DEVELOPING MODEL SPECIES RECOVERY PLANS IN TONGA

BIODIVERSITY CONSERVATION LESSONS LEARNED TECHNICAL SERIES

18

CONSERVATION INTERNATIONAL
Pacific Islands

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18 Developing Model Species Recovery Plans in Tonga

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The Critical Ecosystem Partnership Fund is a joint initiative of l'Agence Française de Développement, Conservation International, the Global Environment Facility, the Government of Japan, the MacArthur Foundation and the World Bank. A fundamental goal is to ensure civil society is engaged in biodiversity conservation.

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CONSERVATION INTERNATIONAL Pacific Islands

CRITICAL ECOSYSTEM PARTNERSHIP FUND

The **Critical Ecosystem Partnership Fund** is a joint initiative of l'Agence Française de Développement, Conservation International, the European Union, the Global Environment Facility, the Government of Japan, the MacArthur Foundation and the World Bank. A fundamental goal is to ensure civil society is engaged in biodiversity conservation.

ABOUT THE BIODIVERSITY CONSERVATION LESSONS LEARNED TECHNICAL SERIES

This document is part of a technical report series on conservation projects funded by the Critical Ecosystem Partnership Fund (CEPF) and the Conservation International Pacific Islands Program (CI-Pacific). The main purpose of this series is to disseminate project findings and successes to a broader audience of conservation professionals in the Pacific, along with interested members of the public and students. The reports are being prepared on an ad-hoc basis as projects are completed and written up.

In most cases the reports are composed of two parts, the first part is a detailed technical report on the project which gives details on the methodology used, the results and any recommendations. The second part is a brief project completion report written for the donor and focused on conservation impacts and lessons learned.

The CEPF fund in the Polynesia-Micronesia region was launched in September 2008 and will be active until 2013. It is being managed as a partnership between CI Pacific and CEPF. The purpose of the fund is to engage and build the capacity of non-governmental organizations to achieve terrestrial biodiversity conservation. The total grant envelope is approximately US$6 million, and focuses on three main elements: the prevention, control and eradication of invasive species in key biodiversity areas (KBAs); strengthening the conservation status and management of a prioritized set of 60 KBAs and building the awareness and participation of local leaders and community members in the implementation of threatened species recovery plans.

Since the launch of the fund, a number of calls for proposals have been completed for 14 eligible Pacific Island Countries and Territories (Samoa, Tonga, Kiribati, Fiji, Niue, Cook Islands, Palau, FSM, Marshall Islands, Tokelau Islands, French Polynesia, Wallis and Futuna, Eastern Island, Pitcairn and Tokelau). By late 2012 more than 90 projects in 13 countries and territories were being funded.

The Polynesia-Micronesia Biodiversity Hotspot is one of the most threatened of Earth's 34 biodiversity hotspots, with only 21 percent of the region's original vegetation remaining in pristine condition. The Hotspot faces a large number of severe threats including invasive species, alteration or destruction of native habitat and over exploitation of natural resources. The limited land area exacerbates these threats and to date there have been more recorded bird extinctions in this Hotspot than any other. In the future climate change is likely to become a major threat especially for low lying islands and atolls which could disappear completely.

For more information on the funding criteria and how to apply for a CEPF grant please visit:

- www.cepf.net/where_we_work/regions/asia_pacific/polynesia_micronesia/Pages/default.aspx
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CRITICAL ECOSYSTEM PARTNERSHIP FUND

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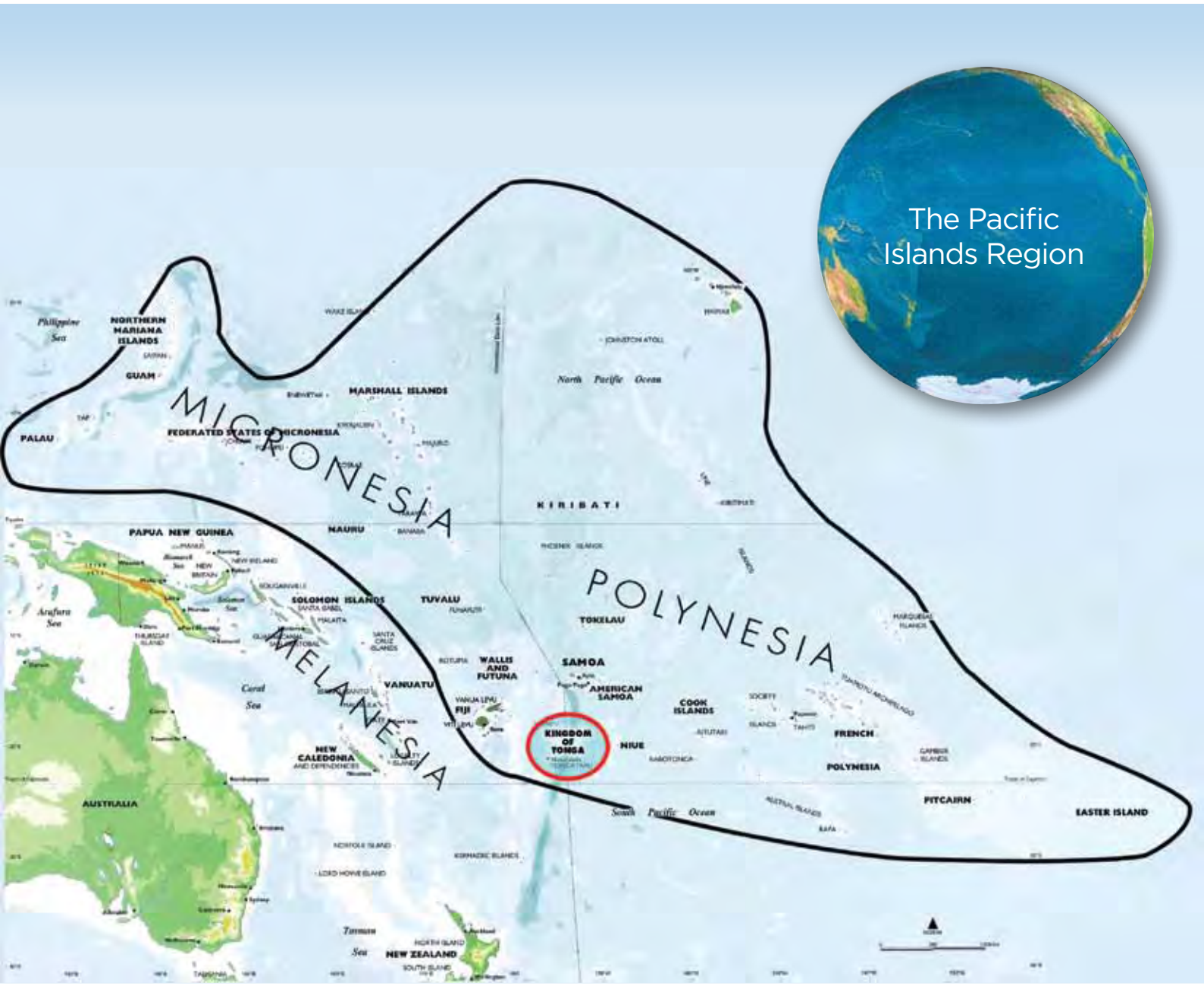
Location of the project in the Polynesia-Micronesia Biodiversity Hotspot



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Megapodius pritchardii, 1864. Artist: Joseph Wolf (1820–1899)
Source: Proceedings of the Zoological Society of London 1864, via Wikimedia Commons.

Lessons Learned

Project Design Process

Aspects of the project design that contributed to its success/shortcomings.

One of the major shortcomings of the design process was that the original scope was too broad. By refining the scope of the project to a single country, instead of three countries as intended, we are unable to make general statements about the efficacy of conservation actions in the Pacific. The advantages of working in a single country were that we were able to gain a more detailed picture of the systems in which conservation actions were applied. In reality, our original approach to evaluation was perhaps naïve in assuming that more information would be available on project outcomes. One of the lessons from this experience would be to review other evaluations and develop an evaluation design based on an evaluation that has been tested in a similar context.

One of the other challenges in the design phase was the time needed to understand the context for conservation in Samoa. A lesson for future evaluations would be to host a focus group meeting at the outset of the project, inviting all the key participants in the system to attend. This type of forum would help facilitate greater understanding of the rationale for the project, the value of doing this type of research and also hopefully get people motivated to be involved. In addition, a more user-driven evaluation would also instill a greater sense of ownership in the findings of the evaluation.

Project Implementation

Aspects of the project execution that contributed to its success/shortcomings.

One of the crucial elements that enabled successful implementation of the project was assistance and support to the researcher by well-connected organizations in Samoa. A valuable lesson for future evaluations by external researchers is the importance of a "gatekeeper" organization. The gatekeeper was essential to introduce the researcher to other stakeholders in Samoa, and also gave greater credibility to the project by their involvement.

Another important aspect that affected and ultimately enabled project implementation was the collaborative and welcoming nature of people working in the Samoan conservation sector. We had limited time to meet and conduct interviews and people were very accommodating in giving their time and following-up with further information.

The scope and time allocated for the project meant that project implementation did not allow for extended interaction with the study participants. The data were gathered over 3 relatively short visits. The project implementation could have been improved if the researcher stayed longer (perhaps with making two rather than three visits) which might have enabled more active and sustained engagement of the project partners.

Other lessons learned

relevant to the conservation community

One of the lessons learned by the researcher was the reality of implementing academic theory into a practical application. While conservation evaluation has received substantial attention in the academic literature, there remains a disconnect between what is optimal or desirable and what is achievable in evaluation application on the ground.

Acknowledgements

We are grateful to Bishop Soane Patita Paini Mafi, Chairman of Tonga Trust Board of Directors and Father Pauli Ta'ai of Niuafo'ou Parish, for their support and for providing accommodation, logistical support for the survey team and a permanent base for the Tonga Community Development Trust (TCDT) on Niuafo'ou. We also thank Peni Koloamatangi, Acting Government Representative on Niuafo'ou for his advice and support in helping with the community workshop at Kolofo'ou. We thank Dr. Tevita Ve'ila, Principal of Niuafo'ou High School for his keen support and being a key facilitator for the community workshops on Niuafo'ou. Soane Patolo, General Manager and Ms Lualini Kalu, Community Facilitator of the MORDI Tonga Trust on Niuafo'ou provided further logistical support in Niuafo'ou.

We are extremely grateful to Lafaele Pe'ei on Niuafo'ou for assisting the survey team in the field and also for sharing his valuable experience on *Malau* ecology and egg collecting. Asipeli Palaki, Acting Director and Lupe Matoto, PoWPA Manager and Deputy Director, Ministry of Environment and Climate Change (TMECC) granted permission to undertake the work and provided two of their staff, Malakai Finau and Senituli Finau to participate in the expedition. The TMECC also agreed PoWPA funds to co-finance the surveys with the Critical Ecosystem Partnership Fund (see below). We also thank all the other staff of Tonga Trust in providing logistical support and organisation of the surveys on Niuafo'ou.

We are particularly indebted to Dr Ann Göth of the Department of Biological Sciences, Macquarie University, Sydney, Australia, for her extreme generosity and expert consultation on undertaking fieldwork on Niuafo'ou. Dr Göth provided detailed field maps and other literature on the *Malau*, audio recordings, and photos from her pioneering *Malau* research work during 19911993. We also thank Dr Phillip McGowan of the World Pheasant Association, UK, for helping to facilitate the research work. Dr Göth and Dr McGowan also reviewed and greatly improved an earlier draft of the conservation strategy (Part 3 of this report).

Finally, this research and subsequent report would not have been possible without the generous funding provided by the Critical Ecosystem Partnership Fund (CEPF) and the PoWPA funds from the TMECC.

PART 1

Conservation Strategy for the Polynesian Megapode *Megapodius pritchardii* on Niuafo'ou, Tonga

TONGA COMMUNITY DEVELOPMENT TRUST

1 Preface

This conservation strategy document concerns one of the most enigmatic and threatened species within the Megapode family – the Polynesian Megapode *Megapodius pritchardii*. The principal objective of this document is to outline and prioritize conservation action for the species, known locally as the *Malau*, on the island of Niuafo'ou, Kingdom of Tonga. This strategy document will be distributed to all those who are in a position to play a significant (and urgently needed) role in the conservation of the species over the next three years: ecologists, biologists, geneticists, agricultural land-use planners, environmental consultants, politicians, policy makers, government officials, grant-maintaining trusts, teachers, non-governmental organizations, and rural community leaders. We also hope readers of this strategy document to bring it to the attention of others who may be able to make a significant contribution to the successful conservation of this highly threatened species.

Readers of this document will notice the length of the report, which is much longer than previous Conservation Action Plans (e.g. Dekker et al. 2000). The reason for this relates to the paucity of conservation science capacity in Tonga. Tongans have very limited (if any) access to scientific resources, in particular access to peer-review journals, reports and other published materials on the *Malau*. There is no doubt that this is having a detrimental effect on Tongan capacity to conserve the country's biodiversity, of which the *Malau* represents one of the most unique biological components. Therefore we have structured the conservation strategy document as follows:

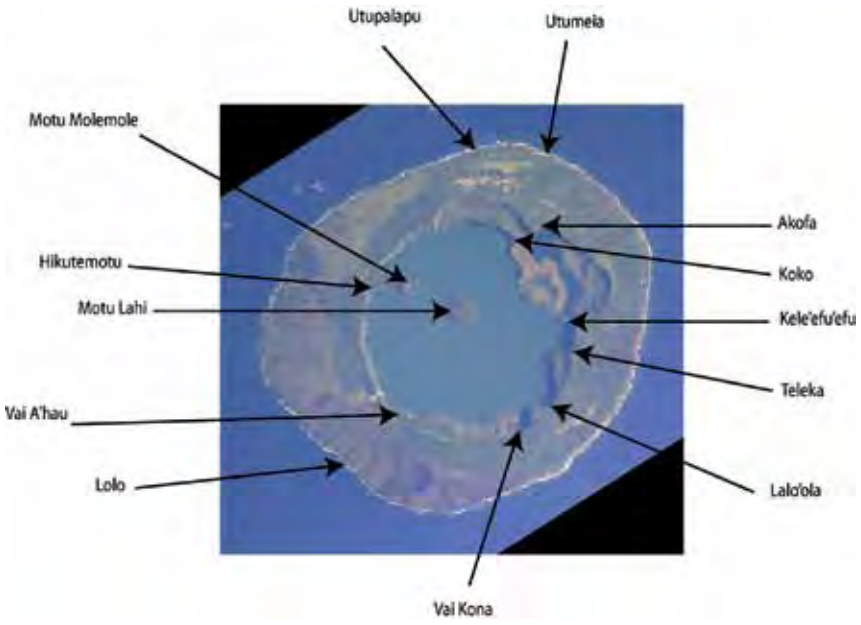
Part One of the document focuses on what is currently known regarding the ecology and conservation of the *Malau* on Niuafo'ou. This is deliberately intended to be a detailed resource for Tongans on all aspects of the species natural history, including its reproductive and population biology, distribution, habitat preferences, previous research undertaken, the historical and contemporary threats faced by the *Malau* and its conservation status.

Part Two contains the results of the most recent survey of the species and its nesting grounds on Niuafo'ou during a two-week period in September 2010. We highlight the current status of the nesting grounds and the species, identify current threats, provide a brief overview of *Malau* egg harvesting on the island, and describes the views and opinions of the principal egg collector on the island. This section also contains the results of questionnaire surveys undertaken at two community workshops during September 2010. These data highlight the role of the *Malau* in the island's cultural heritage and enables us to describe the current status of egg harvesting by people on the island. Importantly these data summarizes the livelihoods of the people of Niuafo'ou, and their views/suggestions regarding *Malau* conservation and current environmental legislation.

Part Three contains the detailed vision and goals of the *Malau* Conservation Strategy. The purpose of this strategy is to prevent the *Malau* from becoming extinct globally. The vision of the people of Niuafo'ou is that conservation efforts focus on community-based sustainable management of egg harvesting and enhanced environmental education over the next three years. To achieve the vision for *Malau* conservation, we propose two priority goals for conservation efforts. We advise field ecologists and biologists, who are likely to carry out this three-year plan, to do so in direct consultation and collaboration with rural community leaders, egg collectors, non-governmental staff and government officials on Niuafo'ou.

FIGURE 1 Google Earth Image of the Island of Niuafo'ou, Kingdom of Tonga. Names shown represent all the main population centres (villages) on the island

FIGURE 2 – Map of known (historical and current) *Malau* nesting grounds



1 SPECIES DESCRIPTION, ECOLOGY AND STATUS

1.1. Introduction

Polynesian Megapode, Niuafo'ou Island, Tonga. Photo: Ann Göth & Uwe Vogel

The Polynesian Megapode *Megapodius pritchardii* is a medium-sized Megapode species endemic to the small volcanic island of Niuafo'ou (GPS 15˚36'S, 175˚38'W), Kingdom of Tonga (Figure 1). The species is the only extant megapode species in Polynesia (Göth & Vogel 1995) where it occurs as a remnant population on Niuafo'ou and also two translocation populations on the uninhabited volcanic islands of Fonualei and Late. On Niuafo'ou the species is known locally as the *Malau* and is confined to the forested inner slopes of the volcanic caldera and two islands in the crater lake. As with other members of the Megapodiidae, the Polynesian Megapode does not use body heat to incubate its eggs and is one of three obligate „*burrow-nesters*' of the Megapode family that uses a geothermal heat source for incubation. On Niuafo'ou the *Malau* buries its eggs in burrows up to 1.5 m deep in volcanically heated loose soil within the caldera and formally also in fissures on the outer slope of the island crater. Typically several burrows, which are used repeatedly by more than one female, are grouped together at „nesting grounds'. Historically *Malau* eggs have been harvested by the people of Niuafo'ou, a scenario similar for many other megapodes throughout South-east Asia and Australia region (see Jones et al. 1995).

Currently the species is considered to be globally threatened and currently listed as ENDANGERED (BirdLife International 2010) principally due to its small and declining population size, over-harvesting of eggs, and predation of egg-laying females and chicks by feral cats (ref). Feral pigs and natural predation by Barn Owl (*Tyto alba*) may also affect the already vulnerable remnant population. Historically all nesting sites on Niuafo'ou are harvested with egg collectors taking all eggs (at least >50% of all eggs found in each nest). Some adults are also reported to be hunted (Göth & Vogel 1995). In 1979, the global population was estimated at 820 adults from a study area of 500 ha (Todd 1983) and in 1991-1993, at 188-235 pairs occupying 641 ha of 719 ha of suitable habitat (Göth & Vogel 1995). This represents 52-65% of possible carrying capacity, assuming an average of 0.5 pairs per ha (Göth & Vogel 1995). The first attempts for assisted colonization on Tafahi Island failed since this island has no geothermal areas for nesting (see Todd 1983). Surveys were conducted in 2003 to assess the success of the assisted colonization's to the islands of Fonualei (where 35 individuals were introduced) and Late (where 60 eggs were buried in volcanically heated sites) during 1991-1993. On Fonualei the species was apparently common and the population estimated to be 300-500 adult individuals (BirdLife International 2010) but there was no evidence of its continued existence on Late (BirdLife International 2010). The species is legally protected in Tonga and egg collection is also illegal under Tongan law, but this is never enforced.

Volcanic island of Niuafo'ou.
Image courtesy of Google Earth

Surveys conducted on Niuafo'ou over two weeks in September 2010 by the World Pheasant Association (WPA), Tonga Community Development Trust (TCDT), and Tonga Ministry of Environment and Climate Change (TMECC) have revealed that the species has undergone a dramatic decline in the number of nests at all known nesting grounds. Historically known from 13 nesting grounds totaling 27 nests, the 2010 surveys found only 10 active nests at seven nesting grounds, although suitable unused nesting habitat was evident at some locations. Consequently the population of the *Malau* on the island has almost certainly declined since the most recent surveys and the species is in danger of extinction. This is despite the fact that community workshops and questionnaire surveys reveal that egg collection is largely opportunistic and the number of expert egg collectors has declined markedly during this time. As a result, the species requires an immediate community-based conservation action plan to aid population recovery on Niuafo'ou and to increase the number of active nests.

1.2. Information on the species and its natural history

MORPHOLOGY

POLYNESIAN MEGAPODE *Megapodius pritchardii* (Gray 1864) is a monotypic, medium-sized megapode. Overall length reported as 28 cm (Jones et al. 1995) or ranging 30-35 cm (Elliot 1994). The following description follows Elliot (1994) and Jones et al. (1995). PLUMAGE: Both sexes have similar plumage characteristics. Overall adult birds are dark slate grey, with a dark ash-grey forehead and crown with slight brownish tinge. The feathers of the nape and back of head are lighter slate-grey and slightly elongated, forming an indistinct short but broad crest. Area around the lores, eyes and ears are virtually bare with some light grey feathers boarding the bare patch. Those on the neck are much reduced in length leaving a variable amount of skin of the head and neck bare. The feathers above the eye extending back to the nape contrast sharply with the darker crown, forming a pale grey streak (only really visible when the birds are in the hand). The feathers on the upper throat and chin are pale white. The lower back, rump and wings are washed reddish brown, with a white patch at the base of the primary feathers and white upper-tail coverts. Both these field characteristics are individually variable and usually concealed. Overall the underparts are grey becoming paler on the belly.

Adult Polynesian Megapode, Niuafo'ou, Tonga. Photo: Ann Göth & Uwe Vogel.

BARE PARTS: The bare skin of the head and neck is vermillion or dark red (Photo 3). Bill is bright yellow and the iris brown. The highly conspicuous legs and feet are bright yellow or orange-yellow, with those of the male being more (duskier) orange-yellow and those of the female more bright yellow. The difference between males and females is only discernable when both are together.

Malau chicks found in two nests on Niuafo'ou, September 2010. Photos: Claudia Torres-Sovero.

IMMATURE PLUMAGE: Immature birds are similar to adults except they are generally duller in coloration, with brown and black barring and less white in the tail and flight feathers. Flight feathers often have traces of buff marks and are generally shorter. The iris tends to be darker brown and the legs and feet more brownish-orange.

CHICKS: The forehead, lores, cheek, chin and throat are ochre with no bare skin visible at the sides of the head (Photo 4). The crown and hindneck are fuscous. The mantle and upper-wing coverts fuscous-brown with the longer coverts contrastingly marked with broad deep black bars and narrow buff bars. Rump and upper-tail coverts are rufous-brown. Chest, side of breast and flanks are pale brown-grey. Flight feathers are grayish-black. Iris and the bill are brown.

1.3. Distribution and habitat

Polynesian Megapode is endemic to the small volcanic island of Niuafo'ou, Kingdom of Tonga. The following description is from Todd (1983). Niuafo'ou is the peak of an active basaltic shield

volcano with a summit caldera formed by the collapse of a composite cone (MacDonald 1948). Two large lakes separated by a line of volcanic ash hills cover most of the caldera floor, leaving the island with a land area of ca. 35 km•. Volcanic eruptions comprise of either lava flows from cracks developing along faults on the outer slopes of the island (in 1853, 1867, 1912, 1929,1935, 1943, 1946), or steam blast eruptions from within the caldera (in 1814 and 1886 – see Richards 1962).

The climate on Niuafo'ou does not vary considerably throughout the year. Todd (1983) reveals that monthly mean temperatures range from 25˚C in August to 28˚C in January, with a mean annual rainfall of 2,700 mm, most of which falls during the hottest period of the year.

View of Vai Lahi crater lake, Motu Molemole and Motu Lahi from the Hikutemotu lookout, on the western side of the caldera, Niuafo'ou. Photo: Huw Lloyd

The crater lake is surrounded by a ridge up to 200 m high which is steep on the inner side, and descends gradually into the sea on the outer slope. Humid broad-leaved forest with a dense canopy is found on the inner slopes of the crater and on the islands in Vai Lahi (e.g. Photo 5). In places where volcanic eruptions have occurred, the cinder hills and lava flows are covered with Ironwood trees Casuarina littorea (Göth & Vogel 1995). There a few forest areas that remain untouched by agricultural practices or disturbance caused by feral pigs but are accessed by local people for fishing or egg collecting (and in rare instances by tourists). These areas are confined to the inner-slopes of the caldera and on the islands e.g. around Hikutemotu in the west of the inner slope, and in the south-east of the inner slopes from Kele'efu'efu toward Vai Kona.

The outer-rim of the island is dominated in the north, east, and south-east by human habitation and agricultural land-use and in the west by older lava flows. There appears to be only very small areas of largely untouched forest between the villages of Mu'a and Tongamama'o but these are over-shadowed by agricultural land-use types. Many areas of secondary regenerating forest can be found on trails leading from the outer-rim to the peaks of the caldera e.g. along the trail from Sapa'ata village south into the caldera, and along the main dirt-track road from Mu'a village into the east of the caldera. The vegetation in these and other areas depends on the length of time since they were last part-cultivated but the woody fauna are dominated by large, old Mango trees (Mangifera indica) with strong evidence of understory and ground habitat disturbance by feral pigs. The vegetation of the volcanic ash hills in the east of the crater that form the land separating Vai Si'i and Vai Lahu lakes is very open Casuarina woodland with a few smaller woody plant types. In many places dead trees are also a common component of this open vegetated landscape.

Undisturbed Malau forest habitat, Motu Molemole, Vai Lahi crater lake, Niuafo'ou. Photo: Huw Lloyd

Regenerating secondary forest dominated by Mango trees, along the main dirt-track road from Mu'a village to Vai Si'i, Niuafo'ou. Photo: Huw Lloyd

Arial view of the volcanic ash hills dominated by Casuarina woodlands that separate Vai Si'i (right in the photo) and Vai Lahi (left in the photo), Niuafo'ou. Note the small freshwater lake Vai Ngoto'umu (left of centre of the photo). Photo: Huw Lloyd

View of Mokotu ridge and Vai Si'i lake from the volcanic ash hills in the caldera, Niuafo'ou. Photo: Huw Lloyd.

Forest habitat on steep slopes of near the Koko nesting ground of the Malau, in the north east corner of Vai Lahi, Niuafo'ou. Photo: Huw Lloyd.

View of forest habitat surrounding a large active Malau nest at Akofa, in the north-west corner of Vai Si'i in the caldera at Niuafo'ou. Photo: Huw Lloyd.

Göth & Vogel (1995) report that Polynesian Megapode is known to inhabit different types of broad-leaved forest on Niuafo'ou in all successional stages, ranging from secondary forest dominated by coconut palms Cocos nucifera, Tavahi trees Rhus taitensis and Mango trees Mangifera indica, to undisturbed forest habitat. This latter forest type is dominated by trees such as Syzygium clusiaefolium, Diopyros samoensis, Ficus sp, and Sterculia fanaiho provide a close canopy habitat with very open understory with ground vegetation dominated by dense leaf-litter cover and rotting wood. All these forest habitats correspond to an area of 719.3 ha although birds were only found in an area of 641.5 ha (Göth & Vogel 1995).

1.4. Behaviour and diet

Polynesian Megapode is usually found in pairs, which suggests the species is monogamous but occasionally solitary birds are encountered. Pairs are frequently found foraging on the ground, with birds tending to remain within 3-10 m of each other. Previous authors have found that pairs tend to spend relatively little time on the vicinity of the nesting grounds (Todd 1983, Jones et al. 1995) but this was not the case in the most recent survey in 2010 (Lloyd & Torres-Sovero, personal observations). Birds are also surprisingly more arboreal than has been documented, with individuals found roosting in the mid-storey, sub-canopy or canopy of trees at three locations during the 2010 surveys (Lloyd & Torres-Sovero, personal observations). *Malau* are naturally difficult to observe whilst foraging on the ground (Photo 11). Individuals tend to be very and are very wary and tend to disappear further into the undergrowth or fly high into the sub-canopy of trees upon approach (Todd 1983, Lloyd & Torres-Sovero, personal observations). On several occasions pairs have been observed foraging off the ground on fallen logs, or even walking along lianas either in the understory or mid-storey (Lloyd & Torres-Sovero, personal observations). Both adults and chicks are strong flyers and have been seen flying across various sections of Vai Lahi crater lake (Göth personal communication).

Adult Malau, Motu Molemole, Niuafo'ou Island. Photo: Claudia Torres-Sovero.

Malau forages by using their large feet to scrape away and uncovering prey items in dense leaf-litter on the forest floor. Their diet consists mainly of animal food items and the male often offers food to the female (Jones et al. 1995). Prey identified by Todd (1983) from field observations included insects (53% of all prey items), land snails (25%), centipedes (13%), and worms (9%). Fallen fruit of Syzygium spp trees comprised of 4 % of the diet. Other prey items were very small and were not identified (Todd 1983) and it remains unclear whether these were invertebrates or fruits. Finsch (1877) reports that F. Hübner recorded snail-shells, small crabs centipedes and, in a few specimens,

seeds in the stomach of birds he collected (Jones et al. 1995). Weir (1973) reported captive birds feeding on cockroaches, termites, ants, worms and coconut. Typical foraging behaviour of a pair can be viewed freely online at: http://www.arkive.org/polynesian-megapode/megapodius-pritchardii/videos.html

1.5. Vocalisations

All known vocalisations of the *Malau* have been formally described by Göth et al. (1999) and the majority of the following information is derived from that publication (which also shows more detailed parameters of the different *Malau* vocalizations). In addition, examples of *Malau*

vocalizations from the recent 2010 survey to Niuafo'ou have recently been uploaded to the Xeno-Canto free access bird sound library website http://www.xeno-canto.org/australasia/ at http://www.xeno-canto.org/australasia/XCspeciesprofiles.php?species_nr2=15536.00 Many of these examples are referenced within the text as (XC -) followed by the relevant library catalogue number. This website also produced free sonograms of each vocalization.

Knowledge and familiarity of the different *Malau* vocalizations are essential for locating and studying the population on Niuafo'ou. The most commonly heard vocalization from both male and females are whistles. Single whistles or bouts of 3-5 whistles are often emitted (e.g. XC63001, XC63056) and have similar pitch but get softer toward the end. Whistles are uttered most commonly when individuals or pairs are flushed by observers, or in response to presumed natural predators e.g. Barn Owl (*Tyto alba*). These whistles are also given, particularly by males, in response to playback as they either fly up into the sub-canopy or from there down onto the ground, during which the female often follows him but silently (Lloyd personal observations). Occasionally the male will utter single or a series of whistles in response to playback and approach observers along the ground to within a few meters to investigate before retreating back near the female (Lloyd personal observations).

Singing adult Malau, Hikutemotu, Niuafo'ou Photo: Claudia Torres-Sovero.

Males and females produce a series of croaking calls when captured or in other threatening situations and are often uttered in bouts for periods of up to 30-60 seconds (Göth et al. 1999). Chicks also utter similar calls to the distress calls of the adults, particularly when being handled by observers. The calls from newly emerged chicks are identical to those published by Göth et al. (1999) of 5-6 day or 51-day old chicks (Lloyd personal observations). Adult male and females also emit a 'cluck' vocalization which is only a fraction of a second in length. This vocalization can only be heard at extremely close range are emitted when individuals appear out of range of their partner when fleeing disturbance or sometimes given by females when laying eggs and interspersed by single whistles (Göth et al. 1999).

In duet one member of the pair generally co-ordinates its vocalizations with that of its partner (Göth et al. 1999). During the duet the male and female produce different sounds and one member of the pair joins in before the other individual has finished its part of the duet (e.g. XC 63007, XC63012). Normally the male initiates the duet but occasionally this is done by the female. The song of the male is composed of three elements – described phonetically as "deeeded-drrrrr" (Göth et al. 1999). This presents the male part of the principal duet vocalization which is typical of Megapodius species. The female's part of the duet is the „coo' -a quavering sound, varying in length but generally softer than the male's duet vocalization (e.g. XC63006 and XC63055). The notes of the terminal section of the female's „coo' vocalization varies, and can continue to increase (e.g. XC63009) or initially increase and then descend at the very end (e.g. XC63014).

Malau sing or duet at all times of the day and year (Göth et al. 1999). Usually there is one song or a duet which is followed by a 5 minute pause before the next one. During 19911993 songs were heard much more frequently than duets but the 2010 survey found the opposite (Lloyd & Torres-Sovero personal observations). At dawn or dusk, pairs often counter-duet to each other and there appear to be some kind of „signal matching' during the vocal interactions between different territorial pairs (Göth et al. 1999). Pairs often respond to playback of the duet with another duet, whilst they fly from the ground up into the mid-story or sub-canopy of the forest. The male always responds first, flying in the direction of the observer whereas the female follows either immediately behind or a few minutes later. Upon further duet playback, pairs will generally move from favored perch-to-perch in a circular pattern, through the mid-story or sub-canopy, again led by the male, who emits a variety of whistles (sometimes whilst flying) before landing and initiating the duet with the female once she has also landed close by (Lloyd & Torres-Sovero personal observations). Even when in the trees and vocalizing, pairs do not remain perched still for any length of time, and often walk around on branches, lianas or up and down the main trunk of the tree (Lloyd & Torres-Sovero personal observations).

1.6. Breeding behaviour

Polynesian Megapodes do not build mounds but lay their eggs at communal, geothermally heated nesting grounds (Jones et al. 1995). In fact the species is one of only three obligate geothermal incubation specialists within the family. The following information is from Todd (1983) and Jones et al. (1995).Generally pairs arrive at a nest between dawn and 10.00am, but some arrive to lay later in the day. The female alone is responsible for all the digging activity at the nest burrow, whilst the male remains nearby watching over the female. When birds approach the nesting ground, quite often they walk from nest burrow to nest burrow looking for a suitable place to bury their egg. While digging the female will periodically leave to burrow to look around, alert for any danger.

Malau eggs harvested from a nest on Motu Molemole, Niuafo'ou in September 2010. Photo: Huw Lloyd.

Female Malau digging at a nest burrow on Niuafo'ou. Photo: Ann Göth & Uwe Vogel.

The female first digs by removing the sandy volcanic soil from the burrow entrance and then working her way back inside the burrow. The feet are used alternatively for powerful back kicks into the soil (females can back kick at a rate of 60 kicks per minute). Once the hole is deep enough the female then lays a single egg before beginning

to cover the egg and fill the burrow. After the burrow has been filled, digging by the female becomes more random so that freshly turned loose soil is scattered over a wider area than the burrow entrance. This whole process (burrow excavation, egg laying and burrow filling) lasts between 2 h 10 min and 3 h 40 min (Todd 1983).

1.7. Nest, eggs and chicks

Polynesian Megapode nests are excavated burrows situated at geothermally heated sites. Each nesting ground may contain one or more nest burrows. Some authors have reported that eggs are laid in burrows between roots of trees (e.g. Curio 1992) but whether nests are purposely dug in these areas to provide structure and stability to the nest burrow of because of heat production by the roots is unlikely. Some nesting grounds on Niuafo'ou, such as those at Akofa (Photo 11) are situated at the base of large rocky outcrops where there are very few tree roots (Lloyd & Torres-Sovero personal observations). Furthermore egg collectors maintain that roots and other vegetation that „mature into' the nest burrows are a major cause of abandonment because this binds the soil together, preventing adults digging the burrows (see Part 2).

Most burrows are typically 15-20 cm in diameter (Jones et al. 1995) but others are much wider. Burrow diameter probably depends on the frequency of use, the number of adult pairs using the nest and also the rate of egg harvest. Eggs can be deposited at a depth ranging from 0.2–1.7 m

inside the burrow (Jones et al. 1995). The eggs are elongate-oval, brownish-buff to reddish-brown in colour when laid but mature into buff-ochre-brown during incubation. In some instances the outer layer light flakes off in places revealing white coloration underneath (see fig x). Egg size varies from 70-80 x 39-47 mm (Todd 1983) or 73.2-76.4 x 41.1-44.5 mm (Rinke 1986), and weigh 6582 g (Todd 1983) or 71-82 g (Rinke 1986) and corresponds to about 24% of the females body weight (Göth & Vogel 1997). Females produce on average, 11.6–16.4 eggs per year with intervals of 14-16 days between successive eggs being laid (Göth & Vogel 1997).

Old infertile egg (left) and a naturally damaged fertile egg (right) recovered from a nest on Motu Lahi Island, Niuafo'ou in September 2010. Photo: Huw Lloyd

Incubation time varies between 47-51 days in soil temperature ranging 29-38˚C (Todd 1983) or from 50-80 days across temperatures ranging 32-33˚C although some eggs are incubated in slightly colder temperature burrows (Göth & Vogel 1997). One study has revealed that natural egg mortality to be 2% (5 eggs from 224 that were laid during the 416 study period on

Hatching of Malau chick, Niuafo'ou. Photos: Ann Göth & Uwe Vogel

Motu Molemole, Niuafo'ou -Göth & Vogel 1997). Excavation of two nests on Motu Molemole and Motu Lahi in September 2010 revealed that natural mortality of eggs and chicks within the nest burrow ranges from 9-11% (Lloyd and Torres-Sovero unpublished data).

Information from egg collectors on Niuafo'ou state that eggs can be found every month of the year, but there is some debate as to whether there is a peak season (Jones et al.1995). Curio (1992) reported less digging/laying activity by females during January-February, whilst Weir (1973) suggested a peak during April-May. No significant variation in the number of eggs was recorded between May-September in 1979 (Todd 1983). In the most recent study, Göth & Vogel (1997) found that eggs were laid year-round but with greatly reduced number of eggs produced during

January–August in 1992, although these findings may not be typical of the species due to the El Ninó event that year (see Göth & Vogel 1997).

When hatched the chicks dig their way to the surface and are precocial. Chicks are able to fly and walk around easily and do not require the aid of their parents for foraging. Following emergence from the next the chicks hide in dense vegetation a short distance from the nest burrow and remain still for about 10 minutes, presumably acclimatizing to the light, temperature, and their own respiration in their new environment (Lloyd and Torres-Sovero unpublished data), before moving away from the nest.

1.8. Threats

The main threats to the *Malau* population on Niuafo'ou are reported to be over-harvesting of eggs and predation of egg-laying females and chicks by introduced feral cats (Elliot 1994, Göth & Vogel 1995). One report states that the remains of seven adult birds were found at just one nest burrow that had been killed in succession (Todd 1983). The only direct evidence of predation by feral cats in recent years was the remains of one chick found near a nesting ground (Göth & Vogel 1995). There is some natural predation of chicks by Barn Owls (*Tyto alba*) and competition between *Malau* and domestic chickens is highly unlikely since chickens do not occur in forest habitat within the caldera (Göth & Vogel 1995). Trapping and hunting by people was reported to occur only on a small scale (Göth & Vogel 1995) and there is almost certainly some adult mortality due to opportunistic predation by domestic (or feral) dogs. Other authors have suggested that introduced rats and pigs may pose a serious threat to the species on Niuafo'ou (Elliot 1994). However only the Polynesian Rat Rattus exulans is found on Niuafo'ou and this species is unable to dig out eggs from the burrows (Göth & Vogel 1995). Habitat degradation and loss does not pose a problem within the caldera but may have had an indirect effect for previous populations on the outer-rim, particularly near villages. Volcanic eruptions (and other stochastic events) have almost certainly had an impact on the Niuafo'ou population – the last steam blast eruption in 1886 is reported to have almost wiped out the islands population (Friedländer 1899).

1.9. Conservation Status

The Polynesian Megapode is currently listed as ENDANGERED because it has a very small population restricted to two tiny islands Niuafo'ou and the assisted colonization population on Fonualei (BirdLife International 2010). The global population is estimated to be 680-970 and decreasing (BirdLife International 2010). Previously estimations for the global population have varied considerably. Weir (1973) considered that the Niuafo'ou population was close to carrying capacity at that time, and numbered >2,000 adults. Bregulla estimated the population on the island to be as few as 100 adults (Ziswiler 1969). Todd (1983) estimated the global population to number around 820 individuals from an area of 500 ha but 1,500 ha of suitable habitat were estimated in extent, giving a total carrying capacity for Niuafo'ou of 2,500 individuals. Elliot 91994) report that the global population was estimated to be 400-800 individuals and considered to be stable. In the most comprehensive and robust population study to date, Göth & Vogel (1995) used playback methodology and estimated the global population to be 188-235 pairs, from a total area of occupancy of 641.5 ha. Furthermore, these authors report that the number of pairs-ha from seven different localities on Niuafo'ou range from 0.1–2.1 pairs. Their evidence also shows that the *Malau*

occupies 89% of 719.3 ha of suitable habitat for the species on Niuafo'ou – which they largely attribute to predation on birds and/or over-harvesting by egg collectors (see previous section above).

Only one survey has been conducted on Fonualei Island since the assisted colonization of the species there during 1991-1993. Watling (2003) reported 54 observations of 56 *Malau* during a two-day visit and photographed an active nesting ground. Based on the area of the island, and the potential extent of suitable habitat, the author estimated that a population of 300500 *Malau* can be considered reasonable to occur on Fonualei (Watling 2003) but this requires substantial and robust verification. Surveys by the same author on Late Island revealed no presence of *Malau* on the island but the authors do not conclude that megapodes are not present there, since they only surveyed a small proportion of the island (see Watling 2003). If a population on Late Island were to become established, then this may merit down-listing the species conservation status to VULNERABLE (BirdLife International 2010).

Adult Polynesian Megapode perched in the forest sub-canopy in response to playback at Hikutemotu, Niuafo'ou, in September 2010. Photo: Claudia Torres-Sovero.

2 STATUS REVIEW OF POLYNESIAN MEGAPODE ON NIUAFO'OU 2010

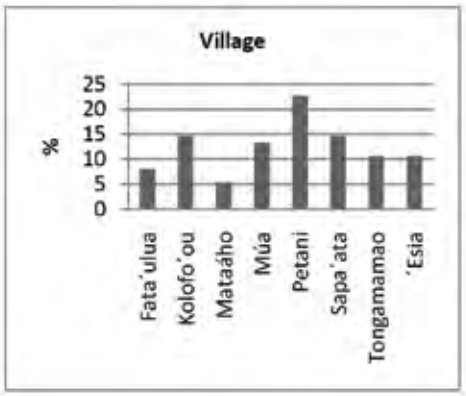
2.1. Introduction

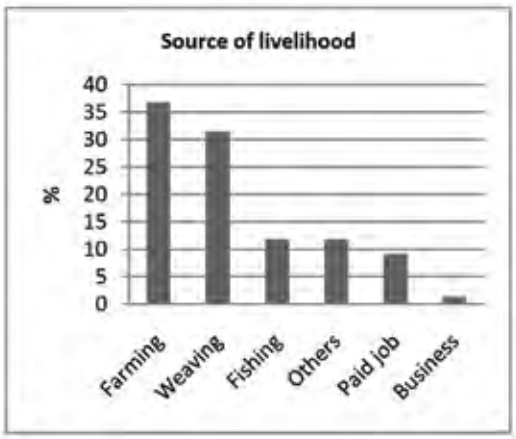
Members of the Tonga Community Development Trust (TCDT), World Pheasant Association (WPA), and the Tonga Ministry of Environment and Climate Change (TMECC) conducted a survey of the nesting grounds of the *Malau* during a two-week visit to Niuafo'ou during 16th-29th September 2010. This was the first rapid survey of the *Malau* since 1993. The team also undertook two community workshops and three school visits to gain a better understanding of the experiences, knowledge and perceptions that the people of Niuafo'ou have toward *Malau* conservation. This would identify and confirm all relevant stakeholders, quantify the needs for further environmental-awareness programs and therefore better develop conservation plans that will promote rural livelihoods to meet local needs but that will not damage the survival prospects of the species. The team was unable to visit the island of Fonualei due to severe weather conditions that prohibited travel to the island.

Here in Part 2 we outline the historical distribution and activity status of *Malau* nesting ground and compare these with the findings from 2010. We highlight the consequences for the species population on Niuafo'ou and outline the main threats to the species in 2010. We include the findings of two community workshops. Utilizing these questionnaire data, we then provide an overview of egg collecting on Niuafo'ou, emphasize the importance and cultural heritage of the species to the people of Niuafo'ou, and describe the views and opinions of the main egg collector on Niuafo'ou.

2.2. Overview of 2010 Community workshops on Niuafo'ou

Two community workshops were held at the villages of Kolofo'ou on 21st September 2010, and Tongamama'o on 24th September. During these workshops and other independent sampling of the Niuafo'ou community, a total of 76 questionnaires were evaluated. Of these, 61 particiants were male, 29 female and one contained no information on gender. Age of participants ranged from 21-76 years old (mean=44 years). Participants belonged to eight different villages (see below), and most (23%) lived in the southernmost village Petani. The main source of livelihood of male participants was farming, and weaving for women. Only 12% of the people received money from overseas (others).





2.3. Distribution of *Malau* nesting grounds

A review of all published literature and unpublished maps reveals that historically the *Malau* was known to occupy 13 nest sites, totaling 27 nesting grounds which house 1 or more nest burrows throughout Niuafo'ou (Table 1). However there remains debate as to the exact number of nesting grounds known historically from a small number of these sites. On the outer-rim of the

island nesting grounds were known from: near the coast of north Niuafo'ou at Utupalapu

(number of nesting grounds=2) and Utumeia (n=1). One nest site was located in the south-west of the outer-rim at Lolo (n=2). All remaining nesting grounds are known from inside the caldera. Along the inner rim of the caldera there has been a nesting ground on the north-west side of Vai

Si'i at Akofa (n=2) and one nesting ground high on the eastern slope of the volcanic rim at Kele'efu'efu (n=1). Moving clockwise around the caldera from north-east to west (Fig 2), there are nesting grounds at Koko (n=3); Teleka (n=1); Lalo'ola (n=2); Vai Kona (n=4); Vai „Ahau (n=2); and Hikutemotu (n=1). The final nesting grounds are located on the two largest islets in the crater lake at Motu Lahi (n=2) and Motu Molemole. During discussions in September 2010, the principal egg collector on Niuafo'ou.

The number of historical nesting grounds is open for debate. Through a combination of both published and unpublished sources, and in interviews with the most experienced egg collector on Niuafo'ou during September 2010, there may have been up to 6 nesting grounds (with 1 or more nest burrows) at Akofa; 5 at Koko; 10 at Vai Kona; 3 at Vai „Ahau; and only 3 at Motu Molemole. These latter numbers of nesting grounds may be less reliable since they do not occur with the same degree of consistency in the materials reviewed or in interviews conducted as the previous figures. The discrepancy may also be due to how we define „nesting ground' and „nest-burrow'. We acknowledge that further verification of the numbers, particularly at Koko and Vai „Ahau are required and would prove highly beneficial for the species conservation.

From the questionnaire survey, a total of 28% of participants identified Vai Kona as an important nesting site for the *Malau*, 16% identified Motu Lahi, 16% Kele'efu'efu, 14% Lalo'ola, and 10% also identified Akofa. When asked about which nesting sites were now abandoned, 34% identified Koko as being abandoned, 20% said Teleka, 17% said Vai Kona, 14% identified an unknown site to us named „Forest', 9% identified Vai „Ahau 9%, and 3% identified Kele'efu'efu and Lolo as now both being abandoned.

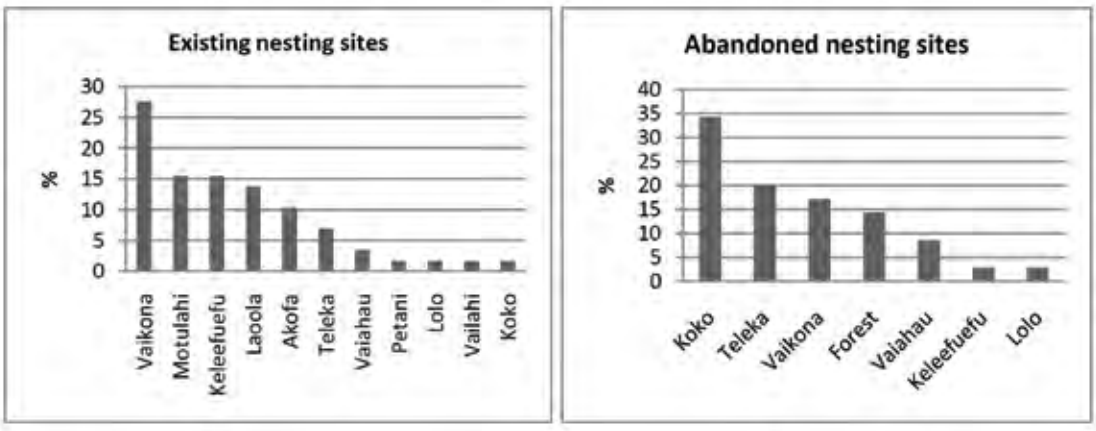


Table 1 Summary of the decline in the number of active nesting grounds (containing 1 or more nest burrows) of Polynesian Megapode *Megapodius pritchardii* on Niuafo'ou Island, Kingdom of Tonga. Historical numbers [a] are based on Todd (1983), unpublished maps, and interviews with egg collectors (see text for possible variation in these numbers). The 1991-1993 numbers [b] are based on Göth and Vogel (1995). Numbers shown with + indicate where verification is required.

NEST SITE	HISTORICAL NUMBER ACTIVE NESTING GROUNDS[a]	NUMBER OF ACTIVE NESTING GROUNDS 1991-1993[b]	NUMBER OF ACTIVE NESTING GROUNDS 2010
Utupalapu	2	0	0
Utumeia	1	0	0
Lolo	2	1	0
Akofa	2+	2	1
Kele'efu'efu	1	1	1+
Teleka	1	1	1
Lalo'ola	2	2	0
Vai Kona	4+	4	4+
Vai 'Ahau	2+	1+	0
Hikutemotu	1	0	0
Koko	3+	1+	1
Motu Molemole	4	4	1
Motu Lahi	2	2	1

2.4. Decline in active nesting grounds

Table 1 reveals the findings of the *Malau* nest survey conducted in September 2010. These numbers were obtained by visiting nests and interviewing the principal egg collectors on the island. It is evident that the Polynesian Megapode has undergone a dramatic decline in the number of active nesting grounds since the survey of Todd (1983). Even more alarming, is the fact that the number of active nesting grounds has continued to decline since the last survey during 1991-1993. In September 2010 there were just 10 active nesting grounds across 7 active nest sites. This represents a dramatic reduction from 27 nesting grounds across 13sites (see previous section). Since Todd (1983) 6 entire nest sites are now abandoned/inactive resulting in the loss of up to 17 nesting burrows. All nesting grounds at the following sites are now INACTIVE: Utupalapu, Utumeia, Lolo, Lalo'ola, Vai 'Ahau and Hikutemotu. The following nest sites are still ACTIVE: Akofa, Kele'efu'efu, Teleka, Vai Kona, Koko, Motu Molemole and Motu Lahi.

Göth and Vogel (1995) found no new nesting grounds since the work of Todd (1983). The 2010 survey also failed to uncover any new nesting grounds since the research of Göth and Vogel (1995),

(1997). However, the 2010 team did find one site below the historical Kele'efu'efu nesting ground which may represent a new recent nesting attempt (Below). Furthermore, we remain hopeful that there may be at least one other (new?) active nesting ground in the vicinity of the southern and south-eastern banks of Vai Kona, which were not searched a thoroughly as the 2010 team hoped.

A possible new nesting ground (upper left hand of photo) at Kele'efu'efu.

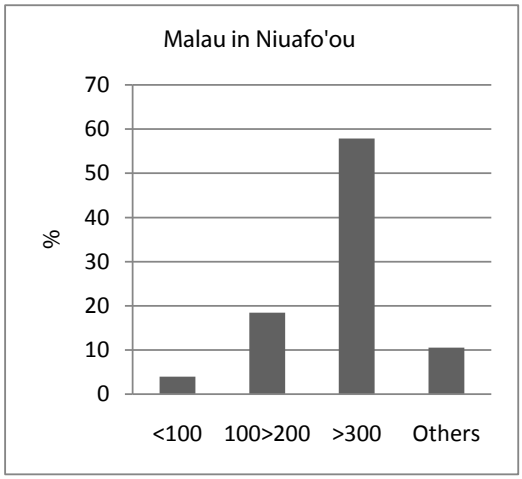
Left: Four photos of nest burrows at active nesting grounds, at Vai Kona. Right: Part of the large active nesting ground of Teleka, Niuafo'ou, September 2010. Photos: Claudia Torres-Sovero & Huw Lloyd

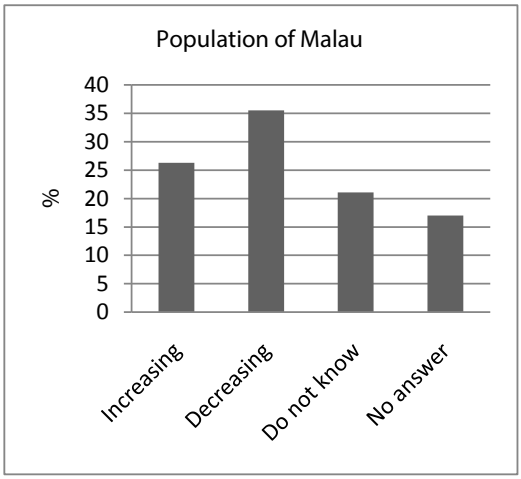
Inactive nesting grounds at Vai 'Ahau (above left) and Motu Molemole (above right) found on Niuafo'ou in September 2010. Photos: Huw Lloyd

2.5. *Malau* Population Status on Niuafo'ou in 2010

During the September 2010 survey, the team encountered only 14 pairs of *Malau* at four known nesting sites using playback. No individuals were seen or heard away from the known nesting grounds. Five pairs were seen/heard at Vai Kona; two pairs at a site below Kele'efu'efu which may represent a new nesting ground (see Photo18); five pairs were seen/heard at Motu Molemole; two pairs were seen/heard at Hikutemotu; and one female was disturbed whilst covering a freshly laid egg in a nest burrow as the team approached Teleka. In addition, one dead adult bird, almost certainly accidently killed by a domestic dog, was found next to a nest burrow at Koko, where *Tilapia* fishing was common.

Extrapolating such figures to estimate the population of *Malau* on the island would be problematic since we followed no standard census methodology (e.g. Distance Sampling point transects) and the survey was only conducted over a very short period of time. Nevertheless, the small number of encounters, coupled with the sharp decline in the number of active nesting grounds (Table 1) indicates that the breeding population of Polynesian Megapode on Niuafo'ou has undergone a significant population decline since Göth and Vogel (1995). We suspect that the current population level is probably closer to the lower estimate of 188 individuals estimated by Göth and Vogel (1995). Further population surveys on the island using the methodology of Göth and Vogel (1995) should be an immediate conservation priority.





When asked how many *Malau* still persist on Niuafo'ou, 4% of participants answered <100, 18% said that 100>200 individuals remained, and 58% said that the *Malau* population numbered >300 individuals. Only 11% did not answer or did not know. 36% of the people agree that population of *Malau* is decreasing, 26% that it is increasing, 21% agreed that they don't know or that it didn't change, but 17% didn't answer the question.

Remains of a Barn Owl (Tyto alba) found on the shore of Vai Si'i, Niuafo'ou in September 2010. Photo: Huw Lloyd.

2.6. Current Threats

Quantifying the number and degree of threats to the *Malau* and relating them to the recent decline in the number of active nesting grounds is problematic. Previous authors have reported that predation by feral cats is one of the principal factors causing the population decline (e.g. Todd 1983). This was also repeated by Göth and Vogel (1995) even though they found only one dead bird killed by a feral cat. In September 2010, we found no evidence of predation by feral cats. There was no evidence of feral cats anywhere within the caldera, let alone near active nesting grounds. Only six feral cats were recorded during the two week survey, and all were seen in the villages of Kolofo'ou, Sapa'ata, Mu'a and Tongamama'o in the outer-rim of the island. Predation by feral cats however, represents the main cause of population decline, according to egg collectors and the majority of people in the local communities. We did find one dead adult, killed (but not eaten) by a domestic dog near a nest burrow at Koko. The dog was almost certainly present in the area as a result of people fishing for *Tilapia* in the immediate vicinity of the nest burrow. Dogs often accompany people when they fish for *Tilapia* in the main crater lakes and this is an obvious form of opportunistic predation. Barn Owls (*Tyto alba*) still represent a natural predator for the species and we did find the remains of a recently killed Barn Owl on the shores of Vai Si'i during the survey. Interviews with other people during the two-week visit revealed that no one hunts adult birds for food or sport. This finding was also corroborated by the most experienced egg collector on Niuafo'ou - *Laphaelle Peei.*

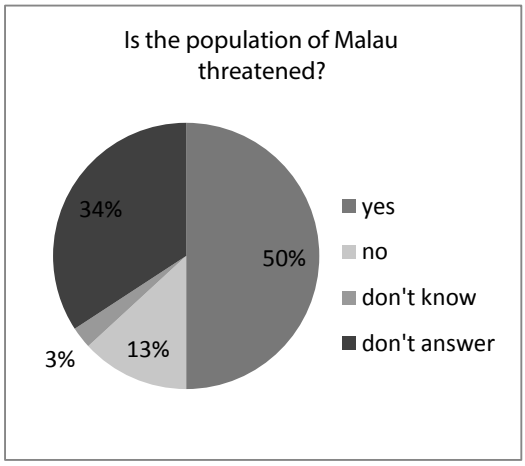
Native forest vegetation with suitable ground vegetation foraging substrate for Malau, at Hikutemotu, Niuafo'ou. Photo: Claudia Torres-Sovero

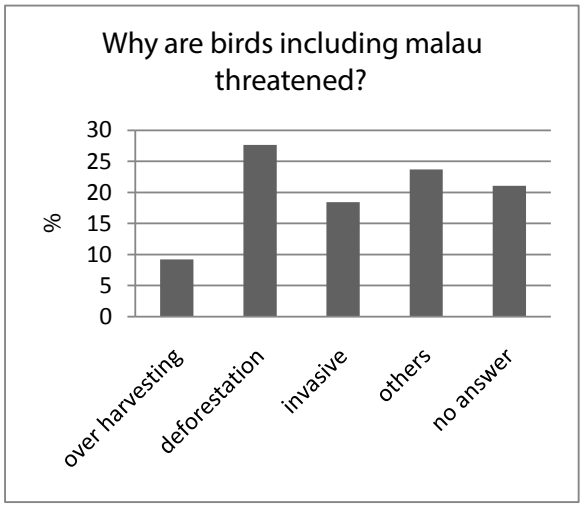
In September 2010 there was no evidence of *Malau* occurring in any areas on the outer-rim of the island or in the vicinity of villages. Very few individuals have been recorded outside of the caldera in recent years – the most recent (and most reliable) sighting being a single adult bird seen by *Laphaelle Pe'ei* in the vicinity of the historical nesting site of Utupulapa in 2009. We also found no evidence of *Malau* along the main tracks and dirt-track roads that lead into the caldera from the villages Esia, Sapa'ata, Mata'aho and Mu'a, despite the fact that there is suitable regenerating secondary forest in these areas. Similarly, no *Malau* were found in the forest that leads from the main road up to the Hikutemou look-out on the top of the caldera, in the west of the island. These trails are regularly used by people and their accompanying domestic dogs. More noticeable however was the presence of feral pigs and the difference in ground vegetation cover and structure in these areas. Here the ground vegetation has been greatly disturbed with the top soil turned over many times and largely devoid of leaf-litter and other ground vegetation – the necessary foraging substrate for both adult and young *Malau* -as a result of repeated foraging activity by groups of

feral pigs. In areas where *Malau* were recorded within the caldera, the forest was less disturbed by people (dominated by largely undisturbed native forest cover with no evidence of Mango trees or other agricultural species), with no evidence of foraging by feral pigs. In these areas the soil was not dug up or churned over and the ground was covered by dense leaf-litter and other vegetation including dead wood.

The loss of foraging habitat caused by feral pigs is probably much more serious than has previously been reported. Two other factors must also be considered as possible threats: natural shifts in geothermal activity, and inbreeding within the population. During September 2010 we collected feathers from four individual chicks. These materials will form the basis of a population genetics study of the Niuafo'ou *Malau* population. Examining the (distribution of) geothermal activity on Niuafo'ou and soil temperature profiles from all existing active nesting grounds should be an immediate research and conservation priority.

According to the results of the questionnaire surveys, 50% of participants consider the population of *Malau* as being threatened, 13% consider the species not threatened, 3% didn't know, and 34% didn't answer. The reasons why birds (including *Malau*) are threatened are: deforestation (28%), invasive species (18%) especially cats and others (24%), 21% didn't answer. 86% of participants have seen a *Malau* in the wild or its eggs, 5% have never seen either a *Malau* or its eggs, and 9% did not answer. The places to see *Malau* were identified as being Vai Lahi (by 35% of participants), Motulahi (13%), Koko (11%), and Vai Kona (11%).





2.7. Egg Collecting on Niuafo'ou – an overview

Malau eggs have been collected by people on Niuafo'ou for as long as records began. Today egg collecting is viewed as an integral component of their cultural heritage – not just by the egg collectors themselves, but also by other members of the community throughout the island.

There is also considerable concern amongst the people of Niuafo'ou that the culture of egg collecting, which involves very subtle but highly skilled field crafts, is being 'lost' or becoming rare on the island. This has coincided with an overall decline in the human population on the island and an increase in the importance (culturally and for livelihoods) of the introduced *Tilapia* fish within the Vai Lahi and Vai Si'i caldera.

Egg collecting involves people digging eggs from the nest burrows by hand (see photos later in section). Experienced egg collectors „test the soil' by placing their hands into the loose soil prior to digging, to gauge the soil temperature and texture, which enables them to determine how many eggs are present and how much effort it will take to excavate the eggs (i.e. whether it is worthwhile). At each nesting-ground all burrows are searched and the eggs, when found, are then removed and wrapped neatly in the leaves of the Si'i tree. For this field craft, egg collectors typically snap a branch with numerous leaves from the tree, keeping the leaves attached to the branch. Each egg is then wrapped using two leaves that are folded over the egg. The collector then strips another third leaf into fine strips, and using one of these strips to tie the bundle tightly, so that the egg is neatly suspended in this „leaf-bundle' (Photo 26). Egg collectors then simply carry the branch which may be full of these neatly wrapped and suspended egg bundles.

It is difficult to quantify accurately the number of eggs taken by collectors and the number of visits made to each active nesting ground, although the questionnaire surveys go some way in indentifying harvesting patterns and other important information (see below). Göth and Vogel (1995) state that at least 50% of all eggs laid are collected or destroyed by being dug out. At periods of the year however, the eggs of all active nesting grounds are harvested, but those at the most inaccessible sites are left (Rinke 1986, Göth and Vogel 1995). In September 2010, it was evident from interviews with egg collectors and other members of the

Niuafo'ou community that the nesting grounds at Kele'efu'efu, Motu Lahi and Teleka were not regularly harvested by egg collectors due to the difficulty in climbing the steep slopes of the caldera (Kele'efu'efu) or the lack of boats to reach the sites (Motu Lahi and Teleka). One further site – Vai Kona – had not been harvested by any egg collectors for at least a couple of months prior to the team's visit. There is no doubt that the most easily accessible nesting grounds e.g. Akofa, Koko and probably Motu Molemole, are harvested more frequently than the other sites.

Todd (1983) estimated the number of eggs harvested from nesting grounds varies at 150-300 per month, with egg harvesting unevenly distributed among nesting grounds. In September 2010 the team accompanied an egg collector to harvest two nesting grounds – one on Motu Molemole and one on Motu Lahi. At Motu Molemole a total of 8 live eggs and one hatched but dead chick were excavated from the nest, and all eggs taken. On Motu Lahi, a total of 27 live eggs, 2 damaged eggs and 1 infertile egg were excavated, along with two hatched, live chicks that were digging their way to the surface. Both chicks were photographed and then released into the forest nearby (see Part 1 Photo 4). All 27 live eggs were harvested.

2.8. Egg Collecting on Niuafo'ou – current situation in 2010

The questionnaire surveys reveal some important factors concerning egg collecting and harvest patterns on Niuafo'ou. 66% of participants said that they had looked for Malau eggs, 26% all women -said that they do not look for eggs, and 8% did not answer. Those who look for eggs, 42% look for eggs during the morning, 16% in the afternoon, 12% in the evening, and 31% look for eggs at any time of the day. The majority of these people search for eggs only opportunistically, whilst they are fishing for *Tilapia* in the crater lakes, which represents the most important food source for the people of Niuafo'ou (see below).

On average, people travel 2 hours to collect eggs (min=30mins, max= 6 hours), although the exact time it takes depends on where they live. A total of 55% of the participants have ever collect Malau

eggs, with 33% saying that they have never collect Malau eggs and 12% did not answer. Of the 55% that have collected eggs, 55% of them collected < 10 eggs throughout 2009, 14% collected 10-20 eggs, 21% collected >20, and 10% of participants did not say how many eggs they collected. In 2010, 31% of those who collected eggs collected <10, 7% collected 10<20, 14% > than 20 eggs and 48% of these participants did not say how many they collected. In a single dig 45% of participants collected >20 eggs, 20% collected 10-20 eggs and 34% collected <10 eggs. Other numbers given by participants include 80, 60, 70, 40, and 39 eggs. Of the participants who collected eggs, 54% said that they collected eggs for self-consumption, 24% said they collected Malau eggs for gifts, and 9% for other reasons. Nobody sells the eggs.

2.9. Over-harvesting of eggs and chick mortality

It is clear from the questionnaire surveys that the majority of people only collect *Malau* eggs occasionally and opportunistically whilst fishing for *Tilapia* in the crater lakes, and that *Tilapia* are a much more important source of food than *Malau* eggs. Nevertheless, over-harvesting of eggs from nests still remains a threat to the *Malau* population because the number of active nesting grounds and breeding population has almost certainly declined dramatically since the 1991-1993 surveys. The number of live eggs excavated from two nest burrows in September 2010 numbered 8-27, with three damaged or infertile eggs, and three chicks (one dead) also recovered from the nests. This represents a fairly healthy number of eggs for just two nests for this time of year, given what is known of *Malau* incubation periods and intervals between successive egg-laying by females. If the same number of live eggs and chicks were evident from all other ten active nesting grounds on Niuafo'ou, the hypothetical total number of eggs during any one 50-90 day incubation period should range from 32-108. If we assume that there may be at least four different 50-90 day incubation periods throughout any calendar year that can be harvested, this would indicate that 320-1080 *Malau* eggs are produced per year from nest nesting grounds on Niuafo'ou. The numbers harvested throughout the year is even more difficult to assume given the opportunistic nature of egg collecting, but it must be at least 50%, collected on an opportunistic basis and efforts biased toward the more accessible nesting grounds. This would still mean that hypothetically 160-540 eggs may be able to hatch across the ten nesting grounds.

We acknowledge the hypothetical nature of these extrapolations, but nevertheless, when viewed with the numbers of eggs collected by people from the questionnaire survey, it gives the impression that productivity of at least some of the remaining and more inaccessible nesting grounds (e.g. Motu Lahi, Vai Kona) could be fairly high under a more sustainable management plan of egg harvesting, even though there are now fewer nesting grounds throughout the island. Furthermore, it poses the question of what is happening to the chicks once they have reached the surface. We suspect that chick mortality currently poses a significant risk to *Malau* population persistence on Niuafo'ou and that these effects are greatly exacerbated when coupled with the effects of opportunistic harvesting of eggs, habitat disturbance caused by foraging activities of feral pigs and predation by domestic dogs. The causes of chick mortality must be identified and efforts to reverse this be implemented with immediate effect.

A series of photos of egg collecting on Niuafo'ou in September 2010. Top: Four photos of people digging at a nesting ground on Motu Molemole Island. Middle: Laphaelle Pe'ei – the principal egg collector on Niuafo'ou - with the eggs excavated from a nest on Motu Lahi (middle left), then wrapping the eggs in leaves of the Si tree (middle top), creating a bundle of neatly wrapped eggs that can be easily carried back to a village. Middle right: Eggs are often cooked in the leaves of another tree on a small open fire (middle bottom). Those found to contain a well-developed chick are considered the best to eat – the chick is removed, plucked and often eaten whole. Bottom: Variation in Malau egg coloration. Egg collectors use the markings on the eggs as an indicator of the number of eggs still remaining in the nest burrow.

2.10. Egg collectors and their perceptions of *Malau* conservation

Göth and Vogel (1995) reported that there were some 15-30 local people who dig for *Malau* eggs throughout the island. Our questionnaire surveys reveal that 42 (55% of all participants) men of 76 men and women surveyed had opportunistically collected eggs in recent years. In September 2010 our surveys also revealed that there were only four men who were considered by many members of the Niuafo'ou community as the principal or expert 'egg collectors' and whom purposely collect *Malau* eggs. One of these men, Lafaelle (Raphaelle) Pe'ei is considered to be the most experienced and trusted. Eggs have been traditionally harvested in particular for „distinguished guests' visiting the island (see also section 2.8), and *Laphaelle Pe'ei* was named consistently as the person that members of the Niuafo'ou community always approach to collect *Malau* eggs for these occasions. The other three principal (or expert) egg collectors on the island are *Fangaehau Hefa*, *Sifa Latu* (living in the village of Petani) and *Amanaki Pe'ei* (living in the village of Esia). All four are over 50 years of age. *Laphaelle Pe'ei* is 57 years old and was taught how to collect eggs by another highly experienced egg collector named Pale Lavelua, who passed away on Niuafo'ou in 1974. Due to his age and health, there is little doubt that Laphaelle is unable to visit *Malau* nests and harvest eggs each month. In September 2010, the team spent some considerable time with Laphaelle, gaining his trust, building up a strong relationship with him and accompanied him on both egg collecting visits to Motu Molemole and Motu Lahi. His views and experiences of egg harvesting will play a vital role in formulating future conservation plans for the *Malau* on Niuafo'ou and he himself will play a critical role in the actual implementation of the recommendations of this action plan.

Laphaelle Pe'ei and other members of the community have also noticed the decline not only in the number of active nesting grounds, but also, he says, in the population of *Malau* across the island. The most consistent theme arising from conservations with Laphaelle is that the *Malau* has declined because of the decline in 'sustainable' egg harvesting by local people. This in turn, is caused by decline in the number of egg collectors on the island because there is no longer the transfer of knowledge, experiences and the field skills from the older egg collectors, to the younger generation on Niuafo'ou. In addition, the overall human population on Niuafo'ou is declining markedly, principally driven by the exodus of children, accompanied by their families, to other islands in Tonga, following their high-school graduation. Children have to leave Niuafo'ou in order to further their education. *Malau* egg collecting is simply not viewed by younger parents or children as a daily part of life, or as a regular cultural experience, nor is it now strongly considered as a sign of „man-hood' in Niuafo'ou society, since this is being „replaced' (in this cultural context) by fishing for *Tilapia* fish in the crater lakes. There are no records of women ever harvesting eggs from *Malau* nests on Niuafo'ou.

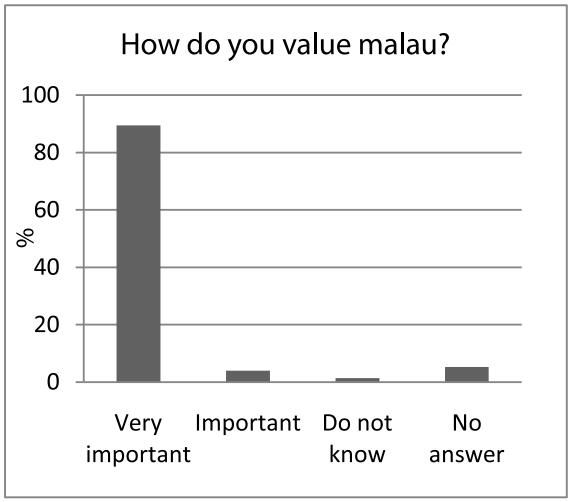
Laphaelle Pe'ei (and other members of the Niuafo'ou community) is adamant that egg collectors perform an essential sustainable management function for the *Malau* population on Niuafo'ou, and that the species survival depends on the preservation of this key aspect of their cultural heritage. By harvesting the eggs, egg collectors encourage the *Malau* to lay further eggs. Regular (i.e. once a month) digging at nest burrows maintains the "looseness' or sandy texture of the soil, making it suitable for egg laying, provided all the soil removed from each burrow is placed back into the burrow. This is one of the key elements to the preservation of active nest burrows. At least two of the other named egg collectors are been accused of being lazy and not replacing the soil back into the burrow, making nesting conditions extremely difficult for female *Malau*. The other key function

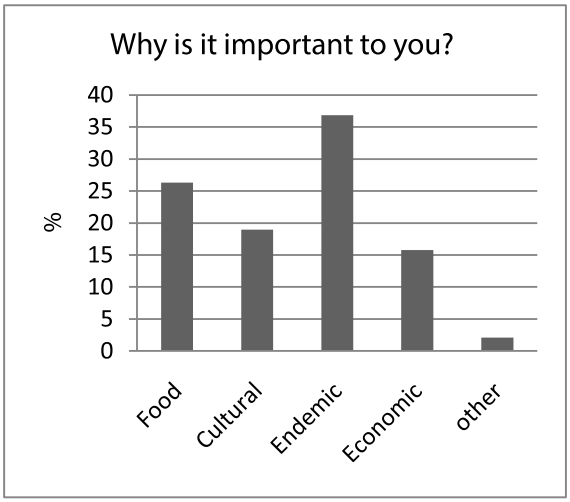
that the egg collectors perform is the removal of tree roots, other vegetation and rocks from the soil – factors that may inhibit digging, damage eggs or prevent hatched chicks from reaching the surface and fledging. Excavation also prevents the surrounding vegetation from „maturing into the soil' further binding the soil and preventing females from laying eggs. Egg collectors attribute vegetation maturation as one of the most important factors leading to nest abandonment.

2.11. Current legislation and community value of *Malau* conservation

The *Malau* is currently protected by law under the Birds and Fish Preservation Act from the Law of Tonga, Act No.13, of 1934, G118/31 and 29/33 to the extent that it is forbidden to remove any eggs or birds throughout the year (Göth and Vogel 1995). However, this law has proved impossible to enforce and more importantly, it conflicts with the cultural heritage (egg collecting) of the people of Niuafo'ou.

Of the 76 people surveyed during both workshops and independent sampling, 89% considered the *Malau* to be important for the people of Niuafo'ou, 4% considered the species to be unimportant, 1% did not know and 5% did not answer. Interestingly, 37% of people considered the *Malau* to be important because it is an endemic species to Niuafo'ou, 26% considered it to be important as a it is a source of food, 19% considered it to be important as a part of Niuafo'ou cultural heritage, 16% said it was important economically, and 2% said it was important for other reasons (unspecified). A total of 73 people (96%) suggested that the *Malau* is in need of formal protection, and only 3 people (4%) did not answer. 34% of the people surveyed knew that there was legislation protected the *Malau*, 41% thought that there was no legislation, 17% did not know and 8% did not answer. The majority of participants, 26%, suggested that the best way to protect the *Malau* is through a combined Government Non-Exploitation Reserve and Community Management initiative, whereas 22% suggested through community management initiative alone, 18% suggested Government Non-Exploitation Reserve, and 12% suggested exploring other options. 21% did not answer.





SUMMARY OF 2010 SURVEYS ON NIUAFO'OU

- Polynesian Megapode (Megapodius pritchardii), known locally as Malau, has undergone a dramatic decline in the number of active nesting grounds on Niuafo'ou since 1983
- Only 7 sites totaling 10 nesting grounds are now active – a decline from 27 nesting grounds across 13 sites in 1983
- Consequently the population has almost certainly undergone a population decline since 1993 and is fully confined to areas within the caldera
- Conservation management must focus on the active nesting grounds of Koko, Akofa, Kele'efu'efu, Teleka, Motu Molemole, Motu Lahi, and Vai Kona
- Current threats to the Malau population include opportunistic egg collection, destruction of foraging habitat by feral pigs, and predation by domestic dogs
- No evidence of predation of adults or chicks by feral cats
- The number of eggs present in excavated nests and collected by people in recent years suggests that all remaining nesting grounds are fairly productive
- The causes of chick mortality must be identified and would greatly aid efforts to reverse population decline on Niuafo'ou
- Conservation research priorities include: examining the distribution of geothermal activity across Niuafo'ou; population genetics (currently underway); population survey using methodology of Gšth and Vogel (1995); and radio-telemetry studies of spatial ecology and movements by newly hatched chicks
- The people of Niuafo'ou recognize that the Malau is endemic to the island, that the species is threatened and needs conservation action
- Malau eggs are an important natural resource for the people of Niuafo'ou. Egg collecting must be acknowledged by international conservation organizations and government agencies as a central component of Niuafo'ou cultural heritage.
- Preservation of this field craft must form the basis of Malau population recovery goals through the immediate sustainable management of egg harvesting at all remaining active nesting grounds
- The majority of people who collect Malau eggs only do so opportunistically when out fishing for Tilapia in the crater lakes. Importantly, Tilapia represents a much more important natural resource to the people of Niuafo'ou than Malau eggs
- The number of people considered as 'expert egg collectors' has declined since 1993. Now only four people are considered as 'expert egg collectors' on Niuafo'ou
- The most experienced egg collector on Niuafo'ou Laphaelle Peei must play a critical role in the conservation management of *Malau* nesting grounds and should be paid a salary by conservation or other organizations for doing so
- The current law prohibiting egg harvesting has not been effective for *Malau* conservation and has always been impossible to enforce. This legislation also conflicts with the cultural heritage of egg collecting by the people of Niuafo'ou

3 CONSERVATION STRATEGY

3.1. VISION

From the results of the 2010 social survey of the community of Niuafo'ou, and the survey of the

Malau nesting grounds, it is evident that the people of Niuafo'ou feel a unique and great sense of pride in being the historic home of the endemic *Malau*. Furthermore, the *Malau* and its eggs are perceived as a unique and important natural resource on Niuafo'ou and that the harvesting of its eggs, a key natural resource, represents a central component of their cultural heritage. The vision of the people of Niuafo'ou is:

The *Malau* continues to persist throughout its natural habitat and range on Niuafo'ou and that there is greater involvement by Tongans at all levels in the conservation of the species and its habitat by emphasizing the link between conservation of the species and sustaining Tongan cultural heritage.

3.2. GOALS

The purpose of this conservation strategy is to prevent the Polynesian Megapode *Megapodius pritchardii* – known locally as the *Malau* -from becoming extinct globally, with particular emphasis on the *Malau* population on the island of Niuafo'ou, Kingdom of Tonga. To achieve the vision for *Malau* conservation, two goals have been identified:

GOAL A: Provide the ecological knowledge and action/interventions/management that will result in the population recovery and conservation of the Malau on Niuafo'ou

This is concerned with the scientifically-based management of all existing active *Malau* nesting grounds and their habitat on the island, and possibly either reactivating some, or all, abandoned nests, or creating new ones in appropriate areas of geothermal activity. Threats to the species' survival must be identified and managed accordingly.

GOAL B: Incorporate ecological knowledge of the Malau into the land-use patterns and other aspects of daily livelihoods of the rural communities on Niuafo'ou.

This is concerned with restoring and then strengthening the links between the island's cultural heritage and the current human population living on the island, and working to ensure that all conservation initiatives are developed with and implemented through the rural communities.

3.3. OBJECTIVES

To achieve the goals described above, we propose a series of specific objectives:

3.3.1. GOAL A: Provide the ecological knowledge that will result in the population recovery and conservation of the Malau on Niuafo'ou

In order to achieve this goal, it is necessary to carry out research so that the population status is more reliably known than at present and conservation management is evidence-based. In addition,

it is necessary to review existing or current proposed policies and environmental legislation to assess whether the *Malau*, its nesting grounds and its habitat are adequately managed, which is necessary given the seriousness of the species' conservation status.

Ensuring that the policy and legislative context is appropriate for the scientifically-based management of the *Malau* population requires the identification of potentially enabling policies or legislation, Therefore, a policy and legislative review is required. Such a review would include species and protected-area legislation, as well as policies, laws and acts relating to more general land uses, land-tenure systems and protected area management. The result would be a clear understanding of the strengths of current legislation in underpinning conservation of the species and its habitat and the identification of gaps and, potentially, areas where legislation may conflict. Such an understanding is necessary for the development of a coherent management programme.

Over the next three years, the following objectives should be met so that Goal A can be achieved:

1: To provide the scientific knowledge necessary to both inform conservation management of *Malau* and monitor changes in the population, nesting grounds and habitat as a result of management.

2: To promote conservation management that will lead to an increase in *Malau* numbers, numbers of nesting grounds and distribution.

3: To review existing legislation on the *Malau*, egg collection, land-use and land-tenure systems and recommend amendments where appropriate.

3.3.2. GOAL B: Incorporate ecological knowledge of the Malau into the land-use patterns

and other aspects of daily livelihoods of the rural communities on Niuafo'ou.

In order to achieve this goal, objectives must be set that are targeted carefully at the various sectors of Niuafo'ou society so that they all have the opportunity to both contribute to *Malau* conservation and benefit from it. Many people, who live in close proximity to or have relatively easy access to *Malau* nesting grounds can influence land-use practices in those areas.

The following objectives should be met so that Goal B can be achieved:

1: Improve networking and co-ordination between all stakeholders, particularly egg collectors, rural communities, church groups, community development non-governmental organizations, government departments throughout Tonga and international conservation organizations.

2: Promote rural livelihoods that will meet local needs but will not damage the survival prospects of the *Malau* and its habitat.

3: Develop new environmental education resources for both schools on Niuafo'ou, enhance the quality of teacher training (particularly in areas relating to island ecology

3.4. ACTIONS

To achieve the objectives that have been identified during the workshops and informed by the nest surveys in 2010, the following actions are necessary:

3.4.1 GOAL A: Objective 1. To provide scientific knowledge necessary to inform conservation management of Malau and monitor changes in the population, nesting grounds and habitat as a result of management

Although it is clear that the number of nesting grounds has declined dramatically since 1993, our knowledge of the species, particularly the primary threats to its persistence remains very poor. Research should focus on the following key topics, for which few or no data exist:

a) Number of eggs laid per 90-day period in each nesting ground

b) Number of eggs harvested purposefully and opportunistically

c) Up-to-date distribution and population estimate (in comparison with Goth & Vogel 1995)

d) Identification and quantification of threats to the population

e) Number of breeding pairs using each active nesting ground

f) Distribution of geothermal activity on Niuafo'ou, to show areas suitable for breeding.

g) Spatial ecological (radio-telemetry) data for both adults and chicks, which could reveal patterns of habitat detection, survival rates and dispersal behavior,

h) Population genetics to identify bottlenecks, response to stochastic events and relatedness/ inbreeding within the population

Research topics a-c above are the most urgently required. Combined with population estimates, these data should provide the baseline against which the success of the conservation action plan can be measured, how progress is being made and provides an understanding of the ecological conditions that are necessary for the *Malau* to survive on Niuafo'ou. It would also provide an opportunity to develop a simple data recording protocol by which egg collectors, government staff, non-governmental organization staff and other members of the Niuafo'ou rural community gather data on the species and promote a community-based approach to the species' conservation. If an appropriate and simple data recording protocol can be developed it could provide the most realistic way of monitoring numbers of eggs and activity at nesting grounds during egg harvesting.

The following specific actions will/should be pursued in the next three years:

Action 1.1: Conduct population survey at all active and inactive nesting grounds and other areas of suitable forest throughout the island, using methods devised by Goth & Vogel (1995) i.e. playback counts and extrapolations of density estimates to areas of appropriate habitat.

Action 1.2: Conduct a spatial ecological study of both adults and young birds using radio-telemetry to determine the number of breeding pairs using each active nesting ground and investigate patterns of habitat-use by both adults and chicks

Action 1.3: Conduct population genetic study to identify effective population size, previous bottleneck events, levels of inbreeding, and the responses of the population (variation in genetic variation) to past stochastic or climatic events

Action 1.4: Identify (or map) distribution of geothermal activity on Niuafo'ou and relate these patterns to distribution of active and inactive nesting grounds

Action 1.5: Identify and, where possible, quantify threats to the decline in population and number of active nesting grounds that would further enable egg collectors to reactivate recently abandoned nesting grounds provided the threats no longer exist

Action 1.6: Develop a participatory monitoring program for egg collectors and other members of the rural community on Niuafo'ou that will engage all relevant stakeholders Action 1.7: Utilize data from these actions to develop and conduct surveys for the species and its nesting grounds on Late Island and Fonualei Island to determine the status and success of the previous assisted colonization of the *Malau* on these islands

3.4.2. OBJECTIVE 2: To promote conservation management that will lead to an increase in Malau population, distribution, and the numbers of active nesting grounds

Whilst detailed scientific knowledge of the species is clearly necessary in the long term as a basis to develop specific management actions, it is still possible to identify some broad management actions that can be taken immediately to prevent further decline in the species population and decline in number of nesting grounds. The population of the *Malau* on Niuafo'ou is very small. The number of active nesting grounds has declined dramatically since 1983 (see Part 2 Table 1) and furthermore since the last surveys in 1993 (see Goth & Vogel 1995). It is urgent that efforts to control egg harvesting and to utilize the expertise of the egg collectors in creating a more sustainable harvesting strategy be done immediately

The following specific actions will/should be pursued in the next three years:

Action 2.1: Employ the most experienced and principal egg collector on the island as the principal guardian and manager of all remaining active nesting grounds for a period of three years.

Action 2.2: Implement a participatory monitoring programme at all active nesting grounds for the next three years with the collector above as the principal conservation manager. Counts of eggs at each nesting ground per 90-day incubation period (see Göth & Vogel 1997) should ideally be conducted in the presence of the project oversight officer from the Tonga Ministry of Environment and Climate Change, or member of staff from Tonga Community Development Trust. Suitable handling protocols for egg counts must be adopted so that eggs that are removed and then replaced in the nest burrows have the greatest chance of survival. Such protocols include egg collectors and monitors wearing gloves to reduce chances of infections, all eggs removed prior to being replaced in the nest burrows are kept as warm as possible, and eggs are returned in the same position as to where they were found. At each count, each time the burrow is dug up, the temperature regime in the burrow will take a day or two to re-establish, and there will be a drop of temperature in the burrow.

Action 2.3: Design and implement a strategy to place greater restrictions of the movements of feral pigs throughout the island, with a strong emphasis on the forested areas along the main tracks and dirt roads into the caldera near the villages of Mata'aho, Mu'a, Tongamama'o, Esia and Sapa'ata. Prohibit the presence of feral pigs, dogs, goats, cats and other domestic animals from several key but accessible areas within the caldera, and particularly within the area of the nesting grounds at Hikutemotu, Vai Kona, Motu Molemole and Motu Lahi.

Action 2.4: Utilize the population genetic data (Objective 1 Action 1.3) to determine feasibility of further assisted colonization (see Seddon 2010, for definition) to other islands such as Fonualei Island or Late Island.

3.4.3. OBJECTIVE 3: To review existing legislation on the Malau, egg harvesting, land-use and land-tenure systems and recommend amendments

The *Malau* is currently protected by law under the Birds and Fish Preservation Act from the Law of Tonga, Act No.13, of 1934, G118/31 and 29/33 to the extent that it is forbidden to remove any eggs or birds throughout the year (see Göth and Vogel 1995). The majority of people on

Niuafo'ou know that the species is threatened and formally protected. However, this law has proved impossible to enforce for several reasons, and more importantly, it conflicts with the cultural heritage and exploitation of a key natural resource of the people of Niuafo'ou.

The following specific actions will/should be pursued in the next three years:

Action 3.1: Review all traditional land-tenure culture and legislation that affects the *Malau* population and identify gaps in protection and sustainable conservation management of active nesting grounds. Determine the viability of introducing seasonal restrictions on egg harvesting (as used historically by local chiefs).

Action 3.2: Review all national environmental protection legislation that affects the *Malau* and identify gaps in protection and sustainable conservation management of active nesting grounds

Action 3.3: Review national land-use policies and legislation, particularly those related to agriculture, feral animal control, forestry and habitat restoration, and identify any conflicts with *Malau* conservation on Niuafo'ou

Action 3.4: Determine the feasibility for the creation of community-based Special Management Areas for sites of critical importance for the *Malau* on government land e.g. around Vai Kona, Motu Molemole and Motu Lahi.

3.4.4. GOAL B: OBJECTIVE 1. Improve networking and co-ordination between all stakeholders, particularly between egg collectors, rural communities, church groups, community development non-governmental organizations, government departments throughout Tonga and international conservation organizations.

There have been few scientific studies of the *Malau* over the years (the most comprehensive being Göth and Vogel 1995) and none have resulted in sustained efforts to conserve the *Malau* or a reduction in its threat status. Several significant factors have contributed to this but one of the most important is the lack of any means to maintain the conservation momentum through coordinating interest and activities to ensure that projects are not just „one-offs'. There is expertise of megapode conservation in other parts of south-east Asia, and even more expertise in *Malau* nesting ground activities given the number of years that egg collectors have been collecting eggs. It is now critical that these are harnessed as effectively as possible, by providing a single focus for implementing the species conservation action plan, so that all those who would like to become involved know who to contact. This will allow much greater interaction between the people of Niuafo'ou and all those who wish to support their conservation efforts and thus have a greater impact.

The following specific actions will/should be pursued in the next three years:

Action 4.1: Establish a coordination body to provide strategic oversight and project management

Action 4.2: Determine the most realistic way for the proposed nesting ground manager to be paid to manage *Malau* nesting grounds and how other financial resources can be secured

Action 4.3: Engage and reach agreement with egg collectors on Niuafo'ou, on their respective roles in *Malau* egg harvesting and their responsibilities. Agreements reached on access, timing, and methods (including soil replacement) of egg harvesting by all relevant stakeholders to reduce impact and frequency of opportunistic egg harvesting

Action 4.5: Improve the physical communication channels to Niuafo'ou, in particular internet and phone access.

Action 4.6: Establish a central repository for all information relating to *Malau* conservation, including scientific data

3.4.5. GOAL B – OBJECTIVE 2: Promote rural livelihoods that will meet local needs but will not damage the survival prospects of the Malau and its habitat

The results of the questionnaire surveys demonstrate that there is an overwhelming desire for the rural communities on Niuafo'ou to become more involved in all aspects of the conservation management of the *Malau* to preserve a key natural resource and component of their cultural heritage. Conservation management of the *Malau* should therefore include elements that benefit the communities by, for example, more effective and controlled burning of land for agricultural purposes, forest restoration, alternative strategies for restricting the movements of pigs, and reduced number of *Malau* eggs opportunistically collected from nesting grounds.

The following specific actions will/should be pursued in the next three years:

Action 5.1: Develop a model approach for the community-based management of *Malau* nesting grounds and its habitat so that both benefit as fully as possible (see also Goal A, Objective 1 Action 2.1)

Action 5.2: Determine the feasibility of establishing one or more areas for the purpose of producing poultry (chicken) eggs as an alternative source of protein.

3.4.6. GOAL B – OBJECTIVE 3: Develop new environmental education resources and sports activities for both schools on Niuafo'ou, enhance quality of teacher training (particularly in island ecology)

There is a greater need for environmental education that specifically addresses the plight of Tonga's forest habitat (nationally) and endemic terrestrial taxa. Successful *Malau* conservation management and the preservation of sustainable egg harvesting will depend in part, on the restoration of this species as a focal point of environmental education in the school curriculum. It is proposed that a pilot primary school education programme be developed for both primary schools on Niuafo'ou with an emphasis on the native forest, the *Malau* and other endemic terrestrial taxa that form the basis of many aspects of their cultural heritage and traditional folklore. This should be reviewed after three years with a view to develop suitable materials for the higher education curriculum in the Niuafo'ou high school.

The following specific actions will/should be pursued in the next three years:

Action 6.1: Develop an education programme and materials for primary school children at both primary schools on Niuafo'ou through the creation of the "Young *Malau* Club" – an activity group run by teachers, other volunteers and women's community groups that link together education, cultural heritage (the dangers of over-harvesting of eggs, medicinal plants, forest conservation) and other activities (e.g. sport, cooking, weaving) for children during school hours and also outside of school.

Action 6.2: Identify areas where teacher training, particularly for environmental sciences, and specifically ecology and knowledge of Tonga's endemic flora and fauna, can be improved

Action 6.3: Develop a Tongan nation-wide awareness programme and identify target audiences.

Tongan Megapode (Megapodius pritchardii) 1864.
Artist: Walter Lawry Buller (1838-1906)
Source: Wikimedia Commons.

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CEPF Large Grant Final Project Completion Report

Developing Model Species Recovery Plans in Tonga

Organization Legal Name

Tonga Community Development Trust

Project Title

Developing Model Species Recovery Plans in Tonga

Report Author and Contact Information

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CEPF Region

Polynesia-Micronesia Hotspot

Grant Amount

USD$50,000

Project Dates

Jul 1, 2009 – Dec 31, 2010

OPENING REMARKS

Provide any opening remarks that may assist in the review of this report.

This project attempts to conserve one of Tonga's rarest land birds known locally as Malau, Polynesian Megapode (Megapodius Pritchardii). Malau has a very special conservation value because it was found only on the island of Niuafo'ou, Tonga's furthest island to the north. In the 1990s, research on Malau raised both a national and a global concern because of the dramatic decline in the population of adult bird. It was listed then under the IUCN Red List as a Critically Endangered species of land bird.

One of the main threats and believed to be responsible for the decline of the Malau was overharvesting of Malau eggs by the local people of Niuafo'ou. In order to address a possible extinction of Malau from Niuafo'ou, a translocation program was carried out in the early 1990s to the two volcanic and uninhabited islands of Late and Fonualei in the Vava'u group.

A follow-up survey was conducted in 2003 and confirmed an increase in the number of adult Malau birds surviving in Fonualei island, although none were sighted on Late. It was one of the successful conservation stories of salvaging a critically endangered species of land bird from the verge of extinction in our region. A consequence of this successful translocation program has been evident in the downgrading of the status of Malau in the IUCN Red List, from Critically Endangered to Endangered. Extinction of the Malau may have been prevented by the success of the translocation program but the main threat posed by humans over harvesting of eggs in Niuafo'ou, the original home for the Malau, is yet to be addressed effectively.

Mechanisms to protect the population of Malau in Niuafo'ou will require the active participation of the local community. The strong co-relation between the environment and culture need to be clarified and promoted as well. If the species becomes extinct then it will be a cultural loss for the future generation of Niuafo'ou as the species is deeply entrenched in the islands oral traditions, poems, and songs.

Niuafo'ou being located in between the main island of Tongatapu and Samoa, relatively isolated with limited western influence. However, current development activities in terms of improving communication and contact with the outside world may very well speed the rate of depletion of the exotic environment and cultural uniqueness of Niuafo'ou. There is already a number of signs and indicators of this loss. The people of Niuafo'ou are well known for speaking their own dialect known as "lea faka-Niua" (lit: speak like a Niua) that may not easily understood by those from the other island groups in Tonga. During our survey in Niuafo'ou, we learned from the people that some of them traced their ancestors to the island of Uvea (Wallis and Futuna) located between Samoa and Fiji. This is an interesting part of the history and culture of Niuafo'ou.

However, the inconvenient truth of the matter is that, this unique dialect is disappearing. Some of the traditional terms and names of events and living things are lost. The Recovery Plan is not only aim to protect and recover the Malau, it will also attempt to intricately revive the dialect and culture.

Achievement of Project Purpose

PROJECT PURPOSE: To develop a well researched stakeholder owned Species Recovery Plan for the Malau

PLANNED VS. ACTUAL PERFORMANCE

Indicator (Purpose-level) vs. Actual at Completion

Indicator 1: Long term partnership with at least one research institution is established to ensure ongoing feed back of information to the successful protection and recovery of Malau.

The project approached the University of the South Pacific and Birdlife International both based in Fiji. Unfortunately neither one can do it due to their workload. The World Pheasant Association based at the University of New Castle, Britain was one of sixteen responds to our call for expression of interest. One of the reasons for their selection is their interest in developing a long term working relationship with Tonga Trust in the protection and recovery of Malau.

Indicator 2: Mainstreaming the conservation work on Malau as a priority in the Ministry of Environment and Climate Change Strategic Action Plan

The project engaged the Ministry of Environment and Climate Change right from the outset for the purpose of mainstreaming the work on Malau to be one of their key priority. Tonga Trust was invited to be a member of the PoWPA Project Technical Working Group. The aim was for PoWPA to include in their work program the need set up Protected Areas for the Malau. The Ministry of Environment and Climate Change is currently submitting the Conservation Action Plan for the Polynesian Megapode to the HM Cabinet to be endorsed by the government.

Indicator 3: Sustainability of conservation activities and recovery of Malau.

i. The project aimed not only to complete the Conservation Action Plan for the Polynesian Megapode but continue to fund raise for its implementation. When the survey was completed in Niuafo'ou, the survey team met with the Ministry of Environment and Climate Change and a team of consultants from UNEP/SPREP that came to develop Tonga's Program of Action under the Pacific Biodiversity Initiative. The Ministry of Environment agreed to focus Tonga's Program on the implementation of some of the key actions from the Malau recovery plan.

ii. The World Pheasant Association (WBA) has also drafted an application to the Mohammed bin Zaed Species Conservation Fund (MBZ) to support key scientific research on Malau.

iii. WBA is supporting scholarship for a Phd student to conduct long term research on the Malau and feedback the result for the ongoing management and recovery of Malau.

iv. Lastly, Tonga Trust will submit a LoI for the 4th round of call from CEPF to support the implementation of the remaining actions.

Describe the success of the project in terms of achieving its intended impact objective and performance indicators.

The project was a success in terms of achieving the following intended impact objective and performance indicators:

i. Securing an informal working relationship with the World Pheasant Association (WBA, not only in providing technical input but ability to fundraise for the implementation of the Recovery Plan.

ii. Mainstreaming the implementation of the recovery plan into the Ministry of Environment and Climate Change strategy

iii. Sustainability of the project is always challenging but getting the attention of potential donors and fundraising immediately after the completion of the Recovery Plan is a positive sign towards sustainability.

iv. Project outputs:

Project Outputs:

OUTPUT 1 : RESEARCH AND INFORMATION COLLECTION

Indicator 1.1: Reports on previous protection and recovery action, ecological requirements, lessons learned, current population, threat level, and locations.

i. The desk review of previous protection and recovery action was done by Tonga Trust. It was challenged by limited information forwarded by members of the Technical Team and those that were available on internet. However, the review exercise provided good baseline information for public awareness raising, as well as, improve planning and coordination of the upcoming species and community-based survey in Niuafo'ou.

ii. Calling for expression of interest to conduct the species survey and drafting of the Recovery Plan was circulated widely through the internet. About 16 applications were received and three were shortlisted and the World Pheasant Association from New Castle University, UK was selected as the successful bidder.

iii. The research survey and information collection expedition to Niuafo'ou was initially planned to be carried out between January and March of 2010. It was delayed to September due to a number of reasons, including inconsistent air and sea transportation from Tongatapu to Niuafo'ou and also the availability of the leading researcher from the World Pheasant Association. The survey was successfully completed in October 2010.

iv. The survey had two components. The first was focused on the species of Malau, observing and finding the locations of where they live, where they lay eggs, environmental conditions, and potential threats. The second was a community-based attitude survey which was carried out concurrently during the two community awareness workshop carried out in Niuafo'ou. The analysis of the survey is included in the Recovery Plan.

v. The species survey planned for Fonualei and Late islands in Vava'u were cancelled due to bad weather.

OUTPUT 2: COMMUNICATION AND AWARENESS PROGRAM.

Indicator 2.1:

i. Communication and social marketing strategy

ii. Awareness and Promotional Materials

iii. Media Programs

i. A draft communication and social marketing strategy was produced at the end of 2009. It helped to reconfirm the target audience, relevant messages, type of medium and who to deliver the message. However, the survey expedition confirmed the appropriate approach to communication strategy. Media is limited to Tongatapu only as it is not accessible to the people of Niuafo'ou. A more direct and participatory form of communication, like community meeting, workshops, school presentation and forming a Malau club at school can be more appropriate.

In terms of social marketing, the survey also helped to reduce the target audiences to the 4 active eggs collectors. The general populations in Niuafo'ou are not engaging in eggs collection and have limited knowledge about the behavior of Malau.

ii. The Executive Director of Tonga Trust participated at the 4th Birdlife International Meeting held in Melbourne, Australia in October 2009. A good opportunity to raise the project profile as well as networking.

iii. Tonga Trust is a member of the PoWPA Technical Working Group. About five meetings were conducted in 2010 which provided a good forum to raise awareness and strengthen networking relationships with relevant stakeholders, such as, Ministry of Environment and Climate Change, Ministry of Agriculture, Forestry, Food and Fisheries, and Crown Law.

iv. Tonga Trust also participated in the PoWPA awareness workshop and survey to the outer islands of Vava'u and Ha'apai in July 2010. There were five workshops conducted in Vava'u with different focus groups and three in Ha'apai. The community-based workshops provided an opportunity to raise people's awareness about the Malau. It was disappointing to learn that very few people in Vava'u know that Malau has been successfully translocated from Niuafo'ou to Vava'u. It is a new introduction not only to the environment but also the culture of Vava'u and it may take time together with increasing awareness for the people of Vava'u to fully appreciate and be proud of the Malau. On the other hand, foreign tourist operators based in Vava'u are more aware about the Malau introduction to Vava'u though we have not heard of any guided tour to see Malau in Fonualei. However, there is already a Bar and Restraunt in Vava'u called Megapode. Polynesian megapode is now a potential attraction for nature tourism in addition to whale watching and bird watching in Vava'u.

v. A media release was issued through the local media (television, radio and newspaper) and through major conservation network, such as IUCN, Birdlife International, Pacific Invasive Species, and it helped to raise the profile of the outcome of the survey on the Malau. We received lots of interest and enquiries from different parts of the world, including the organization from Germany that funded the translocation of Malau eggs in the 1990 who wanted to re-establish working relationship with the Tonga Trust.

OUTPUT 3: CAPACITY BUILDING

Indicator 3.1:

i. Trained locals on technical methods of research

ii. Communities are trained on monitoring:

i. One TCDT staff and two staff from the Ministry of Environment and Climate Change were trained on technical methods of research during the expedition. It was clear that the limited time and capacity hampered a complete achievement of this indicator. The project tried to recruit a University student from USP to participate in the survey and to take up further study on Malau but we were unsuccessful in getting one.

ii. There was a slight change in approach when we learned from the community workshop that not many local people dig up Malau eggs. The survey found out there were only 4 active eggs digger. During the survey, two local men from Niuafo'ou were trained on reviving and monitoring of harvesting sites.

OUTPUT 4: RECOVERY PLAN

Indicator 4.1:

i. Species Recovery Plan

i. The Conservation Action Plan for the Polynesian Megapode was completed in December 2010 and was submitted to the Government of Tonga for formal endorsement by the Cabinet.

ii. Funding proposal is also underway to the following potential donors: (a). GEF - PAS Island Biodiversity Project (UNEP/SPREP); (b). Mohammed bin Zaed Species Conservation Fund; and (c). CEPF. It is envisaged that the implementation of the Conservation Action Plan will be underway as soon as these proposals are endorsed by donors.

Describe the success of the project in terms of delivering the intended outputs.

The successes of the project in terms of delivering the intended output are as follows:

i. The desk review of previous activities was completed and was particularly useful for upcoming activities, such as, logistical planning for the upcoming species and community attitude survey in Niuafo'ou, and also in providing information for public awareness raising;

ii. The combined species and community attitude survey was successfully carried out in Niuafo'ou. The information from both surveys complements each other;

iii. A draft communication and social marketing strategy was completed and helped communication activities to be more targeted;

iv. A number of awareness raising activities were successfully carried out at both the national level in Tongatapu and also at the community level in Niuafo'ou;

v. Limited capacity building activities were made available and local staff and local community members took advantage of it;

vi. Completion of the Conservation Action Plan for the Polynesia Megapode in a timely manner;

vii. Discussion with potential donors and partners for the implementation of proposed actions from the Conservation Action Plan for the Polynesian Megapode began immediately after the survey.

Were any outputs unrealized? If so, how has this affected the overall impact of the project?

The species survey planned for Fonualei and Late islands was cancelled due to poor weather. However, it did not affect the overall impact of the project.

Conservation Impacts

Please provide the following information where relevant

- *Hectares Protected*: N/A
- *Species Conserved*: N/A
- *Corridors Created*: N/A

Lessons Learned

Describe any lessons learned during the design and implementation of the project, as well as any related to organizational development and capacity building. Consider lessons that would inform projects designed or implemented by your organization or others, as well as lessons that might be considered by the global conservation community.

Project Design Process: (aspects of the project design that contributed to its success/ shortcomings)

It was clear from the beginning that the project will be challenged by lack of local Tongans with the scientific knowledge and technical expertise about the Malau. One of the options for the project was to seek available regional experts. An informal technical team was set up with one staff from Birdlife International and a researcher from the UK. Both provided tremendous amount of information and technical advise during the project design phase. The lessons is that, it will be most helpful if CEPF sets up a group of mentors or technical advisors and made available for projects to seek advises from at any time during the project cycle. If not, than project may have to do it based on liasing with the right people and organization based on willingness and vested interest. These advises can make lots of difference and contributed to the successful design process.

Project Execution: (aspects of the project execution that contributed to its success/shortcomings)

The best way to recruit the best people with the appropriate expertise to carry out a particular task is to call for expression of interest. We initially approach a pool of experts for availability to conduct the species survey. Since none were available, we then circulate widely through regional and international network a calling for expression of interest. The result exceeds our expectations when we received 16 applications from different parts of the world. The competitive edge among the bidders provides the best value for your money. *:*

One of the lessons learned by the researcher was the reality of implementing academic theory into a practical application. While conservation evaluation has received substantial attention in the academic literature, there remains a disconnect between what is optimal or desirable and what is achievable in evaluation application on the ground.

Additional Funding

Provide details of any additional donors who supported this project and any funding secured for the project as a result of the CEPF grant or success of the project.

**Additional funding should be reported using the following categories:*

A Project co-financing (Other donors contribute to the direct costs of this CEPF project)

B Grantee and Partner leveraging (Other donors contribute to your organization or a partner organization as a direct result of successes with this CEPF project.)

C Regional/Portfolio leveraging (Other donors make large investments in a region because of CEPF investment or successes related to this project.)

Donor	Type of funding*	Amount	Notes
EU Sustainable Harvesting Project	B	15,000	Tonga Trust is a member of the National Water Safety Committee which responsible for surveying the Sustainable Rainwater Harvesting status and options in the outer islands, including Niuafo'ou. The follow-up action is the distribution of 150 water tanks in the surveyed islandss and about10 new plastic water tanks (10,000 litres) are planned to be sent to Niuafo'ou at the first quarter of 2011.
Mainstreaming of Rural Development Innovations programme (MORDI)	B	30,000	Tonga Trust is Chairing the Project Review and Assessment Committee (PRAC) for MORDI and recently endorsed a number of community projects to upgrade damaged water tanks in Niuafo'ou, organic vegetable gardening, hall and road construction.
Program of Work on Protected Areas (POWPA)	B	5,000	Tonga Trust is a member of the PoWPA Technical Working Group. PoWPA supported the cost for 2 staff of the Ministry of Environment and Climate Change to participate in the survey expedition to Niuafo'ou.
Tonga Community Development Trust	B		Two of Tonga Trust projects were exposed to the people of Niuafo'ou: The Amatakiloa (Women in Development) and Disaster Preparedness.

Provide details of whether this project will continue in the future and if so, how any additional funding already secured or fundraising plans will help ensure its sustainability.

This project will continue in the future, especially focusing on the implementation of the Conservation Action Plan for the Polynesian Megapode. Funds are yet to be secure, though discussions with the Ministry of Environment and Climate Change and the GEF-PAS Biodiversity Initiatives reached an agreement in November 2010 that they will fund activities from the Conservation Action Plan close to US$25,000. In addition, the World Pheasant Association is lodging an application to the Mohammed bin Zaed Species Conservation Fund of another US$25,000. WBA is also seeking financial support for a Phd scholar to conduct long term study on Malau in Niuafo'ou. Tonga Trust is drafting a LoI to be submitted to the fourth round of CEPF to supplement the implementation of the remaining activities of the Conservation Action Plan for the Polynesian Megapode. It is envisaged it would be close to an extra US$50,000 per year for the next three years and a total cost of about US$150,000.

Additional Comments/Recommendations

The successful development of the Conservation Action Plan for the Polynesian Megapode could not have been materialized without the financial support of the Critical Ecosystem Partnership Fund. CEPF has provided the seed funding to strategically look at how we can conserve the Polynesian Megapode and prevent from possible extinction from its original home in Niuafo'ou. Informal partnership has been developed between Tonga Trust and the World Pheasant Association and this relationship will be very instrumental in the implementation of the Conservation Action Plan.

Even though there have been some initial discussion with potential donors on funding the implementation of the Action Plan, funding commitment is yet to be secured. Other donor such as MBZ is lined up as a potential source of funding. Lastly, the CEPF fourth round has recently opened and we would recommend submitting a LoI for the implementation of the remaining actions in the next three years.

Information Sharing and CEPF Policy

CEPF is committed to transparent operations and to helping civil society groups share experiences, lessons learned, and results. Final project completion reports are made available on our website, www.cepf.net*, and publicized in our newsletter and other communications.*

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