations are particularly large. However, the control of introduced predators, including black rats, has been shown to increase the breeding success of a range of bird and parrot species (e.g. Nelson *et al.* 2002; Moorhouse *et al.* 2003).

1.6 Ultramarine Lorikeet

1.6.1 Nomenclature

Vini ultramarina (Kuhl 1820). The species is known locally as the pihiti on all islands except Nuku Hiva where it is referred to as the pihitikua. Other names include: Lori des Marquises, Lori ultramarin (French), Marquesas lory and Goupil's lory. It is referred to interchangeably in this report as the Ultramarine lorikeet or pihiti.

1.6.2 Description

The pihiti is a small (18cm), predominantly iridescent ultramarine-blue lorikeet with a darker mauve-blue crown, nape, lower chest, vent thighs and flanks. Its mantle and wing-coverts are ultramarine and its rump and uppertail coverts a light ultramarine. Flight feathers are light blue and underwing coverts a dull blue. Throat is dark blue with white-tipped feathers. Belly is white with slaty bases to feathers giving a mottled appearance. Undertail coverts are light turquoise. Uppertail is a whitish-blue with light ultramarine at margins while undertail is white. Lower mandible of bill is blackish-brown and upper mandible and legs orange (Juniper and Parr 1998).

1.6.3 Distribution and status

The Ultramarine lorikeet is the most threatened of *Vini* species and is regarded as one of the most threatened of all insular lorikeets (Kuehler *et al.* 1997). Accordingly, it is listed as endangered by the IUCN and on CITES Appendix 1 (IUCN 2000; Table 1) and is recognised within the region and internationally as a species of high priority for conservation action (Wilson 2000; Sherley 2001). The species is endemic to the northern Marquesas islands of Nuku Hiva, Ua Pou and Ua Huka though may have once ranged more widely in the archipelago (Steadman 1989).

In the mid 1970's the species occurred on three Marquesan Islands, Ua Pou (estimated 250-300 pairs), Nuku Hiva (est. 40-150 birds) and Ua Huka (200-250 pairs), to where it may have been re-introduced (Holyoak 1975; Holyoak and Thibault 1984) Populations on Ua Pou and Nuku Hiva underwent a catastrophic decline such that surveys by the Zoological Society of San Diego in the mid-1990's failed to find any birds and the species was considered possibly extinct on both islands (Kuehler *et al.* 1997). Isolated birds have

recently been re-discovered on both the first (Raust 1998) and the second island (Raust 1999; Meyer 2000). Between 1992 and 1994 a translocation of 29 birds was conducted from Ua Huka to Fatu Iva, the southern most island in the Marquesas (Kuehler *et al.* 1997). Although by 1997 numbers had increased (Lieberman *et al.* 1997) black rats became established in the mid-late 1990s and this population is now highly endangered (Thibault and Meyer 2000). The only relatively healthy population, estimated at 1000-1500 individuals in 1991, exists on the small island of Ua Huka, the only rat-free island in the lorikeet's range (Seitre and Seitre 1991; Kuehler *et al.* 1997). This population is believed to have been introduced from a single pair in the 1940s (Decker 1980) - a testimony to the resilience of the species given a favourable, rat-free environment.

1.6.4 Ecology

There have been no detailed studies of the biology or conservation requirements of the Ultramarine lorikeet. Most observations of habitat associations and diet are largely anecdotal or based on captive individuals. Surveys in the 1970's reported they were only found in pristine forests above 700 metres on Nuku Hiva and predominantly in montane forests between 700 and 1000 metres on Ua Pou, though here they were also commonly noted in banana, coconut and mango plantations in coastal areas (Holyoak and Thibault 1984). Given the availability of seemingly favourable habitat on Nuku Hiva, this apparently broader range of habitat preferences on Ua Pou may be a result of the widespread presence of rats on Nuku Hiva compared with Ua Pou at the time, rather than apparent differences in population habitat preferences between islands. As discussed below the situation has since changed markedly on Ua Pou following the establishment of black rats on the island. The pihiti is reported to feed predominantly on flowering and fruiting trees consuming pollen, fruit, nectar, and insects most often in pairs or small groups (Seitre and Seitre 1991; Kuehler *et al*. 1997), though there is no information on the relative importance of food types or seasonal preferences. Nesting is reported between June and August, though they may breed all year round, with young sighted in January and February (R.Sulpice, pers. comm.). They use tree hollows or holes in old coconuts for nests and usually lay two eggs. Fledging in captivity is reported at eight weeks.

3. PROJECT AIMS

The aims of the project were to:

- review literature and published and unpublished records concerning the current and historic status and distribution of the Ultramarine Lorikeet in the Marquesas Islands;
- determine the current status and distribution of the species' populations on each island within its range;
- gather basic information on habitat use and ecology of lorikeets with particular emphasis on feeding and nesting requirements of the Ua Huka population;
- determine the current status, distribution and density of rats on each of the islands within the lorikeet's range;
- confirm the rat-free status of Ua Huka and introduce measures to prevent the introduction of rats to the island;
- determine the distribution and density of rats on Fatu Iva and evaluate the feasibility of a rat eradication program on the island;
- introduce mitigation measures to counter the threat posed by nest predation by black rats on Nuku Hiva, Ua Pou and Fatu Iva;
- raise awareness amongst the community of the status, plight and threats of the Ultramarine lorikeet and other birds of the Marquesas Islands.

Figure 1: The *Vini* genus (clockwise from top): Ultramarine lorikeet, Kuhl's lorikeet, Stephen's lorikeet, Blue lorikeet and Blue-crowned lorikeet

4. METHODS

3.1 Study sites

This study was conducted between May and July 2002 on the four islands within the pihiti's contemporary range; Nuku Hiva, Ua Pou, Ua Huka and Fatu Iva in the Marquesas archipelago of French Polynesia (Figure 2 and Table 1). The Marquesas Islands are amongst the most geographically isolated groups of oceanic islands, situated in the south-east Pacific Ocean about 4850km from Mexico, the nearest continental region, and 1400 kilometres from the French Polynesian capital of Papeete. There are twelve islands in the group stretching 350 kilometres from north-west to south-east, of which six are inhabited with a total population of 7500 people. The islands are small, volcanic outcrops characterised by rugged, irregular relief with a total land area of approximately 1050 km^2. Rainfall on the islands fluctuates significantly but is generally higher on islands further south, with Fatu Iva and Ua Huka having the highest and lowest rainfalls of the inhabited islands respectively. The rugged, irregular topography, variable climate and extent of clearing, has resulted in diverse microhabitats on individual islands and variability in vegetation between islands. Generally, vegetation varies from low altitude dry shrubland, grasslands and forest to rainforest and cloud forest on the upper windward slopes and summits. Many of the islands have been subject to intensive grazing from introduced herbivores (goats, cattle, sheep and horses) and sporadic fires and cyclones resulting in large areas of grassland and weed infestation. Villages have extensive cultivated gardens that include many introduced fruiting and flowering plants and most village families have additional small plots nearby that consist predominantly of coconut palms, banana, papaya, breadfruit and mango plantations.

3.1.1. Nuku Hiva

Nuku Hiva is the largest of the Marquesan islands. The island has a number of long valleys with permanent watercourses and a large basin in its interior known as the Toovi plateau. Surrounding the plateau are mountain ranges with well developed rain forest and cloud forest. A range of other habitats occur on the island including native forests, pine plantations, coconut and banana plantations, dry woodlands and shrublands and large open areas particularly in the west, that are the result of deforestation due to introduced grazing animals. As the administrative centre of the Marquesas, Nuku Hiva has a large wharf area to which commercial and private vessels dock directly. Consequently it has one of the longest established and widespread rat populations of the islands. It's pihiti population is correspondingly very small, possibly even extinct.

3.1.2 Ua Huka

Of the inhabited Marquesas islands, Ua Huka has the lowest but most variable rainfall. It has a variety of habitats including dry woodland and shrublands, hibiscus forests, high elevation cloudforests, and mixed coconut and banana plantations with numerous native and introduced plant species (Meyer 1996). In contrast to all other inhabited Marquesas islands, Ua Huka has no direct docking facilities for vessels. Incoming goods and cargo are first loaded onto smaller whaling boats that are then brought to a small wharf. While there is a very real threat that rats might hide in incoming cargo, the potential for rats moving directly from larger ships to the island is significantly lower. Consequently, and perhaps somewhat fortuitously, blacks rats are not known to exist on Ua Huka at the present time. Despite considerable habitat degradation over large parts of the island due to grazing by goats, horses and cattle, owing to its rat-free status, it is nonetheless

regarded as a refuge among Marquesan islands for the region's avifauna with five endemic Marquesan terrestrial birds and numerous breeding seabirds.

3.1.4 Ua Pou

Ua Pou, located 50 km south of Nuku Hiva, is about 105km^2 in area, roughly diamond shaped, and characterised by radiating ridges topped with towering pinnacles. On the upper parts of the main ridges are rainforests and native forest. In the populated valleys are numerous plantations of cultivated food plants. The lower slopes around most of the island that are not bare due to introduced herbivores, are extensively covered in thickets of *Leucaena leucocephala,* an introduced invasive that forms monoculture stands excluding native vegetation. The island has a wharf and rats are believed to have become established on the island in the early-mid 1980s.

3.1.4 Fatu Iva

Fatu Iva is the most southerly, wettest and most rugged of the islands in the Marquesas. It is dominated by extensive cloudforest at higher elevations, native forest at mid-elevations and coconut and banana plantations in its two populated valleys. Its eastern and seaward, western slopes are drier and poorly vegetated while many areas of its lower slopes have been denuded entirely by goats. Its two population centres, with a combined population of 500 people, are the villages of Hanavave in the north-west and Omoa in the south-west. While the island has no direct docking facilities a population of black rats has become established on the island within the last decade.

Table 1: Some physical characteristics of the five largest Marquesan Islands

Island	Area (km2)	Elevation (m)	Annual rainfall (mm)
Nuku Hiva	336	1227	2000-3000
Hiva Oa	315	1276	1200
Ua Pou	105	1252	910
Fatu Iva	85	1125	2500
Ua Huka	83	884	755

3.2 Status and distribution of the Ultramarine Lorikeet

3.2.1 Surveys on Ua Huka

A total of 33 fixed line transects were established in six broad habitat associations on the island of Ua Huka (Table 3). Most of these transects were restricted to the southern side of the main caldera because of access difficulties to the northern parts of the island, the need to replicate transects and the lower relative availability of habitat to the north. Transects were 400 metres in length and all birds within 50 metres of the centre transect line were recorded by direct sighting or from calls. Information recorded included flock size, number of young or juvenile individuals, activity, locality, and substrate. Surveys were repeated at least three times in each transect between dawn and 10:30am over a period of 5 weeks under similar weather conditions. Data were pooled for each site and for each habitat type and abundance expressed as number of individuals per hectare. An estimate of total pihiti population size for Ua Huka was made by determining the mean number of birds per hectare of habitat type multiplied by an estimate of availability of that habitat type on the island as determined by vegetation mapping and aerial photography. (Examples of habitat types are depicted in figures 5a-5j)

Figure 5a: View into Ouia valley, Fatu Iva with rainforest at lower altitudes and *Dicranopteris* fernland on lower ridges and slopes (Photo: M.Ziembicki)

Figure 5b: Intermediate zone of montane mesic rainforest in foreground dominated by *Hibiscus-Pandanus-Angiopteris.* Montane rainforest on slopes in background. Fatu Iva. (Photo: M.Ziembicki)

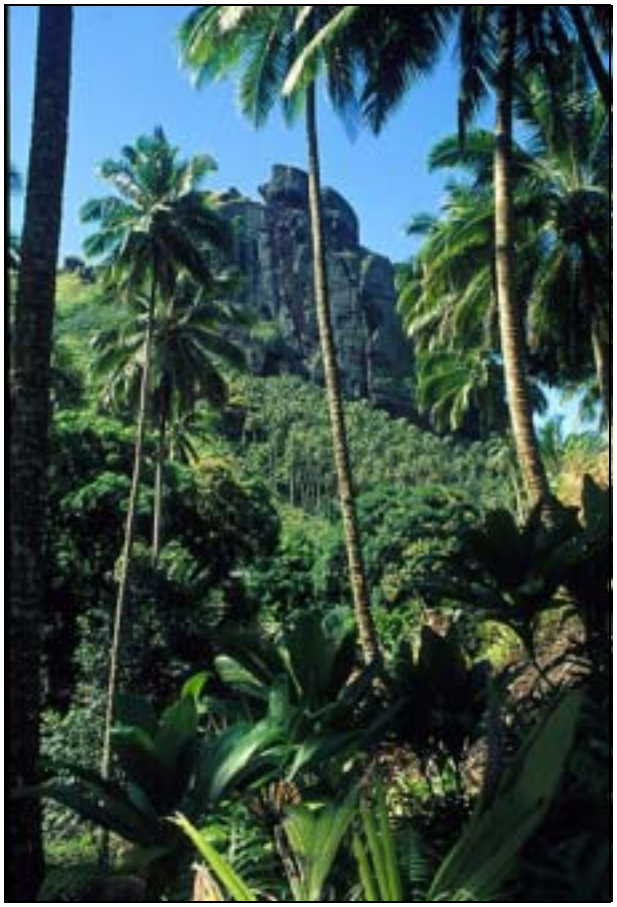

Figure 5c: Coconut *Cocos nucifera* and mango *Mangifera indica* plantation in Hanavave valley, Fatu Iva (Photo: M.Ziembicki)

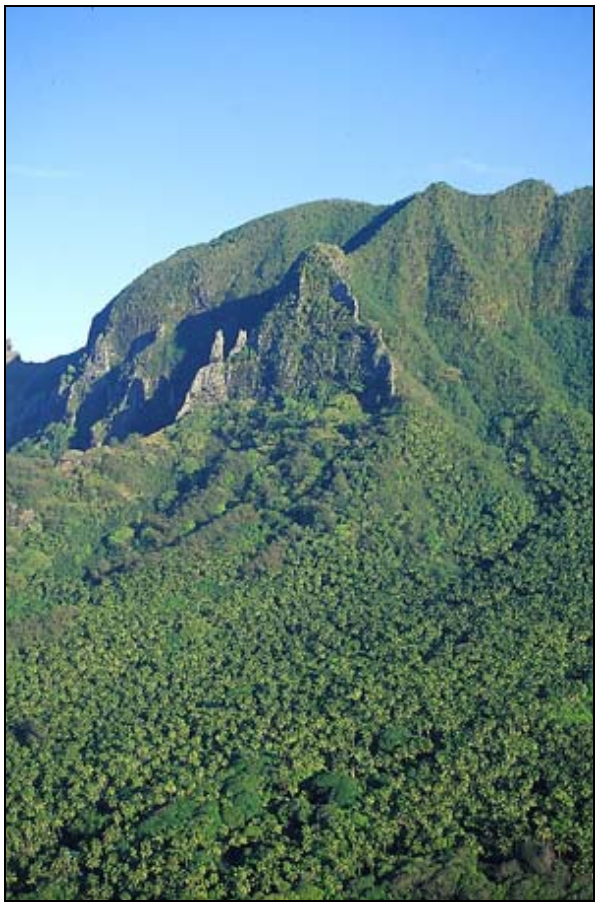

Figure 5d: Coconut, mango and mixed fruit tree plantations at lower elevations grading to *Hibiscus-Pandanus* forest and C*asuarina equisetifolia* on ridges at mid-elevations. Cloud forest at high elevation. (Photo: M.Ziembicki)

Figure 5e: *Weinmannia-Metrosideros m*ontane rain forest on Fatu Hiva (Photo: M.Ziembicki)

Figure 5f: Banana plantation surrounded by *Hibiscus tiliaceus* in upper reaches of the Punahitahi valley, Fatu Hiva (Photo: M.Ziembicki)

Figure 5g: Steep upper slopes of caldera on Fatu Hiva with mesophytic forest and *Dicranopteris* ferns and grass cover above (Photo: M.Ziembicki)

Figure 5h: Transition zone on Ua Huka with coconut plantation in valley floor, mesophytic forest above, and *Miscanthus* grass cover on upper slopes (Photo:B.Decker, in Mueller-Dombois & Frosberg 1998)

Figure 5i: Xerotropical vegetation of introduced grasses and shrubland highly impacted by foraging goats and horses, typical of degraded areas on many Marquesas islands (Photo: B.Decker in Mueller-Dombois & Frosberg 1998)

Figure 5j: Pluviotropical zone at low elevation on Nuku Hiva, with *Pandanus* and *Cocos* in foreground, *Dicranopteris* ferns on central ridge and rainforest on slopes in background (Photo: B.Decker, in Mueller-Dombois & Frosberg 1998)

Table 2: Broad classification of habitat types of Ua Huka.

Class	Common plant genera
Dry open woodland & shrubland	*Pisonia, Psidium, Xylosma, Cordia, Heliopterum*
Cultivated plantations	*Cocos, Mangifera, Carica, Musa, Inga, Artocarpus, Citrus, Inocarpus, Pandanus, Syzigium, Coffea, Ficus*
Montane rain and cloud forest	*Metrosideros, Weinmannia, Scaevola, Syzigium, Freycinetia, Piper, Ficus*
Hibiscus–Pandanus forest	*Hibiscus, Pandanus, Glochidion, Psidium, Piper*
Domestic and botanic gardens	*Cocos, Mangifera, Carica, Musa, Inga, Artocarpus, Citrus,* many other introduced and domesticated plants
Grasslands, denuded areas	*Miscanthus, Waltheria, Sida, Cassia*

3.2.2 Surveys on Nuku Hiva, Ua Pou and Fatu Iva

The low numbers of lorikeets on the islands of Nuku Hiva, Ua Pou and Fatu Iva precluded the employment of line transects as used on Ua Huka. Instead, extensive searches were conducted through most likely habitats on these islands. Records were kept of routes followed and amount of time spent searching. Interviews with local people were conducted on all islands and proved an effective means of gathering information on likely sighting locations and patterns of decline in pihiti numbers over time.

3.1 Aspects of the feeding and nesting ecology of the Ultramarine Lorikeet

3.1.1 Diet and foraging behaviour

Foraging observations of lorikeets were made during transect surveys and opportunistically whenever possible. A feeding observation was defined as an individual or flock visibly feeding on a food resource. Information recorded included number of individuals present, food resource consumed and surrounding habitat characteristics.

3.3.2. Nesting sites and nest availability

Potential nest sites of lorikeets on Ua Huka were located by searches, opportunistic sightings and consultation with local landowners and workers. For the purposes of the study the use of a nest site was defined as an observation of one or two individuals actively exploring or using a tree hollow. Where practical nest trees were re-visited at least once and observed for signs of use. Due to technical difficulties with a micro-video camera and the inaccessibility of some sites with tree climbing equipment in many cases it was not practical to directly examine whether nests were or have been active. It is, therefore, not certain that particular sites were actually chosen as nests. However, the main aim of the exercise was to determine the lorikeet's potential preferences for tree types so that artificial nests could be strategically deployed in favoured nesting trees. Information recorded included species of tree used, height of tree, height of nest cavity and and notes on surrounding habitat. Observations of lorikeet behaviour were also recorded.

The availability and abundance of potential nest sites for lorikeets was assessed by surveying five of the most common hollow forming trees that pihiti are known to use for nesting. The tree species included *Artocarpus altilis*, *Pandanus tectorius*, *Hibiscus tiliaceus*, *Mangifera indica* and *Pometia pinnata*. Trees were chosen randomly within survey transects with the provision that they were of a minimum diameter at breast height (DBH) of 20cm, with the exception of *Pandanus tectorius* for which trees with a DBH of at least 15cm were selected. For each tree the DBH and height were measured and an estimate of total canopy made. The number of hollows with an entrance diameter of at

least 4-5cm were counted for each tree from the ground using binoculars. This technique would have inevitably over-estimated the actual number of usable nests available to lorikeets because no assessment of depth, orientation or other factors that may determine lorikeet preference for nest sites was made.

3.4 Rat surveys

3.4.1 Ua Huka

Rats were surveyed for in the villages of Vaipaee and Hokatu using snap traps and commercially-made live cage traps. Trapping efforts were concentrated in villages under the premise that should rats occur on the island they would most likely first be established in a populated centre. A total of 10 snap traps and 4 live traps were placed in the vicinity of homes along the watercourse in Vaipaee and in residences in the centre of Hokatu village. Since the commencement of the study live traps have also been placed around the wharf area in Vaipaee by the quarantine officers of the Department of Agriculture when cargo ships are off-loading goods.

A rat species is known to occur on the small islet of Tahuata only a few hundred metres from Ua Huka. The locals regularly visit the islet during the Sooty Tern *Sturnus fuscata* breeding season to collect eggs. Previous, unconfirmed reports and interviews with locals suggested that the rats there may be *Rattus rattus.* If so, this would pose a major threat to the establishment of rats on the main island nearby. To establish the identity of rats on this islet we trapped on the island using snap traps baited with roasted coconut or bread. A sampling effort of 78 trap nights was made.

3.4.2 Fatu Iva

Rats were trapped in the Punahitahi valley on Fatu Iva as part of a collaborative program with the Fatu Iva Monarch Conservation Project, a project also run by the Société d'Ornithologie de Polynésie to help conserve this critically endangered Fatu Iva endemic (Blanvillain and Ziembicki 2002). Trapping was conducted using Victor™ snap rat traps baited with bread. Twenty-five traps were deployed in pairs at 50 metre intervals from the entrance to the upper reaches of the valley within 15 metres of the watercourse.

3.4.3 Other islands

Due to time constraints no formal efforts were made to trap rats on the islands of Nuku Hiva or Ua Pou. The presence of black rats on these islands is well established and their distribution is likely to extend over most areas of the islands. However, the relative abundance of rats in different habitats and at different altitudes is unknown and requires further investigation, particularly for the upper reaches of valleys on Ua Pou where pihiti are known to occur.

3.5 Conservation efforts

Our conservation actions were concentrated on the islands of Fatu Hiva and Ua Huka.

4.5.1 Prevention of rat introduction to Ua Huka

The highest conservation priority for the pihiti is preventing the introduction of black rats to Ua Huka owing to the island's robust pihiti population and current rat-free status. The greatest chance of the accidental introduction of rats to Ua Huka is through stowaways in cargo that arrives by ship to the island. To minimise this possibility we provided the local council with live rat traps. Concerns of locals over the use of bait stations with poison precluded the use of these in the wharf area because of the potential of small children to tamper with them. Live traps are now routinely deployed in the wharf area, during and

immediately after the arrival of cargo ships by local Service du Développement Rural employee and quarantine officer, Mr Robert Sulpice.

4.5.2 Rat control on Fatu Iva

In collaboration with the Fatu Iva Monarch Conservation Program we initiated a rat eradication program in the Punahitahi valley. Following approval from local authorities this site was chosen as a favourable initial target site for rat control because of a confirmed presence of black rats in the valley, its proximity to the village of Omoa, the valley's relatively narrow layout allowing for a concentrated effort, the identification of several Fatu Iva monarch territories and repeated sightings of lorikeets, including presence of potentially favourable nesting trees.

Baiting involved the use of bait stations consisting of PVC tubes (30cm in length with a 7.5cm diameter) baited with a 50 gram pellet of Ratman® poison. Twenty-two tubes were placed adjacent to the watercourse in the upper reaches of the valley at 25 metre intervals. Using funding available through the Fatu Iva Monarch Conservation Program a local government employee was trained and employed to conduct the baiting program and is responsible for checking and re-baiting bait stations within the valley twice a week. At time of writing this programme is still in progress.

4.5.3 Provision of artificial nest boxes and protection of nest trees

Following the identification of preferred nesting trees, artificial nest boxes were placed in favourable trees in preferred habitat types on Fatu Iva (n = 17) and the botanic garden on Ua Huka (n = 8). The nests consisted of PVC pipes 17cm in diameter and 35cm in length with a 5cm diameter entrance hole (Figure 3a). Each nest was fitted with an internal ladder, perch and a mix of rotting vegetation and soil as a substrate. Nests were placed at heights ranging from 8-20 metres (e.g. Figure 3b). Although, Ua Huka is rat-free and safe nesting sites are abundant the purpose of providing artificial nest sites on the island was to assess the likelihood that lorikeets would use such nests. Lorikeets are regular visitors to the botanic gardens because of the variety of food resources available there and the potential use of the nests could be readily monitored by the garden's employees.

Searches were made for nesting trees on the island of Fatu Iva within the region where lorikeets were most commonly observed. Although no active nest trees were found, potential trees with nest hollows that might be favoured by lorikeets and that were relatively isolated from other trees were protected using tree guards consisting of a 50cm wide strip of thin metal sheeting placed at least 2 metres above the base of the tree. Where trees were within close proximity to other vegetation, branches were removed to ensure rats could not climb or jump across to them. A total of seventeen nests were placed on trees within the Omoa, Punahitahi and Yolande valleys on Fatu Iva while an additional 12 trees were protected with metal guards.

Figure 3a : Installing an artificial nest box in the Botanic gardens, Ua Huka

Figure 3b: Installing a nest box in Omoa valley, Fatu Hiva (note tree band below nest).

4. RESULTS

4.1 Status and distribution of pihiti

4.2.1 Nuku Hiva

Despite ten days of searching favourable habitats at all elevations on Nuku Hiva no pihiti were recorded on the island. The size and terrain of the island prevented an exhaustive search of all favourable areas and it is possible that a small number may exist in remote valleys or ridges. However, interviews with locals failed to identify any leads. Most people were either totally unaware of the existence of the lorikeet or had not seen the birds for many years.

4.2.2 Ua Huka

Ua Huka is home to the most robust Ultramarine lorikeet population accounting for over 98% of the world's population of the species. An estimated 2375 individuals exist on the island with a minimum of 1763 and maximum of 2987. Mean flock size was low at 1.7 (range 1 – 17) reflecting that most observations were of single individuals. Most observations of larger flocks occurred in flowering *Inga edulis* trees in the botanic gardens where highest densities were also recorded. Outside the botanic gardens highest numbers were recorded from cultivated plantations and forest remnants where food abundance was at its greatest.

4.2.3 Ua Pou

In one week of searching only one individual lorikeet was observed towards the end of Hakahetau valley, south of Poutemoka peak. This was a juvenile bird with black colouration on its chest. Information regarding the likely presence of lorikeets in this valley was obtained following conversations with locals in Hakahetau who reported that there were a small number of lorikeets consistently seen at the far end of this valley. In the villages of Hakahau and Hohoi interviews with locals revealed that most people were aware of the pihiti although had not seen any for several years. Numerous people reported that lorikeet numbers declined drastically some 10-15 years ago. This date again coincides with the approximate arrival date of black rats to the island. Locals consistently reported a pattern in the decline of lorikeets. Having been consistently seen all over the island in the past, they declined initially from coastal areas and were seen only at higher altitudes at the ends of valleys before disappearing from valleys they were once common in altogether. Such a pattern would parallel the likely spread of rats following their establishment on an island.

4.2.4 Fatu Iva

In July 2002, three weeks were spent on Fatu Iva to assess the status of the translocated population on the island. Areas surveyed at least once included the Omoa village, Omoa valley, Hanavave village and associated valleys, Ouia valley, Punahitahi valley, Hoopu valley, Puipuauwihi valley, Yolande valley, Hanaui valley, Vaieenui valley, Araki valley, Matau valley, Tetana valley, Vavata valley, ranges between Ouia and Hanavave valleys and the Omoa to Hanavave road. Repeated searches were conducted in the vicinity of the original translocation release site and in other areas where lorikeets were seen by locals.

Despite intensive efforts a total of only eight observations of lorikeets over three weeks were made on Fatu Iva. These included six observations of a single individual and two observations of a pair. Of these, three observations were in the Yolande valley, three in the Punahitahi valley and two in the Omoa valley in an area between the two other valleys. All observations were therefore in the same general vicinity and in a radius of approximately

1.5 kilometres of the original release site. Therefore, it is quite likely that the same birds were repeatedly sighted. No young or sub-adults were observed.

Interviews with locals in Omoa village confirm that lorikeets have disappeared from the village area and surrounding valleys and are now only seen occasionally as single individuals or in pairs at the far ends of Omoa, Punahitahi and Yolande valleys. This is in contrast to the situation just 3-4 years ago when they were regularly seen in the village, especially during mango and kava fruiting season. Similarly, locals in the Hanavave valley no longer see lorikeets even though they had spread there since their translocation and release in the Omoa valley (Kuehler, Lieberman et al. 1997).

According to our observations we estimate that less than ten, and possibly as few as three, lorikeets remain on Fatu Iva.*

4.3 Foraging and nest site preferences

4.2.3 Diet and feeding ecology

A total of 119 feeding observations of 29 food items were made during the study period on Ua Huka and from other opportunistic observations made on Ua Pou and Fatu Iva. Food items utilized by the Ultramarine lorikeet are summarised in Table 5. Four food resources accounted for more than half of all feeding observations, including *Cocos nucifera* flower nectar (16.8%), *Mangifera indica* fruit (15.1%), banana flower nectar (11.8%) and nectar from *Hibiscus tileaceus* flowers (10.1%). Other commonly utilized resources included *Casuarina equisetifolia* seeds (7.6%), *Pometia pinnata* fruit (6.7%), *Ficus prolixa* fruit (4.2%), *Inga edulis* flowers (4.2%), *Albizia falcataria* seeds (4.2%) and *Decaisnina forsteriana* flowers (4.2%). Other notable feeding observations included the consumption of small Lepidoptera larvae from leaves of *Inocarpus fagifer* and the small bipinnate leaves of *Albizia falcataria* by two juvenile birds, while three other adults in the flock observed concurrently consumed only the seeds of the tree.

4.2.4 Nesting sites and nest availability

Lorikeets were observed on eight occasions using or exploring nest cavities in four species of trees, namely, *Artocarpus altilis, Pometia pinnata, Pandanus tectorius,* and *Hibiscus tileaceus.* The physical characteristics of these trees are presented in Table 3.

Of the five species of trees examined to determine relative nest site availability *Artocarpus altilis* and *Pometia pinnata* had the greatest amounts of hollows per tree and the highest percentages of trees with hollows potentially available to lorikeets. However, these trees are only relatively common in cultivated valleys and rare outside these areas. Although exhibiting a lower number of cavities per tree and fewer trees with cavities, *Pandanus tectorius* and *Hibiscus tileaceus* are prevalent over broader areas of Ua Huka (Table 4).

* In February 2003 a team of botanists from the National Tropical Botanic Gardens and the Smithsonian Institution, including Jean-Yves Meyer, head of the biodiversity inventory program of the Délégation à la Recherche (Govt of French Polynesia), failed to observe any lorikeets in their week on the island despite several individuals sighted by JYM in the same areas visited in 2000 (Meyer, pers. comm.).

Table 3: Parameters of nest trees used or explored by pihiti on Ua Huka (*nest tree repeatedly revisited by lorikeet pair)

Species	Tree height (m)	Nest height above ground (m)	Estimated entrance hole dimensions (cm)
Pandanus tectorius	13	7	8 x 8
Pandanus tectorius	12	8	8 x 8
Pandanus tectorius	11	7	7 x 7
Pandanus tectorius	11	7	7 x 7
Artocarpus altilis	15	10	6 x 10
**Artocarpus altilis*	18	11	5 x 8
Cocos nucifera	8	8	?
**Hibiscus tiliaceus*	10	7	4 x 15
Pometia pinnata	12	8	6 x 8

Table 4: Some physical characteristics of five commonly used nest trees on Ua Huka

Species	n	DBH (cm)	Height (m)	% canopy cover	No. cavities per tree	% trees with hollows
Artocarpus altilis	19	42.4	19.1	78.4	1.1	58
Pometia pinnata	15	41.2	10.5	81	1.0	53
Pandanus tectorius	18	15.9	10.6	89.4	0.7	50
Mangifera indica	7	89.3	16.6	80	0.4	43
Hibiscus tileaceus	11	31.0	11.9	82.1	0.3	27

TABLE 5: Food resources utilized by the pihiti in the Marquesas Islands

Plant species	Fruit	Flower/Nectar	Seed	other
Albizia falcataria			X	pinnae
Artocarpus altilis	X			
Barringtonia asiatica		X		
Calophyllum inophyllum		O		
Carica papaya	X	X		
Casuarina equisetifolia			X	
Ceiba pentandra		X		
Citrus sinensis		X		
Cocos nucifera		X		
Coffea arabica		O		
Cordia subcordata		X		
Corozo oleifera		O		
Decaisnina forsteriana		X		
Erythrina variegata		X		
Ficus prolixa	X			
Freycinetia impavida	O			
Guettarda speciosa		O		
Hibiscus tiliaceus		X		
Inga edulis		X		
Inocarpus fagifer	X			
Mangifera indica	X	X		
Morinda citrifolia		O		
Musa sp.		X		
Pisonia grandis		X		
Pometia pinnata	X			
Psidium guajava	X			
Scaevola subcapitata		O		
Spondias dulcis		O		
Strelitzia reginae		X		
Sweetenia macrophylla		X		
Syzigium malaccense		O		
Syzygium jambos		X		
Tamarindus indica	X			
Tectona grandis		O		
Terminalia glabrata		X		
Thespesia populnea		X		
Lepidoptera larvae				X
Hemiptera adult & larvae				O

X = Observed food items consumed. O = Food items consumed by pihiti reported from the literature but not observed in the current study (Sources: Holyoak and Thibault 1984; Meyer 1996; Kuehler *et al.* 1997).

4.3 Rat surveys and control

4.3.1 Ua Huka

Two Pacific rats *Rattus exulans* were trapped in the village of Vaipae and two common house mice *Mus musculus* were trapped in live traps in the village of Hokatu. Locals interviewed were adamant that no black rats occur on their island. However, given the difficulties associated with definitively identifying black rats from other closely related species found in the Pacific this information is not necessarily reliable. Retrospectively, a greater trap effort should have been made to ensure the black rat-free status of Ua Huka because of the very few with which biologists or other trained personnel visit the island.

4.3.2 Fatu Iva

In total four rats were trapped on Fatu Iva; two Pacific rats *Rattus exulans* and two black rats *Rattus rattus.* Details of the morphological measurements of these specimens are presented in (Blanvillain and Ziembicki 2002). These results confirm the presence of black rats on the island at least as far as the upper reaches of the Omoa valley. The date of the arrival and establishment of the black rat population on the island is not known. Kuehler *et al.* (1997) do not indicate whether they had trapped for rats prior to or during their translocation project. Thibault and Meyer (2000) first confirmed the presence of black rats at the entrance to the Omoa valley. Conversations with several locals revealed that they first became aware of a large tree climbing rat in about 1997-8. One account from a local schoolteacher concerned an incident circa 1997 when a rat was seen escaping from cargo that had just landed on an old makeshift dock in the village of Omoa. Conscious of the health and agricultural consequences of an established black rat population, particularly to coconut crops, locals gave chase in vain and were later unable to trap the escapee.

The extent of the distribution of black rats over the island is not known. Their fecundity and dispersal ability, especially in a new resource rich and predator-free environment, is potentially great. It is therefore quite likely that their distribution by now extends over the entire island. The size and rugged topography of Fatu Iva prohibit a rat eradication program for the island. However, concerted and strategically deployed rat control programs maybe an effective means of controlling rat numbers in specific areas. The greatest potential and need for such programs are in areas favoured for breeding by pihiti and Fatu Iva monarchs and those areas where it is in the interests of locals to control rat populations (e.g. coconut plantations). It is in such an area that our control efforts in the Punahitahi valley were made.

4.4 Conservation efforts

Unfortunately, because of the short duration of the project and the difficulties and expense associated with regularly returning to the Marquesas Islands, we have not had a chance to adequately assess the progress of our conservation actions to date. Of particular interest is whether lorikeets have come to use the artificial nest boxes that were provided on Ua Huka and Fatu Iva. Although there are local individuals on both islands that are able to observe nests from the ground there is not the equipment or expertise on the islands to climb and physically examine each nest box provided for signs of use. Ground-based observations have thus far failed to observe use of nest boxes.

Ua Huka quarantine officer, Mr. Robert Sulpice, continues to deploy traps around the Vaipaae wharf when cargo ships arrive.

The rat control programme on Fatu Iva continues and has resulted in a reduction in rat numbers in the Punahitahi valley, however, we have no information regarding actual rat densities, pihiti numbers and breeding success in the valley.

5. DISCUSSION

5.1 Historical and current status and distribution of pihiti and effects of threatening processes

The story regarding the current and historical distribution of the Ultramarine lorikeet in the Marquesas is both interesting and complex. The species is believed to have once ranged over most of the archipelago (Steadman 1989) but now only occurs in significant numbers on the small island of Ua Huka, to where it is believed to have been introduced, or re-introduced, from Ua Pou in the 1940's (Decker 1980). The decline of populations in historic ranges on Ua Pou and Nuku Hiva has coincided with the establishment of black rats on the islands. Similarly, the recently translocated population on Fatu Iva, while having initially increased, has undergone a dramatic decline since the arrival of rats, such that it too is on the point of local extinction. That black rats, particularly as nest predators, have decimated populations of various birds on many islands throughout the Pacific is well documented (Atkinson 1977; Moors 1983; Atkinson 1985; Hay 1985; Seitre and Seitre 1991; Vitousek *et al.* 1997). The influence of rats is likely to be especially pronounced where it's compounded by habitat loss, degradation and fragmentation, as in the case of the rapid decline, at least in contemporary times, of Ultramarine lorikeet populations.

While black rats are heavily implicated in the demise of lorikeet numbers on Ua Pou, Nuku Hiva and Fatu Iva, several questions arise suggesting there may be more to the story. Steadman (1989) suggests that lorikeets were pre-historically more widespread in the Marquesas yet, according to current knowledge, just prior to the 1940s, the species was found only on Nuku Hiva and Ua Pou. If true, this leads to a question concerning the reasons for the demise of pihiti populations on islands prior to the arrival of black rats in the Marquesas. Possibly, lorikeet populations are susceptible to other threats such as introduced or natural avian diseases or other stochastic events such as severe storms. Introduced diseases, including birdpox and avian malaria have been cited as a main reason for the decline of forest birds in Hawaii (Munro 1944), however, we have no information on avian diseases in French Polynesia.

Secondly, it seems that despite the pressure of rats on lorikeets, small populations have persisted on Ua Pou and possibly Nuku Hiva. It may be that such small populations are able to persist, at least for the short term, under a certain threshold of rat predation and competition. A theory put forward by Thibault (*in litt.*) (cited in Birdlife International 2000) suggests that, rather than being relict populations from former established populations, the small numbers of lorikeets observed on Nuku Hiva and Ua Pou may be the result of immigration of individuals or small groups from Ua Huka. This idea raises interesting questions regarding the historical distribution, dispersal and population dynamics of pihiti populations in the islands. If lorikeets can disperse between islands relatively easily then they may readily colonise neighbouring islands following local extinctions. However, if they move between islands readily why were there no established populations on Ua Huka prior to the 1940s or the other Marquesas Islands to the south?

Finally, while there is no information on the lifespan or adult mortality of pihiti in the wild it seems unlikely that the very rapid decline (less than five years) of the translocated population on Fatu Iva is due only to nest predation of eggs and young by rats. Nest predation may explain low recruitment to the population but not the reduction of numbers of adults unless rats are actively preying on adult birds at the nest. However, there is at this stage no evidence that rats do prey on adult lorikeets.

5.2 Foraging and nesting biology

Our data from the short study period on Ua Huka and other islands provides a snapshot of the foraging behaviour and diet of the Ultramarine lorikeet. The broad range of food items consumed suggests there may be significant variation in foraging patterns and the importance of certain foods depending on their availability between seasons. For example, the beginning of our study period coincided with the end of the mango fruiting season during which mango fruit was a dominant food item consumed. However, towards the end of the period when there were fewer mangoes, nectar from coconut flowers became the dominant food item. Many of the dominant food resources utilized are from introduced and cultivated plants, many of which provide food resources all year round. To this end, the habitat degradation and loss of broad dry woodland areas on many islands, due to introduced herbivores and invasive plants, may be countered to some extent by the associated enrichment of pihiti habitat because of introduction of cultivated plants. One interesting observation was of a flock of lorikeets feeding on the larvae of Lepidoptera on an infested *Inocarpus fagifer* tree. It is not known whether the consumption of insects is a common occurrence or occurs only during the breeding season.

Observations of potential or actual nesting sites on Ua Huka were limited to tree hollows of five tree species. Our main goal was to determine which types of trees were likely to be favoured by lorikeets so we could target such trees for deployment of artificial nest boxes. Accordingly, our definition of nest use was broad and included observations of lorikeets exploring hollows or repeatedly visiting a hollow. The majority of these observations were in trees close to or in cultivated plantations or forest remnants. We do not know, though suspect, that rat densities on infested islands are probably higher in cultivated habitats compared with natural forests. This requires further investigation considering the implications for current and future rat control operations.

5.3 Future research and conservation

Our study is essentially exploratory, a first stage in a research and conservation effort required for this species. Future research priorities will require examining the habitat requirements, nesting biology and foraging ecology of the Ultramarine lorikeet over broader time periods. Similarly, a more thorough understanding of the distribution and biology of black rats and their effects on the pihiti and other birds in the Marquesas is required.

The simplest, most cost-effective and urgent conservation priority for the Ultramarine lorikeet is ensuring against the introduction of black rats to the island of Ua Huka (see section 7). The apparent failure of the Fatu Iva translocation and the vulnerability of the Ua Huka population suggests serious consideration should be given to initiating a translocation of pihiti to another island, most suitably Mohotani. This island is uninhabited, is believed to be rat-free and has apparently suitable habitat. However, before any such undertaking more research into the species' biology, habitat requirements and the suitability of the Mohotani is required. Conservation efforts for the

remaining lorikeet populations on Ua Pou, Fatu Iva and Nuku Hiva will require long term, labour intensive and expensive action if these populations are to be saved from the threat of rats. Such efforts will rely on sustained funding and involvement and training of locals. There is some scope and interest for such programs on Ua Pou and Fatu Iva. Significantly, there are currently very few opportunities for involving and training of locals in wildlife management and conservation issues in the Marquesas Islands and French Polynesia more generally. Any programs that may be able to address these requirements will be of benefit to the region as a whole.

6. COMMUNITY INVOLVEMENT AND EDUCATION

We profited greatly through consultation and collaboration with locals and collected valuable information regarding the distribution, historical status and feeding and nesting biology of the species through conversations and interviews with a range of local inhabitants. Several individuals were more closely involved with the project by acting as guides, interpreters and in the case of rat control on Fatu Iva, facilitators of the program.

An important aim of the project was to raise awareness among the locals of the plight of the pihiti and other Marquesan birds on their islands. During our conversations we highlighted the threats the birds of the Marquesas face, including the health, agricultural and environmental problems posed by rats. Distribution of posters of the pihiti and other local birds to schools and community centres, and discussions in the course of our work with community leaders, including teachers, police, government employees and landowners, also contributed to the community education campaign. Inevitably, this formed only a small part of our work. Future efforts should focus more on this important aspect.

7. RECOMMENDATIONS

UA HUKA

The most important and simple action for the conservation of the Ultramarine lorikeet is to prevent the establishment of rats on the island of Ua Huka. Permanent rat baiting stations should be established on the Vaipae wharf and surrounds and in the villages of Hane and Hokatu which are most vulnerable to stowaways. A monitoring program, facilitated by training and financing local islanders, should be established to assess rat status on Ua Huka by regular trapping in the main villages. In the event of the discovery of black rats on the island a coordinated and comprehensive rapid response strategy is required to eradicate rats on the island as quickly as possible.

Promote the island as a bird refuge and develop a sense of pride among the island's inhabitants to this end. Initiate more concerted education campaigns in the Marquesas Islands generally to highlight the effects of rats and habitat degradation due to grazing and weed infestation.

Assess the use of artificial nest boxes by lorikeets and examine other possibilities for providing predator-proof nesting environments.

Continue and expand field study of the Ua Huka population with particular regard to habitat associations, nesting and foraging biology and the relative effects of threatening processes.

FATU IVA

Continue rat control program in Punahitahi valley on Fatu Iva (in conjunction with the Fatu Iva Monarch Conservation Programme). Make a concerted effort to find the nest trees used by the remaining lorikeets on Fatu Iva and expand the rat control program to include other valleys where these may occur in addition to continued rat-proofing of nesting trees.

Monitor the status of the Fatu Iva population and assess and monitor the utility of established measures to minimise the effects of rats on lorikeets.

UA POU

Initiate a program to protect the remaining lorikeets on Ua Pou by controlling rats in valleys inhabited by lorikeets and protection of nest trees. There is keen interest in this from the community and community leader and president of the Motu Haka Cultural Association, Mr. Toti Teikiehuupoko. Mr Teikiehuupoko is particularly concerned with the plight of the pihiti and natural history of the Marquesas and is keen to establish a program to save the pihiti on his island by involving the local community and training young Marquesans in conservation methods.

NUKU HIVA

Make a concerted effort to establish the status of lorikeets on the island and assess the feasibility and local interest of initiating targeted rat control programs in relevant areas if applicable.

MOHOTANI

Assess the possibility of translocating a pihiti population to the uninhabited island of Mohotani, following the eradication of cats and removal of sheep from the island. This

has been proposed in the past by Seitre and Seitre (1991) who note the island would make a suitable refuge being a 'typical' Marquesan island with several habitat types. Serious consideration should be given to establishing this island as a permanent nature sanctuary.

GENERAL

Assess the potential influence of other threatening processes on lorikeet populations in the Marquesas Islands. Particular emphasis should be placed on determining whether avian malaria is a significant cause for concern in the Marquesas and Eastern Polynesia generally.

Future plans

Subject to funding, further work is planned for 2005 with a focus on assessing the implemented conservation actions on Fatu Iva and Ua Huka, expanding conservation efforts to include the remaining population on Ua Pou and assessing the potential of Mohotani for a translocation project. In the meantime members of the Société d'Ornithologie de Polynésie are due to visit Ua Huka in mid-2004 as part of the Nuku Hiva pigeon translocation project. This will allow them to comprehensively assess the use of nest boxes by pihiti on the island and to survey for rats and introduce more comprehensive measures against the establishment of rats on the island.

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9. APPENDICES

APPENDIX 1 – Budget Expenses

APPENDIX 2: List of some common plants occurring within survey transects including common English, French and Marquesan names

Species	Family	English name	French name	Marquesan name	Status
			Bois noir	maru maru	
				forkafe	
				pia	
				tamanu	
		candlenut		hama	
				ketae	
		Marquesan apple		vi	
Albizia falcataria	Fabaceae				
Aleurites moluccana	Euphorbiaceae		Arbre lumiere	ama	
Artocarpus altilis	Moraceae	Breadfruit tree	Arbre a pain	mei, uru	Introduced
Barringtonia asiatica	Lecythidaceae	Sea poison tree	Bonnet de pretre	hutu	
Calophyllum inophyllum	Clusiaceae	Ball nut, Beauty leaf		kamanu	Indigenous
Cananga odorata	Annonaceae	Perfume tree	Ylang ylang	motoi	Introduced
Carica papaya	Caricaceae	Papaya, Pawpaw			
Casuarina equisetifolia	Casuarinaceae	Coast she-oak	Bois de fer	toa	Indigenous
Ceiba pentandra	Bombacaceae	Kapok	Kapokier	uruuru	Introduced
Cerbera manghas	Apocynaceae		Manglier veneneux	eva	Indigenous
Citrus sinensis	Rutaceae	Lemon tree	Citronnier		Introduced
Cocos nucifera	Arecaceae	Coconut palm	Cocotier	ehi	Indigenous
Coffea arabica	Rubiaceae	Coffee	Caféier d' Arabie	kafe	Introduced
Cordia subcordata	Boraginaceae	Island walnut		mako mako	Indigenous
Corozo oleifera	Arecaceae	American oil palm			Introduced
Decaisnina forsteriana	Loranthaceae	mistletoe		Tapuvae(FH) ouna (HO) kouna(NH)	
Erythrina variegata	Fabaceae	Coral tree	Arbre au corail, erythrine	enatae	Introduced
Ficus prolixa	Moraceae	Banyan, Strangling fig	Figuier banyan	a'oa	Indigenous
Freycinetia impavida	Pandanaceae			kiekie	
Guettarda speciosa	Rubiacea			hano	Indigenous
Hibiscus tiliaceus	Malvaceae	Beach hibiscus, Cottonwood	Faux hibiscus	hau, fau	Indigenous
Inga edulis	Fabaceae	Ice cream bean	Pacayer	pakai	
Inocarpus fagifer	Leguminosae	Polynesian chestnut	Chataignier	ihi, mape	Introduced
Leucaena leucocephala	Mimosaceae	Leadtree, Coffee bush	Acacia	atiku	Introduced
Mangifera indica	Anacardiaceae	Mango	Manguier	mako	Introduced
Morinda citrifolia	Rubiaceae	Indian mulberry, Noni	Noni	noni	
Musa sp.	Musaceae	Banana	Bananier	huetu	Introduced
Pandanus tectorius	Pandanaceae	Pandanus		ha'a	Indigenous
Pisonia grandis	Nyctaginaceae			pukatea	Indigenous
Pometia pinnata	Sapindaceae			kava	
Psidium guajava	Myrtaceae	Guava	Goyavier	tuava	Introduced

Scaevola subcapitata	Goodeniaceae				Endemic
Spondias dulcis	Anacardiaceae		Pomme-cythere		Introduced
Swietenia macrophylla	Meliaceae		Acajou		
Syzigium malaccense	Myrtaceae	Tahiti apple, Malay apple	Ambosier, pomme rose Jambosier rouge	kehika	Introduced
Syzygium jambos	Myrtaceae		Jambrosade	kehika	Introduced
Tamarindus indica		Tamarind			Introduced
Tectona grandis	Verbenaceae	Teak	Teck		Introduced
Terminalia glabrata	Combretaceae		Badamier	maii	Introduced
Thespesia populnea	Malvaceae	Pacific rosewood	Bois de rose	mi'o	Indigenous