MAKATEA, A SITE OF MAJOR IMPORTANCE FOR **ENDEMIC BIRDS**

BIODIVERSITY CONSERVATION LESSONS LEARNED TECHNICAL SERIES

16

CONSERVATION INTERNATIONAL
Pacific Islands

BIODIVERSITY CONSERVATION LESSONS LEARNED TECHNICAL SERIES

16 Makatea, a site of major importance for endemic birds

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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.

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CRITICAL ECOSYSTEM PARTNERSHIP FUND

CONSERVATION INTERNATIONAL Pacific Islands

Location of the project in the Polynesia-Micronesia Biodiversity Hotspot

Contents

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Lessons Learned

The difficulty of the fieldwork was perhaps slightly underestimated during project planning. Indeed, the geology of the island makes the fieldwork very difficult to be processed, and as a consequence only a small surface of the island could be surveyed.

Black Rats were believed to be absent from the island according to observations from previous surveys. However, this species was found during the rat-trapping campaign. The lesson learned from this unexpected detail is that rat-trapping and species identification should always be performed in order to confirm the rats species.

The project raised the importance of implementing awareness to the local community as several people among the population were unaware about the importance of their island in terms of biodiversity.

Because of the remoteness and inaccessibility of the island, the visitors are scarce. We learnt that it is crucial to listen and pay attention to the community opinion and develop good relations with the residents in order to make them support the scientific work and management actions.

Project Design Process

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

The design of the project meant that it was successfully implemented, although we recommend a lengthier fieldwork period for the future in order to increase the relevance of data collected.

Project Implementation

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

Collaborations initiated during project planning were comprehensively developed and broadened during the implementation of the project. These collaborations contributed to the success of the project.

Good relationships were developed with the community during the course of the survey.

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Introduction

The remote island of Makatea is not currently classified as a natural or protected reserve yet is home to a forest with the richest flora of all the Tuamotu archipelago, plus three endemic and threatened bird species.

This project has sought to provide and update valuable scientific knowledge about plants and birds in the area, evaluating local populations of both endemic and introduced species on the island, as well as developing strategic plans for the conservation and preservation of local species and for the eradication of introduced predators and invasive plants.

The tangible results of the project, aside from the increased understanding of Makatea's rich biodiversity and its key threats, have included the development of a Plan of Action for two endemic species and a feasibility study for the eradication of rats from the island.

The project outcomes detailed in the following pages will hopefully spark further interest and support from the local community and conservation agencies to continue to protect the precious heritage of Makatea, and possibly see it established as the first large mammalian free island in French Polynesia to help secure the futures of a number of globally threatened species.

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Project Outcomes

1 Collect data on Makatea plant species

The different plant species were identified, which showed that the island of the Makatea holds the richest flora of all the Tuamotu Archipelago (76 atolls). It is home to 77 native species (four of them are protected) and 13 endemic species to French Polynesia, 4 of them being endemic to the island of Makatea (including a new genus discovered during this fieldtrip).

The different vegetal formations of the island were identified and precisely mapped.

Although Makatea has a unique flora, 18 species are invasive. The main recommendation to protect the native vegetation is to survey and control these invasive plants. It has also been suggested to classify the island as a natural reserve (Jacq and Butaud 2009).

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2 Gather data on the Polynesian Imperial-pigeon and the Makatea Fruit-dove

OVERVIEW:

The island of Makatea hosts at least two species of concern, the Makatea Fruit-dove Ptilinopus chalcurus (VU) and the Polynesian Imperial-pigeon *Ducula aurorae* (EN) and an additional one that represents an endemic sub-species, the Tuamotu Reed-warbler Acrocephalus atiphus eremus. Populations of native birds on Makatea appear to be relatively stable, and there may even be prospects for population recovery as the anthropogenic mining activities that once occurred on the island have ceased (Albar et al. 2009). Makatea was heavily exploited for its vast phosphorous reserves, but the mining stopped in the 1960s and the human population was only 61 people in 2007 (Institut Statistique de la Polynésie française). Hunting pressure and rates of habitat loss were reduced, and the forests appear to be recovering in several areas (Jacq and Butaud 2009). Nonetheless, bird populations remain small and restricted to the land area of Makatea. Together, these may make the populations vulnerable to stochastic threats such as extreme weather, avian diseases, or inbreeding depression. The island is being considered for new mining activities, which may further affect the birds. Finally, the island's proximity to Tahiti makes it vulnerable to invasion by the same predatory Circus approximans that likely caused the extinction of *Ducula aurorae* and the decline of Grey-green Fruit-dove Ptilinopus purpuratus (LC) on Tahiti (Gouni and Zysman 2007).

Method:

All previous literature on the three species mentioned above was collected.

The populations of these species were assessed using the method of counting points, and the data collected were then analyzed with the software Distance 6.0 Release 2.

Maps of the birds and their habitats were produced. The main threats affecting these species were identified.

A Plan of Action for the two endemic species was established.

RESULTS:

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Ptilinopus chalcurus

We estimated densities and total populations based on point transect surveys conducted in July 2009 on Makatea Island. Surveys were conducted at 51 stations, and across the course of a week. Survey data were analyzed with program Distance (Thomas 2006) to estimate population densities. We excluded the most distant 15% of the observations, which left 49 for detection curve fitting. We used no pooling. We considered half-normal, hazard rate, negative exponential, and uniform detection function models. We used cosine series expansions with all models, and evaluated the relative fit and suitability of each model with a model selection approach (Burnham and Anderson 2002). The top-ranked model included a negative exponential detection function. Due to the restricted number of detections, parameters were constrained to obtain monotonicity. The resulting curve was nonetheless intuitively appealing, as it showed a decline in detectability with distance, and because the chi-square test for fit did not reject the model. Parameter estimates resulted in the density and abundance estimates presented below.

When multiplied by the total land area on Makatea (2800 ha), the resulting estimated population size was 993 birds, with a 95% confidence of being between 444 and 2219. Please note that the survey design included only a portion of the island (some of Makatea was inaccessible). Additionally, our ability to estimate a robust detection function was hindered by limited observations. Nonetheless, we feel as if our estimate is a reasonable approximation of the actual population size. The last estimate of this population was about 1000 individuals in 1987 (Thibault and Guyot 1987).

Observations	Estimated Density	95% Confidence Interval	Estimated Population	95% Confidence Interval
49	0.287/ha	0.16 to 0.79	804	444 to 2219

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Ducula aurorae

We estimated densities and total populations using the same method described above. We right truncated the observation set at 100 m because of declining detectability at greater distances. We observed 76 birds during the survey sampling periods, and used 69 observations for curve fitting. We pooled observations into 20 m bins. We considered half-normal, hazard rate, negative exponential, and uniform detection function models and used cosine series expansions with all models. Using a model selection approach (Burnham and Anderson 2002), we evaluated the relative fit and suitability of each model. The top-ranked model was a uniform detection function. Due to the restricted number of detections, parameters were constrained to obtain monotonicity. The chi-square test for fit did not reject the model. Parameter estimates were similar across models, but the uniform detection model resulted in the density and abundance estimates presented below.

When multiplied by the total land area on Makatea (2800 ha), the resulting estimated population size was 1206, with a 95% confidence of being between 867 and 1677. The last estimate of this population was comprised between 100 and 500 birds in 1987 (Thibault and Guyot 1987).

Observations	Estimated Density	95% Confidence Interval	Estimated Population	95% Confidence Interval
69	0.417/ha	0.31 to 0.60	625	867 to 1677

© JF Butaud.

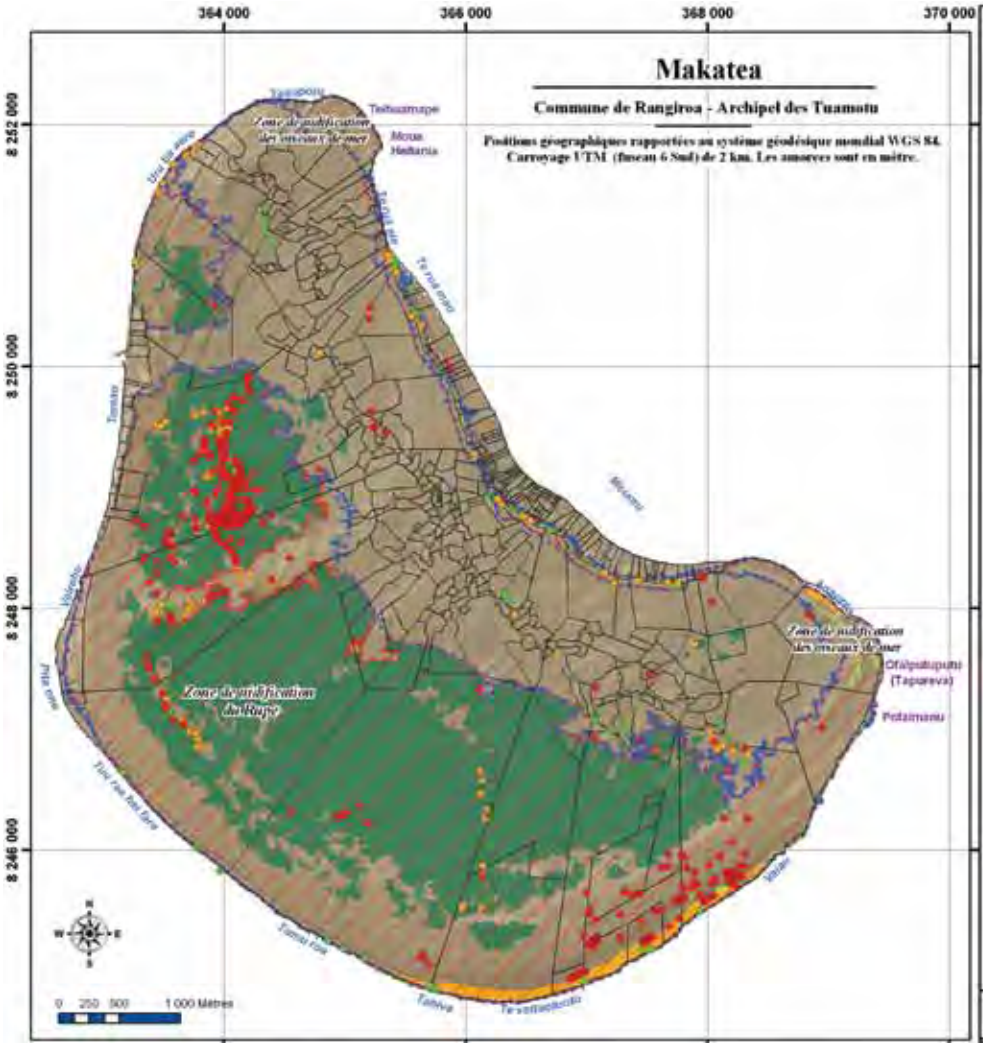
Acrocephalus atyphus

Although the species Acrocephalus atyphus is widespread in the Tuamotu and thus listed by Birdlife as LC, it should be noted that Makatea hosts a subspecies Acrocephalus atyphus eremus, which is endemic to this island.

The same method was used as previously described. We right-truncated detections beyond 90 m because of declining detectability at greater distances, although other truncation distances resulted in similar density estimates. Detections were pooled into 4 equal-width bins. We detected 74 birds, of which 72 were used to develop a detection function. We considered half-normal, hazard rate, and uniform detection function models. We used cosine series expansions with all models. We evaluated the relative fit and suitability of each model with a model selection approach (Burnham and Anderson 2002). The top-ranked model was a hazard rate detection function. Due to the restricted number of detections, parameters were constrained to obtain monotonicity. The resulting curve was nonetheless intuitively appealing, as it showed a decline in detectability with distance, and because the chi-square test for fit did not reject the model. Parameter estimates resulted in the density and abundance estimates presented below.

When multiplied by the total land area on Makatea (2800 ha), the resulting estimated population size was 6820, with a 95% confidence of being between 3695 and 12587.

Observations	Estimated Density	95% Confidence Interval	Estimated Population	95% Confidence Interval
72	2.44/ha	1.32 to 4.50	6820	3695 to 12587



Zones d'intérêts patrimoniaux

Utilisant les limites de la végétation

Plantes patrimoniales

- Plantes protégées*
- Plantes patrimoniales
- Arbres remarquables

* : Arrêté 306 CM du 20 février 2008

Habitats remarquables (1023 ha - 36%)

- Zone littorale Sud et Est
- Fruticée à Capparis (Puapiro) - Scrophulariaceae nov
- Forêt à Homalium- Pouteria (Mouo-Moto)

Zones de nidification des oiseaux (1713 ha - 61%)

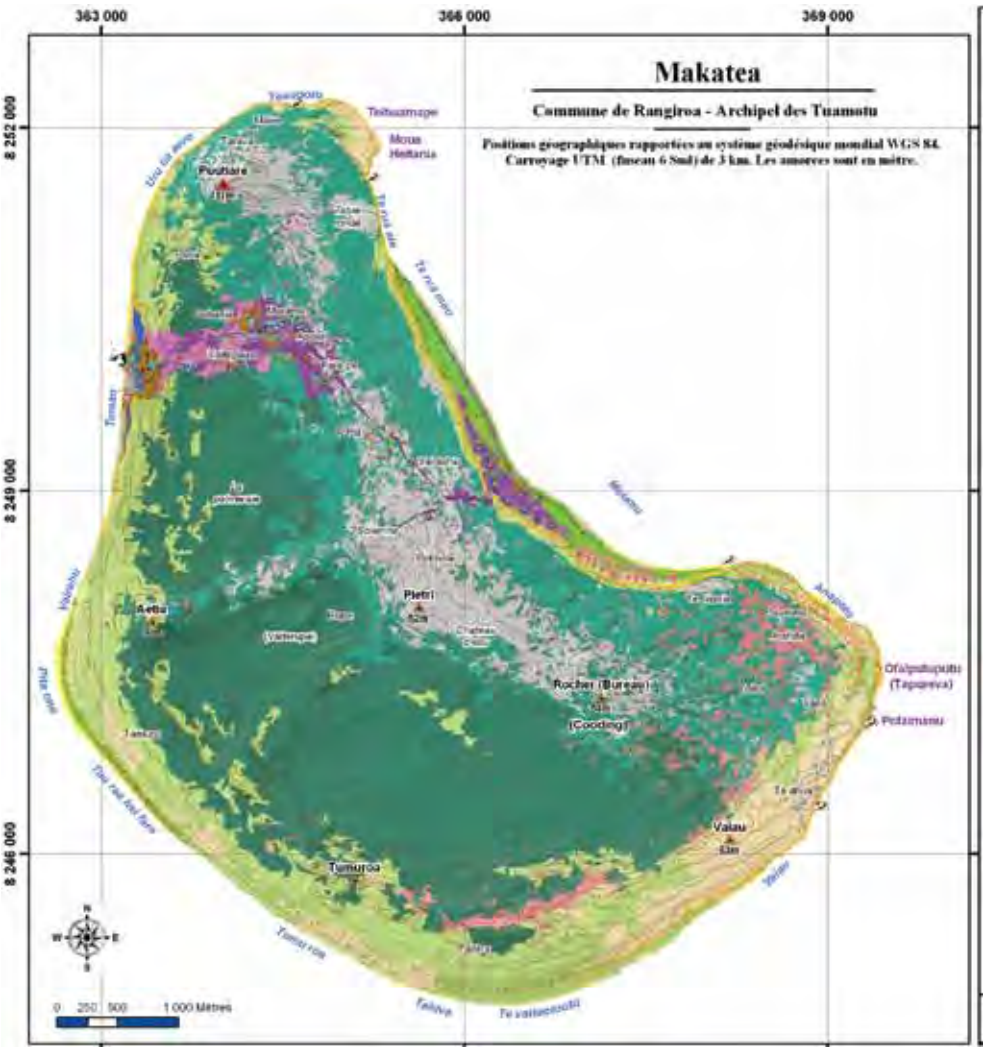
- Oiseaux de mer et Rupe

Aire protégée proposée (catégorie IV, 1771 ha - 62 %)

- Cadastre de Makatea
- Autres habitats

Toponymie : :

Italique et bleu : baie ou plage
Gras et noir : sommet
Normal et noir : lieu dit



Formations végétales

Interprétation des photoplans de 2001

Zones nues

- Eboulis
- Bâtis et voiries
- Sable ou grès de plage
- Point culminant
- Sommets
- Failles et diaclases

Courbes de niveau

- maîtres
- secondaires

Formations anthropiques

Herbacées
- Pelouse secondaire (Matie)

Fourrés
- Fourré à Hibiscus (Purau)
- Fourré à Leucaena (Faux acacia)

Forêts et plantations
- Cocoteraie (Ha'ari)
- Forêt anthropique
- Forêt de Casuarina (Aito)
- Forêt à Adenanthera (Ptiptio popa'a)
- Forêt à Syzygium (Faux Pistachier)

Zones exploitées pour le phosphate

Végétations éparses
- Végétation éparse à Guettarda-Timonius (Tafano-Pairau)

Landes
- Lande arbustive à Dodonaea - Nephrolepis ('Apiti-'Amo'a)

Forêts
- Forêt à Pandanus-Guettarda (Fara-Tafano)

Formations naturelles

Végétations éparses
- Végétation éparse sur Karst à Pandanus (Fara)

Landes
- Végétation de la façade océanique à Scaevola - H. tiaretherianum ('Apata-Tohonu)

Fruticées
- Fruticée à Capparis - Scrophulariaceae nov (Puapiro)

Fourrés
- Fourré à Pandanus-Ficus (Fara-'Ora/Mati)
- Fourré à Pemphis ('A'ie)

Forêts
- Forêt à Guettarda-Hernandia (Tafano-Tiarina)
- Forêt à Homalium- Pouteria (Mouo-Moto)

Toponymie : :

Italique et bleu : baie ou plage
Gras et noir : sommet
Normal et noir : lieu dit

Italique et noir (petit) : site culturel
Gras et violet : pointe
Entre parenthèses : d'autres toponymes cités

3

Evaluate the populations of introduced mammals and implement biosecurity measures

A rat-trapping control campaign was carried out on the island. 282 night-traps were conducted using VICTOR snap traps and coconut as a bait. 17 rats were caught in the traps. The presence of Pacific rats *Rattus exulans* and Black rats *Rattus rattus* in low densities was established.

No mouse was observed.

A few cats were observed in the village, and feral cats are believed to be present in the other areas of the island.

The presence of dogs and pigs were confirmed but these species are confined to the village.

The biosecurity measures that were planned in order to prevent any possible invasion of Black Rats were not carried out because of the presence of Black rats. Instead, a feasibility study for the eradication of rats from the entire island was drafted.

Makatea, a site of major importance for endemic birds

4

Raise awareness among local people on the wealth of their natural heritage and involve them in the implementation of biosecurity measures

A public information meeting was organized and held at the city hall of Makatea, with the help of the Mayor, in order to encourage inhabitants to sustainably manage their environment. Nine persons attended this public information meeting. All members of the scientific team presented briefly the purpose of their work on the island, and explained the possible future actions in order to protect the heritage and environment of Makatea. They gathered feedbacks from residents, generally reluctant to the idea of eradicating rats from the entire island. The meeting also provided an opportunity to learn that the Common waxbill Estrilda astrild was observed on the island in 2009.

Two members from the team visited the single class of primary school of the island, including twenty children. The presentation lasted two hours, and the following topics were discussed: the endemic birds of Makatea, habitat, threats, why and how to protect them. It appeared that children had little awareness of the importance of biodiversity for Makatea, and were unfamiliar with the risks to birds. An oral quiz controlled the knowledge acquired by children during the presentation. They seemed to be very interested and concerned.

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5

Collect data on seabirds

The presence of 6 seabird species previously mentioned as breeders was confirmed, and the discovery of an additional breeding seabird species, the Audubon's Shearwater, was made. Two other species (Lesser Frigatebird and Greater Frigatebird) were also observed but their breeding status could not be confirmed.

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6

Evaluate the potential for the translocation to Makatea of the IUCN Critically Endangered species: Tahiti monarch *Pomarea nigra* and the Tuamotu Kingfisher *Todiramphus gambieri*

The island of Makatea presents a suitable habitat for a population of Tahiti monarch. Indeed, 34% of the forest could host several hundreds of Tahiti Monarch territories. It could then be possible to consider the introduction of this species, provided that the rats are eradicated from the island and the area is protected.

Translocation of the Tuamotu Kingfisher from Niau to Makatea is a potential rescue strategy for the endangered bird. Habitats on Makatea are dissimilar to those of Niau, but the vegetation is not different from many other tropical islands in the region. As such, the island may provide suitable habitat for the birds, which are likely evolutionarily adapted to dispersal and settlement. However, the vegetation and geomorphological differences between Niau and Makatea are greater than the differences between Niau and Anaa. After evaluating the island of Makatea, the same research crew assessed the high islands of the Anna Atoll complex. Vegetation, ecology, and island size were all more compelling on Anaa. Thus, we recommend that translocation of Tuamotu Kingfishers first include a movement of individuals from Niau to Anaa. Only then should a translocation to Makatea be considered.

NOTE Outcomes 5 and 6 were added during the project, and were not included in the original project proposal.

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PART 2

Etat de population de Carpophage de la Société, et de Ptilope de Makatea sur l'île de Makatea et mesures de conservation

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Crédit photo : Albar G./SOP Manu

Etude réalisée par la Société d'Ornithologie de Polynésie « Manu »,
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Avec le soutien de :

CRITICAL ECOSYSTEM PARTNERSHIP FUND

Makatea est l'île des Tuamotu la plus proche de Tahiti, et possède une grande richesse biologique avec plusieurs espèces végétales et animales endémiques (Gouni et Zysman, 2007 ; Jacq et Butaud, 2009). Pourtant, elle a été relativement peu visitée par les scientifiques en raison de la difficulté à y accéder (une heure d'avion puis 4 heures de bateau en haute mer) et à y travailler (le terrain étant très difficile).

Néanmoins, entre juin et juillet 2009, la Société d'Ornithologie de Polynésie « Manu » (SOP Manu) a organisé une mission de terrain pluridisciplinaire sur Makatea.

GENERALITES

A. L'île de Makatea

Makatea est un atoll surélevé situé dans la partie ouest de l'archipel des Tuamotu en Polynésie française, à 215 kilomètres de Tahiti (figure 1), et dont la superficie est de 28 km2 (Andréfouët et al., 2005). Il forme une commune associée à la commune de Rangiroa. Sa population en 2007 était de 61 habitants (recensement ISPF-INSEE). Les principales activités économiques de l'île sont la récolte de crabes de cocotiers (Birgus latro), la pêche, la coprahculture et l'agriculture (Lagouy, 2007).

Figure. 1 : Localisation de Makatea

De 1906 à 1966, la Compagnie Française des Phosphates de l'Océanie a extrait 11,2 millions de tonnes de phosphates de Makatea. Elle employait plus de 2000 personnes au plus fort de son activité (Beslu, 2008). Aujourd'hui, les anciennes zones minières de l'île sont facilement reconnaissables : elles comportent de nombreux trous (contenant autrefois le phosphate) tandis que la végétation est clairsemée et mesure au plus quelques mètres de hauteur (obs. pers.).

B. La flore de Makatea

Les différentes formations végétales de Makatea sont indiquées sur la figure 2. Dans la partie centrale de l'île, on trouve principalement des forêts à Homalium-Pouteria, des forêts à Pandanus-Guettarda et, dans les anciennes zones d'exploitation du phosphate, une végétation éparse à Guettarda-Timonius. La partie périphérique, elle, est majoritairement constituée de forêts à Pandanus-Ficus (Jacq et Butaud, 2009).

Makatea compte 403 taxons de plantes vasculaires, dont 332 introduits et 71 indigènes. La flore indigène de Makatea est d'ailleurs la plus riche de toutes les îles des Tuamotu. Enfin, l'île comporte quatre taxons endémiques : Homalium mouo, Myrsine ovalis var. wilderi, Pandanus sp. nov. et Scrophulariaceae sp. nov (Jacq et Butaud, 2009).

Cote de Makatea © T Ghestemme /SOP.

Forêt indigène à Homalium © T Ghestemme /SOP.

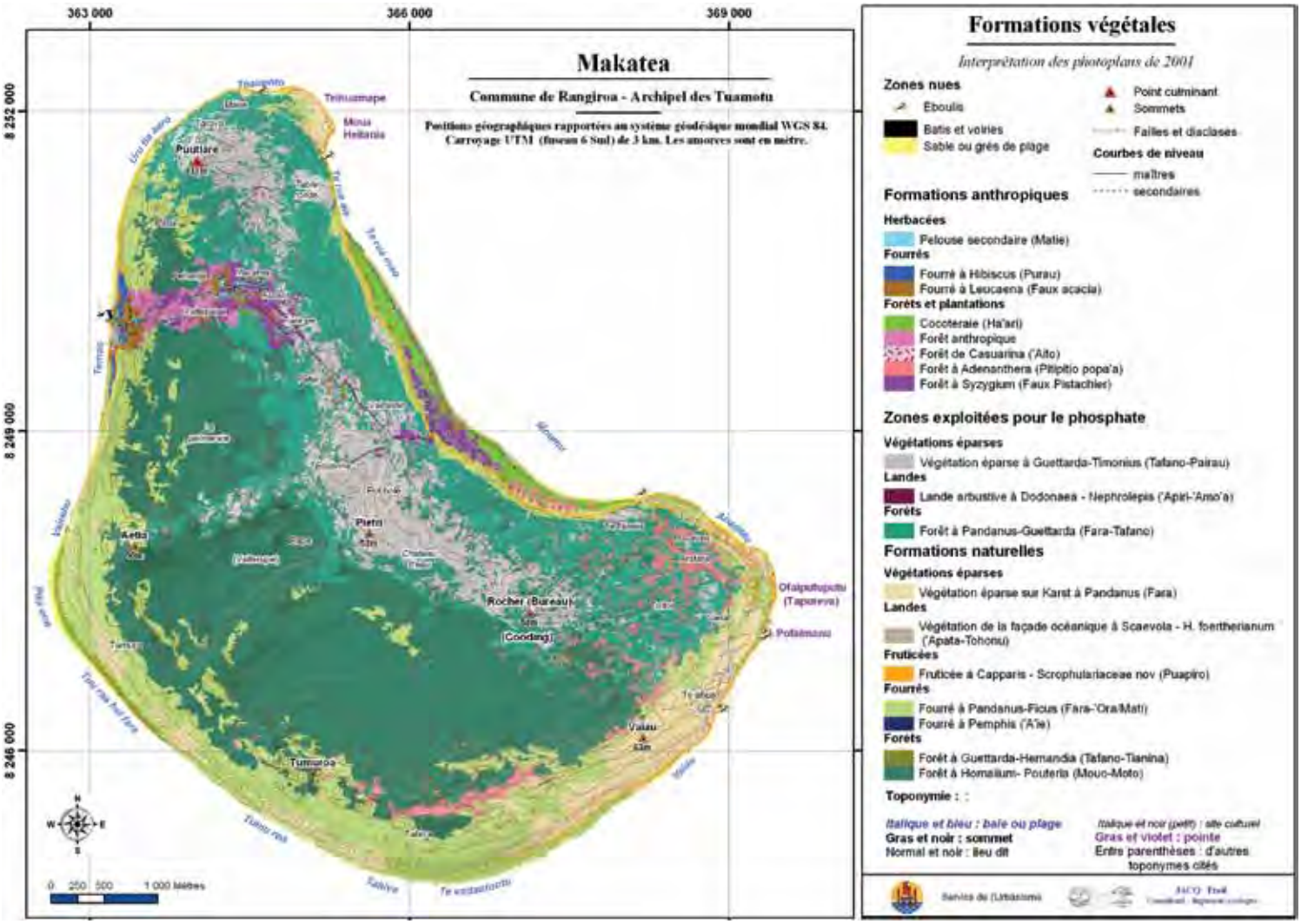

Figure 2 : Formations végétales de l'île de Makatea (Jacq et Butaud, 2009)

C. L'avifaune de Makatea

Makatea a reçu la visite de plusieurs ornithologues depuis le XIXème siècle. L'avifaune est donc relativement bien documentée, et les espèces présentes à ce jour sur Makatea sont (Jacq et Butaud, 2009 ; obs. pers.) :

- oiseaux marins : *Anous minutus, Anous stolidus, Fregata ariel, Fregata minor, Gygis alba, Phaeton lepturus, Phaeton rubricauda, Puffinus lherminieri, Sterna bergii, Sterna fuscata, Sula leucogaster, Sula sula*
- oiseaux terrestres : *Acrocephalus atyphus eremus, Ducula aurorae, Egretta sacra, Ptilinopus chalcurus*
- oiseaux migrateurs : *Eudynamys taitensis, Numenius tahitiensis, Pluvialis fulva, Tringa incana*
- oiseaux introduits : *Gallus gallus, Zosterops lateralis.*

L'île de Makatea fait partie des 32 Zones Importantes pour la Conservation des Oiseaux (ZICO) de Polynésie française (ZICO n° PF 23), et est également un site Alliance for Zero Extinction (AZE). Enfin, elle fait partie de la Zone d'Oiseaux Endémiques des Tuamotu-Gambier (EBA n° 214) (SOP Manu, 2009).

Parmi les espèces ou sous-espèces aviaires citées ci-dessus, trois sont endémiques de Makatea : *Acrocephalus atyphus eremus* (Rousserolle de Makatea), *Ducula aurorae* (Carpophage de la Société), car supposée disparues de Tahiti et Moorea et *Ptilinopus chalcurus* (Ptilope de Makatea) (Cibois et al., 2007 ; Gouni et Zysman, 2007).

1. *Ducula Aurorae*

Le Carpophage de la Société *Ducula aurorae* (photo 2) vivait autrefois sur Tahiti, Moorea et Makatea mais aujourd'hui seule Makatea abrite avec certitude une population de cette espèce. Les dernières observations de *Ducula aurorae* sur Tahiti ont été rapportées à la fin des années 1990. On pense que l'introduction du busard de Gould Circus approximans sur Tahiti et Moorea est responsable de ce déclin (Gouni et Zysman, 2007).

Ducula aurorae. © T Ghestemme /SOP.

Ces trois taxons endémiques relèvent de la catégorie A de la liste des espèces protégées par la réglementation territoriale de Polynésie française selon l'article 4 de l'arrêté n°296 CM du 18 mars 1996. Les articles 1 à 3 de cet arrêté définissent les mesures de protection. L'arrêté n°296 CM du 18 mars 1996 a été révisé par l'arrêté n°1300 CM du 30 août 2007 lui-même modifié par l'arrêté 306 CM du 20 février 2008.

1.1 Matériel et Méthodes

A. ESTIMATION DES EFFECTIFS D'OISEAUX ENDÉMIQUES

La méthode des points de comptage (Bibby et al., 1998) a été utilisée pour évaluer les effectifs des taxons endémiques. A chaque point de comptage, l'observateur note pendant 10 minutes tous les oiseaux endémiques vus et entendus, avec pour chaque toucher l'espèce d'oiseau ainsi qu'une estimation de la distance entre l'observateur et l'oiseau. Les oiseaux en vol ne sont pas notés. A la fin du comptage, l'observateur se déplace jusqu'au point de comptage suivant, qui devra se trouver à 200 mètres de distance au moins (pour minimiser la probabilité de compter deux fois un même oiseau).

Les points de comptage ont été effectués entre 6h et 10h du matin, et entre 15h30 et 17h30, périodes pendant lesquelles les oiseaux sont les plus actifs et donc les mieux détectables.

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Les données recueillies ont ensuite été analysées avec le logiciel Distance 6.0 Release 2 (Thomas et al., 2009). Ce logiciel permet de connaître les densités de chaque espèce d'oiseau en fonction du nombre de touchers et des distances estimées par l'observateur.

Enfin, les effectifs totaux pour chaque espèce ont été obtenus en multipliant les densités par la superficie des milieux favorables.

Tableau 1 : Densité et population totale du Carpophage à Makatea

Espèce	Densité (ind/ha)	Nombre total sur l'île
Ducula aurorae	0,417	625 (0.417 x 1625 ha de formations naturelles non exploitées)

NB : L'estimation de 1200 individus présentés dans le rapport de mission de la SOP surestimait la population car l'ensemble de l'île a été prise en compte lors de l'extrapolation. Hors seule les formations naturelles qui n'ont pas été exploitées précedemment pour le phosphates constituent l'habitat favorable au Ducula.

B. PRÉSENCE DE RAT NOIR ET DE RAT POLYNÉSIEN

72 tapettes à rats ont fonctionné pendant la première nuit de piégeage, puis deux tapettes ont été perdues donc 70 tapettes ont fonctionné les trois nuits suivantes. Au total, 282 nuits-pièges ont été effectuées. 17 rats ont été piégés, dont 4 Rats noirs Rattus rattus, 11 Rats polynésiens Rattus exulans et 2 rats dont l'espèce n'a pu être déterminée sur le terrain.

Aucune souris Mus musculus n'a été piégée, mais l'espèce serait présente sur Makatea aux dires d'un habitant de l'île (Jacq et Butaud, 2009).

1.2 Résultats et Discussion

A. LES CARPOPHAGES DE LA SOCIÉTÉ

En 1987, Thibault et Guyot estimaient que la population de cette espèce sur Makatea était comprise entre 100 et 500 individus. Gouni et Zysman (2007) ont repris le chiffre publié par Birdlife qui était de 300 individus au maximum. Ainsi, l'estimation de 625 individus obtenue lors de la présente étude représente de loin l'effectif le plus important jamais estimé pour l'espèce. Cela confirme que les effectifs remontent depuis l'arrêt de l'exploitation des phosphates et de la chasse, et on peut dire que l'état actuel de la population de Carpophages de la Société est satisfaisant.

On peut noter que conformément aux observations de Thibault et Cibois (2006), les carpophages sont maintenant présents dans les anciennes zones d'exploitation du phosphate, ce qui n'était pas le cas lors de visites de Thibault en 1972 et 1986 (Thibault et Guyot, 1987). Cependant, ces zones ne sont utilisées que ponctuellement ou juste pour le survol et n'ont pas été pris en compte dans le calcul des effectifs.

La figure 3 indique la répartition actuelle du Carpophage de la Société sur Makatea.

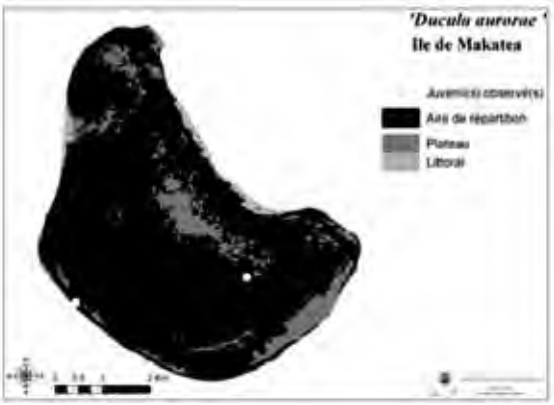

Figure 3 : Répartition du Carpophage de la Société sur Makatea (Jacq et Butaud, 2009).

B. LES BIAIS PROBABLES

Il est important de noter les biais pouvant avoir mené à une sur-ou une sous-estimation des densités d'oiseaux :

- Aucun point de comptage n'a été réalisé dans la partie sud de l'île, très difficile d'accès. Or, les forêts du sud comportent peut-être des densités d'oiseaux différentes de celles du nord.
- Une autre possibilité de biais est que les Carpophages de la Société se déplacent sur plusieurs centaines de mètres au minimum et ont des probabilités d'être comptés plusieurs fois sur des points de comptage différents. Cependant la prise en compte des formations végétales non modifiées pour l'extrapolation des effectifs permet de réduire ce biais.

C. DES POPULATIONS QUI RESTENT MENACÉES

Jacq et Butaud (2009) ont noté que certaines plantes introduites ont un fort potentiel d'invasion et constituent une menace pour la flore indigène de Makatea. L'habitat des oiseaux peut donc s'en retrouver modifié, avec les conséquences négatives que l'on sait : par exemple, la dégradation de l'habitat indigène est un des facteurs ayant mené le Carpophage des Marquises Ducula galeata au bord de l'extinction (Gouni et Zysman, 2007).

L'arrivée de nouvelles espèces animales sur Makatea serait potentiellement dangereuse pour l'avifaune indigène. Ceci est déjà survenu par le passé, puisqu'en 2003 ou 2004, deux Martins tristes Acridotheres tristis ont été introduits sur l'île. Le premier a rapidement été abattu et le second a été tué en 2006 (Jacq et Butaud, 2009). Le Capucin donacole Lonchura castaneothorax a également été observé sur l'île par le passé (Thibaut et Guyot, 1987) mais ne semble plus y être présent aujourd'hui. Enfin, la présence de l'Astrild ondulé sur Makatea (voir résultats de la réunion publique d'information) doit être confirmée avant d'entreprendre quelque action que ce soit.

Le Busard de Gould Circus approximans n'a jamais été observé sur Makatea, mais son arrivée sur l'île serait une catastrophe puisque cette espèce est soupçonnée d'avoir causé la disparition du Carpophage de la Société sur Tahiti et Moorea (Gouni et Zysman, 2007).

Enfin, des projets industriels pour Makatea existent au moment de l'écriture de ce rapport (C. Serra, comm. pers.) : une cimenterie et une extraction de gravats, cette dernière étant prévue dans les forêts à Homalium-Pouteria. Si ces projets étaient réalisés sans tenir compte de leurs impacts

environnementaux, les conséquences sur l'avifaune de l'île pourraient être très néfastes. Par exemple, les forêts à Homalium-Pouteria sont fréquentées par les Carpophages de la Société, et comportent plusieurs sites de nidification pour cette espèce (figure 5 ; obs. pers.). C'est également dans ces forêts que l'on trouve le plus de Ptilopes de Makatea (figure 6). La destruction de ces forêts pour une extraction de gravats aurait donc un impact très négatif sur les populations de ces deux espèces endémiques de l'île.

D. IMPLICATIONS POUR LA CONSERVATION DU DUCULA

Au vu de ces résultats et des données déjà disponibles, il est proposé la stratégie de conservation suivante :

- la préservation de la population de Makatea *in situ*, et pour cela :
  - prévenir l'arrivée de toute nouvelle espèce envahissante, animale ou végétale, par la mise en place de mesures de biosécurité : formation d'une personne de Makatea à la reconnaissance des plantes envahissantes, traitement des végétaux arrivant sur l'île pour éviter l'arrivée de nouveaux insectes, mise en place de stations de dératisation au niveau du port pour empêcher l'arrivée du Surmulot *Rattus norvegicus*. Les contacts de la SOP Manu et de la DIREN doivent être accessibles par les habitants (à la mairie par exemple), au cas où une nouvelle espèce animale ou végétale ferait son apparition sur l'île,
  - estimer régulièrement les effectifs de l'espèce, au minimum tous les 5 ans. En cas de déclin, une identification des causes sera menée et une réponse rapide pourra être mise en place,
  - surveiller la progression des espèces végétales envahissantes et les contrôler ou les éradiquer quand cela est possible : *Adenanthera pavonina, Coccoloba uvifera, Epipremnum pinnatum, Eugenia uniflora, Fimbristylis cymosa* subsp. *cymosa, Furcraea foetida, Kalanchoe pinnata, Lantana camara, Leucaena leucocephala, Melinis minutiflora, Momordica charantia, Russelia equisetiformis, Syzygium cumini* et *Tecoma stans* (Jacq et Butaud, 2009).
  - à chaque mission sur l'île, sensibiliser la population aux oiseaux et aux menaces pesant sur eux, via des interventions dans les écoles, des réunions publiques d'information, la fourniture de supports pédagogiques (posters par exemple). En effet, lors de la mission de 2009, la réunion d'information a permis de recueillir des renseignements et des avis intéressants, et l'intervention dans l'école primaire a apporté de nouvelles connaissances sur l'avifaune aux enfants. La SOP Manu a par ailleurs envoyé des livres à l'école de Makatea après la mission,
  - s'assurer que les éventuels projets industriels sur l'île ne mettraient pas en péril l'habitat des oiseaux endémiques.
- la constitution d'au moins une population de secours sur une autre île. Dans cette optique, des prospections devraient être menées sur d'autres îles des Tuamotu pour voir lesquelles comportent un habitat favorable à une introduction.

Une restauration de Makatea (éradication des rats, élimination ou contrôle des espèces végétales envahissantes et réhabilitation des anciennes zones exploitées) serait une des meilleures solutions pour préserver cette île et en particulier son avifaune sur le long terme, mais une telle action n'est malheureusement pas possible à l'heure actuelle et ce pour deux raisons :

- si certains des projets industriels envisagés étaient réalisés, ils pourraient compromettre la plupart des actions entreprises dans le cadre d'un plan de restauration de l'île,
- lors de la réunion publique d'information, il est apparu que la population était globalement réticente à l'idée d'une dératisation de l'île, en raison notamment des conséquences sur la

chasse aux crabes de cocotiers qui est une des principales activités économiques sur Makatea. En effet, la consommation de la chair de ce crabe est à proscrire pendant plusieurs mois après l'épandage du raticide.

Enfin, Makatea présente certaines caractéristiques qui pourraient en faire un site de choix pour accueillir des populations secondaires d'espèces aviaires menacées d'extinction en Polynésie française. Malheureusement, la présence du Rat noir et du Rat polynésien compromettrait fortement les chances de réussite d'éventuels programmes d'introduction, du moins pour les espèces aviaires sensibles aux rats. Par exemple, le Rat noir exerce une prédation directe sur les espèces Pomarea nigra et Pomarea whitneyi, classées « en danger critique d'extinction » selon l'UICN et dont la constitution de populations secondaires est actuellement envisagée. Ces deux espèces ne peuvent donc pas être introduites sur Makatea à l'heure actuelle.

1.3 Conclusion

Cette étude confirme l'importance de Makatea pour la conservation du Caprophage de la Société, considéré comme éteint sur les îles de Tahiti et Moorea

L'île est d'autant plus importante pour l'avifaune que, selon Cibois et al. (2007), elle a joué le rôle de « réservoir » pour les Rousserolles des Tuamotu lors du dernier maximum interglaciaire, il y a

125.000 ans. En effet, les atolls bas des Tuamotu ont été entièrement submergés suite à la montée du niveau marin, et seuls les atolls surélevés (Makatea, Niau et Ana'a) ont pu conserver des terres émergées comportant des rousserolles. Lorsque le niveau marin est redescendu, c'est principalement à partir de Makatea que les rousserolles ont recolonisé les autres atolls des Tuamotu.

Dans le contexte actuel de changement climatique et de montée du niveau marin, il est certain que Makatea jouera à nouveau un rôle essentiel dans la préservation de la biodiversité aviaire des Tuamotu.

Cependant, pour s'assurer que Makatea sera capable de jouer ce rôle, il est essentiel de prendre des mesures visant à la préservation de son habitat sur le long terme. D'éventuels projets industriels devraient être considérés avec beaucoup de prudence, pour s'assurer que ceux-ci ne mettent pas en péril le patrimoine naturel exceptionnel de cette île.

2. *Ptilope de Makatea*

Le Ptilope de Makatea (*Ptilinopus chalcurus*, photo 3) est également un oiseau forestier, au régime alimentaire composé en majorité de fruits. La nidification a lieu d'août à janvier au moins (Gouni et Zysman, 2007).

Ptilinopus chalcurus Crédit photo : Serra C./DIREN 2009

Contrairement au Carpophage de la Société, cette espèce semble avoir été moins affectée par l'exploitation des phosphates sur Makatea. L'espèce est classée « vulnérable » (VU) sur la liste rouge de l'UICN.

Ces trois taxons endémiques relèvent de la catégorie A de la liste des espèces protégées par la réglementation territoriale de Polynésie française selon l'article 4 de l'arrêté n°296 CM du 18 mars 1996. Les articles 1 à 3 de cet arrêté définissent les mesures de protection. L'arrêté n°296 CM du 18 mars 1996 a été révisé par l'arrêté n°1300 CM du 30 août 2007 lui-même modifié par l'arrêté 306 CM du 20 février 2008.

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Les points de comptage ont été réalisés pendant la mission de terrain, soit du 29 juin 2009 au 5 juillet 2009. Tous les points de comptage ont été faits dans la moitié nord de l'île pour des raisons de temps et d'accessibilité.

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Enfin, les effectifs totaux pour chaque espèce ont été obtenus en multipliant les densités par la superficie des milieux favorables (28 km •).

B. PRÉSENCE DE RAT NOIR ET DE RAT POLYNÉSIEN

72 tapettes à rats ont fonctionné pendant la première nuit de piégeage, puis deux tapettes ont été perdues donc 70 tapettes ont fonctionné les trois nuits suivantes. Au total, 282 nuits-pièges ont été effectuées. 17 rats ont été piégés, dont 4 Rats noirs *Rattus rattus*, 11 Rats polynésiens *Rattus exulans* et 2 rats dont l'espèce n'a pu être déterminée sur le terrain.

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2.2 Résultats et Discussion

A. LES PTILOPES DE MAKATEA

La seule estimation de la population de Ptilopes de Makatea est donnée par Gouni et Zysman (2007) qui avancent un chiffre d'un millier d'individus. L'effectif de 804 individus estimé en 2009 (voir tableau 1) est donc relativement peu élevé, mais peut s'expliquer par le comportement cryptique de l'espèce (voir ci-dessous). Le statut de la population de cette espèce peut donc être considéré comme satisfaisant.

La répartition actuelle du Ptilope de Makatea est indiquée sur la figure 3.

Figure 3 : répartition du Ptilope de Makatea

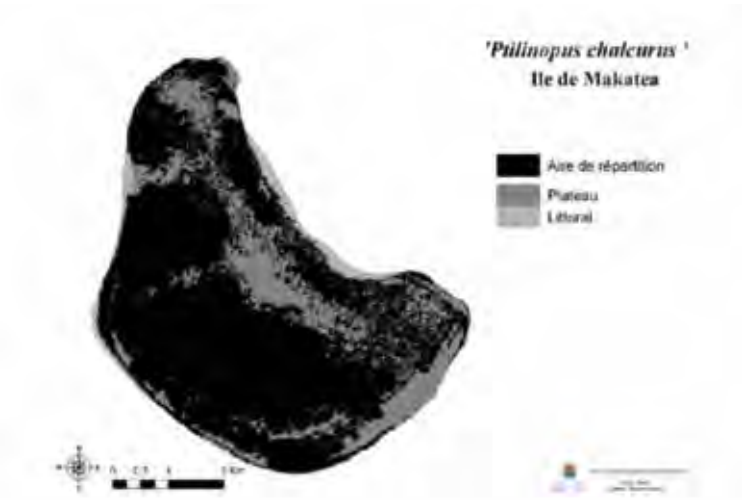

Tableau 2 : Densité et population totale du Ptilope de Makatea

Espèce	Densité (ind/ha)	Nombre total sur l'île
Ptilinopus chalcurus	0,287	804 (0.287 x 2800 ha : ile totale)

B. LES BIAIS PROBABLES

Il est important de noter les biais pouvant avoir mené à une sur-ou une sous-estimation des densités d'oiseaux :

- Aucun point de comptage n'a été réalisé dans la partie sud de l'île, très difficile d'accès. Or, les forêts du sud comportent peut-être des densités d'oiseaux différentes de celles du nord.
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C. DES POPULATIONS QUI RESTENT MENACÉES

Jacq et Butaud (2009) ont noté que certaines plantes introduites ont un fort potentiel d'invasion et constituent une menace pour la flore indigène de Makatea. L'habitat des oiseaux peut donc s'en retrouver modifié, avec les conséquences négatives sur les tailles de populations.

L'arrivée de nouvelles espèces animales sur Makatea serait potentiellement dangereuse pour l'avifaune indigène. Ceci est déjà survenu par le passé, puisqu'en 2003 ou 2004, deux Martins tristes *Acridotheres tristis* ont été introduits sur l'île. Le premier a rapidement été abattu et le second a été tué en 2006 (Jacq et Butaud, 2009). Le Capucin donacole *Lonchura castaneothorax* a également été observé sur l'île par le passé (Thibaut et Guyot, 1987) mais ne semble plus y être présent aujourd'hui. Enfin, la présence de l'Astrild ondulé sur Makatea (voir résultats de la réunion publique d'information) doit être confirmée avant d'entreprendre quelque action que ce soit.

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Enfin, des projets industriels pour Makatea existent au moment de l'écriture de ce rapport (C. Serra, comm. pers.) : une cimenterie et une extraction de gravats, cette dernière étant prévue dans les forêts à *Homalium-Pouteria*. Si ces projets étaient réalisés sans tenir compte de leurs impacts environnementaux, les conséquences sur l'avifaune de l'île pourraient être très néfastes. Par exemple, les forêts à *Homalium-Pouteria* sont fréquentées par les Carpophages de la Société, et comportent plusieurs sites de nidification pour cette espèce (figure 5 ; obs. pers.). C'est également dans ces forêts que l'on trouve le plus de Ptilopes de Makatea (figure 6). La destruction de ces forêts pour une extraction de gravats aurait donc un impact très négatif sur les populations de ces deux espèces endémiques de l'île.

D. IMPLICATIONS POUR LA CONSERVATION DU PTILOPE DE MAKATEA

Au vu de ces résultats et des données déjà disponibles, il est proposé la stratégie de conservation suivante :

- la préservation de la population de Makatea *in situ*, et pour cela :
  - prévenir l'arrivée de toute nouvelle espèce envahissante, animale ou végétale, par la mise en place de mesures de biosécurité : formation d'une personne de Makatea à la reconnaissance des plantes envahissantes, traitement des végétaux arrivant sur l'île pour éviter l'arrivée de nouveaux insectes, mise en place de stations de dératisation au niveau du port pour empêcher l'arrivée du Surmulot *Rattus norvegicus*. Les contacts de la SOP Manu et de la DIREN doivent être accessibles par les habitants (à la mairie par exemple), au cas où une nouvelle espèce animale ou végétale ferait son apparition sur l'île.
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- si certains des projets industriels envisagés étaient réalisés, ils pourraient compromettre la plupart des actions entreprises dans le cadre d'un plan de restauration de l'île,

lors de la réunion publique d'information, il est apparu que la population était globalement réticente à l'idée d'une dératisation de l'île, en raison notamment des conséquences sur la chasse aux crabes de cocotiers qui est une des principales activités économiques sur Makatea. En effet, la consommation de la chair de ce crabe est à proscrire pendant plusieurs mois après l'épandage du raticide.

Enfin, Makatea présente certaines caractéristiques qui pourraient en faire un site de choix pour accueillir des populations secondaires d'espèces aviaires menacées d'extinction en Polynésie française. Malheureusement, la présence du Rat noir et du Rat polynésien compromettrait

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2.3 Conclusion

L'île est d'autant plus importante pour l'avifaune que, selon Cibois *et al.* (2007), elle a joué le rôle de « réservoir » pour les Rousserolles des Tuamotu lors du dernier maximum interglaciaire, il y a 125.000 ans. En effet, les atolls bas des Tuamotu ont été entièrement submergés suite à la montée du niveau marin, et seuls les atolls surélevés (Makatea, Niau et Ana'a) ont pu conserver des terres émergées comportant des rousserolles. Lorsque le niveau marin est redescendu, c'est principalement à partir de Makatea que les rousserolles ont recolonisé les autres atolls des Tuamotu.

Dans le contexte actuel de changement climatique et de montée du niveau marin, il est certain que Makatea jouera à nouveau un rôle essentiel dans la préservation de la biodiversité aviaire des Tuamotu. Cependant, pour s'assurer que Makatea sera capable de jouer ce rôle, il est essentiel de prendre des mesures visant à la préservation de son habitat sur le long terme. D'éventuels projets industriels devraient être considérés avec beaucoup de prudence, pour s'assurer que ceux-ci ne mettent pas en péril le patrimoine naturel exceptionnel de cette île.

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Makatea, un site majeur pour l'avifaune endémique

Ptilinopus chalcurus

Les principaux résultats

INVENTAIRES ET CARTOGRAPHIES

LES OISEAUX

- Oiseaux marins : *Gygis alba, Anous spp., Fregata spp., Phaeton spp., Puffinus lherminieri, Sterna spp., Sula spp.*
- Oiseaux migrateurs : *Eudynamys taitensis, Numenius tahitiensis, Pluvialis fulva, Tringa incana*
- Oiseaux terrestres endémiques :
  - Carpophage de la Société *Ducula aurorae* : 1 168 individus
  - Ptilope de Makatea *Ptilinopus chalcurus* : 804 individus
  - Rousserole des Tuamotu *Acrocephalus atyphus* : 7 599 individus

LES PLANTES

- Plantes indigènes de Makatea : 77 espèces
- Plantes endémiques : *Homalium mouo, Myrsine ovalis* var. *wilderi*, *Pandanus sp. nov.*, *Scrophulariaceae sp. nov*

LES INVERTEBRES ET PETITS VERTEBRES

- Invertébrés: 5 libellules, 1 demoiselle, 14 fourmis, Crabe de cocotier
- vertébrés : 6 reptiles indigènes

LES ESPECES INTRODUITES

- Oiseaux introduits : *Gallus gallus, Zosterops lateralis*
- Mammifères introduits *: Felis silvestris, Rattus exulans, Rattus rattus*

Cette présence interdit la constitution d'une population de secours de *Pomarea nigra* sur cette île.

- Plantes introduites ou envahissantes : 400 espèces

SENSIBILISER

- Rencontre avec les scolaires
- Tenue de réunion publique
- Réunion avec les autorités locales

ENJEUX DE CONSERVATION

DEFINITIONS DES ENJEUX

Paysagers : atoll soulevé aux paysages remarquables
Culturels : sites archéologiques, sites industriels
Floristiques : les espèces endémiques et envahissantes
Faunistiques : avifaune endémique menacée par les mammifères introduits

LES ZONES D'INTERETS PATRIMONIAUX

Les falaises internes et falaises littorales
Les forêts à *Homalium*
Les forêts à Pandanus
Les forêts littorales de Tahiva et Vaiau

Les recommandations

PRESERVATION DES SITES

Projet de classement d'une partie de l'île en aire protégée
Propositions d'actions de lutte contre les espèces envahissantes
Mise en place de mesures préventives à l'établissement d'espèces introduites
Réhabilitation des zones détériorées par l'exploitation du phosphate

PRESERVATION DES ESPECES

Amélioration des connaissances des espèces patrimoniales
Mise en place d'une gestion raisonnée des ressources naturelles
Prise en compte de la nécessité de préserver les espèces dans les futurs projets de développement

ANNEX 2

Feasibility study for the eradication of rats and cats from Makatea island

(Tuamotu, French Polynesia)

Lucie Faulquier,
Société d'Ornithologie de Polynésie, Tahiti

1. INTRODUCTION

Biological invasions are considered to be the second greatest cause of native species global extinctions, just after natural habitat degradation and transformation (Vitousek et al. 1997). According to the IUCN Red list, invasive alien species (IAS) are the third greatest threat for species at risk of extinction (Soubeyran 2008). IUCN assesses that IAS are threatening 30% of birds, 15% of plants, 11% of amphibians and 8% of mammals in the Red list categories.

Among these biological invasions, those happening in islands are especially harmful. Islands are characterized by small areas and evolutive / geographic remoteness, which implies that special ecosystems have evolved with a total absence of any predator, leading to an exceptional endemism. The introduction of new species, and particularly 'aggressive' species, has had a disastrous effect on 'naive' island species, which have no means to survive against these new species (Courchamp et al. 2003).

The 120 French Polynesian islands, separated from any land mass and possessing a great habitat diversity, have a high level of endemism and avian richness, amongst the most outstanding on tropical islands (Soubeyran, 2008). In addition, its 28 breeding seabird species and 15 roosting seabirds form one of the most diversified communities in the tropical Pacific (Gouni & Zysman, 2007).

Makatea Island provides habitat for 22 bird species, including the Makatea Fruit-dove Ptilinopus chalcurus (VU) and the Polynesian Imperial-pigeon *Ducula aurorae* (EN) and an additional endemic sub-species, the Tuamotu Reed-warbler Acrocephalus atiphus eremus. The island has been recognized as an IBA (Important Bird Area) and an EBA (Endemic Bird Area) by Raust & Sanford (2007), and is an'Alliance for Zero Extinction' (AZE) site.

This document assesses the feasibility for eradicating rats from Makatea Island as the result of a survey of the island, including collection of information about plants, birds, invasive species and field terrain, but also about local community commitment and interest.

2. GOAL, OBJECTIVES AND OUTCOMES

2.1 Goal

The goal of the proposed project is to gather all required information on Makatea Island and assess the feasibility for the restoration of the island by the eradication of introduced mammals that threaten the biodiversity.

2.2 Objectives and Outcomes

The objectives that this project will achieve and the outcomes that will be seen as a result of achieving these objectives are:

Objectives	Outcomes
1. Eradicate Pacific rats and Ship rats from Makatea Island	1.1 No Pacific and Ship rat on Makatea Island
	1.2 Increase in bird population size
	1.3. Protection of plant biodiveristy
	1.4 Improve Makatea inhabitant welfare and health
2. Eradicate feral cats from Makatea Island	2. Increase in bird population size
3. Consider the translocation of threatened endemic species	3.1 Tahiti Monarch
	3.2 Tuamotu kingfisher

3 THE SITE

3.1 Location, size, topography

Makatea is a raised coral atoll in the northwestern Tuamotu Archipelago (Fig. 1 and Fig. 2). It is located 79 km southwest of Rangiroa and approximately 220 km east of Tahiti. Makatea is one of only four islands of the Tuamotu Archipelago (along with Nukutavake, Tikei, and North Tepoto) that do not take the form of a typical atoll. It is surrounded by tall cliffs, rising to 75 meters above sea level with two peaks: Mt Puutiare reaching 111m and Mt Aetia reaching 90m (Gargomini et al. 2006). This island is 7.5 km long, with a maximum width of 7 km in the south. The land surface is 2820 ha (Andréfouët et al. 2005).

Fig. 1. Location of Makatea

Fig. 2. Satellite photo of Makatea

Makatea is one of three important Pacific raised coral islands that had large phosphate deposits, the other two being Nauru and Banaba. The Pacific Phosphate Company Ltd (PPC), which was founded by John T. Arundel and involved in mining at Nauru and Banaba, formed the Compagnie des Phosphates de l'Océanie with a Tahitian syndicate to mine phosphate on Makatea.

The mining produced hundreds if not thousands of hand dug holes across the upper plateau of Makatea. Each cylindrical hole is about 8 ft. in diameter and 50 to 75 ft. in depth. An unsuspecting visitor could easily fall into a hole and suffer severe injury or death while walking in the thick undergrowth that mask these holes.

The island is not served by flight and the nearest island is Rangiroa (about 80 km away). To access the island from Tahiti, it is necessary to fly from Papeete to Rangiroa (2 to 4 flights per day; Air Tahiti company) and then rent a boat from Rangiroa to Makatea. The journey time from Rangiroa to Makatea by boat is about 4 hours. The main wharf is located on the west coast of the island and is only accessible in fair weather.

3.2 Climate

The climate is tropical characterized by two distinct seasons. The wet season occurs generally from December to March, and the dry season from July to October. The mean temperature ranges around 25°C and the daily temperature range is approximately 4°C. The island benefits from the influence of the prevailing Easterly trade winds, which are usually quite moderate due to the lack of relief.

3.3 Population and land use

The human population of the island was estimated at 61 in 2007 (ISPF). Makatea Island is an associated commune of Rangiroa. The main village is called Moumu.

There is a ghost town, Vaitepaua, and an adjacent abandoned port, Temao, on the northwest coast of Makatea from the phosphate mining era.

The main economic resource in the past was phosphate mining. From 1908 to 1966 the 'Compagnie Française des Phosphates de l'Océanie' (CFPO) extracted 11 millions of tons of phosphate, and this activity drew about 3000 people to Makatea (Beslu, 2008; Gargominy et al. 2006). For over two decades, Makatea was a very active island due to the ships arriving to load phosphate and to bring supplies and food to the many workers and their families that lived there. After the end of the phosphate exploitation, Makatea was left almost totally on its own with only a few families left to guard the island. The once active village where the miners lived had a school, bakery, first aid medical centre and all necessary amenities. All that remains today has been degraded by time and nature. The school and other structures have been levelled to the ground and grown over by vines and jungle.

Nowadays, the islanders live of agriculture, copra cultivation, some fishing and trade in coconut crabs (Lagouy 2007).

3.4 Biological values

3.4.1 PAST BIOLOGICAL SURVEYS

In the past century, many scientists visited Makatea:

- T.R Peale from the United States Exploring Expedition (USEE) in 1939 and Ernst Quayle from the Whitney South Pacific expedition (WSSE) in 1922 collected birds from Makatea.
- The botanist Wilder in 1926, 1929 and 1932 (Wilder 1934) described an apparently complete list of birds.
- Molluscs were collected and studied by T.R. Peale in 1839 and Albert de la Rue and 1955, and by Olivier Gargominy and Benoît Fontaine from the National Museum of History and Nature (Paris, France) in 2005 (Gargominy et al. 2006).
- The botanist Jacques Florence in 1982 and 1988 (Florence 1982; Florence et al. 2007) and the botanists Jean-Yves Meyer and Jean-François Butaud in 2004 (Meyer & Butaud 2004) studied plants of Makatea.
- The ornithologist Jean-Claude Thibault in 1972, 1986 and 2006 (Thibault & Guyot 1987; Thibault & Cibois 2006) studied the bird population.
- The marine biologist Elodie Lagouy studied the population of Coconut Crab Birgus latro in 2007 (Lagouy 2007).

- A team of ornithologists and botanists in 2009 (Jacq & Butaud 2009; Albar et al. 2009) took part in a field survey carried out by the Ornithological Society of French Polynesia. The objectives were to update the population estimates for the three endemic species, update data on seabird population, evaluate the populations of introduced mammals and raise awareness among local people about the wealth of their natural heritage. Maps of the birds and their habitats were produced. The main threats affecting these species were identified, and some recommendations to protect the native vegetation have been made such as the survey and control of these invasive plants. It has also been suggested to classify the island as a natural reserve (Jacq & Butaud 2009).

3.4.2 VEGETATION

The island of Makatea holds the richest flora of all the Tuamotu Archipelago (76 atolls). It is home to 77 native species (four of them protected) and 13 endemic species to French Polynesia, 4 of them being endemic to the island of Makatea (including a new genus discovered during this fieldtrip): Homalium mouo, Myrsine ovalis var. wilderi, Pandanus sp. nov. and Scrophulariaceae sp. nov (Jacq & Butaud, 2009).

The different vegetal formations of the island were identified and precisely mapped by Jacq and Butaud in 2009 (Fig.3).

Although Makatea has a unique flora, it holds 332 introduced species of vascular plants, 18 of them being invasive.

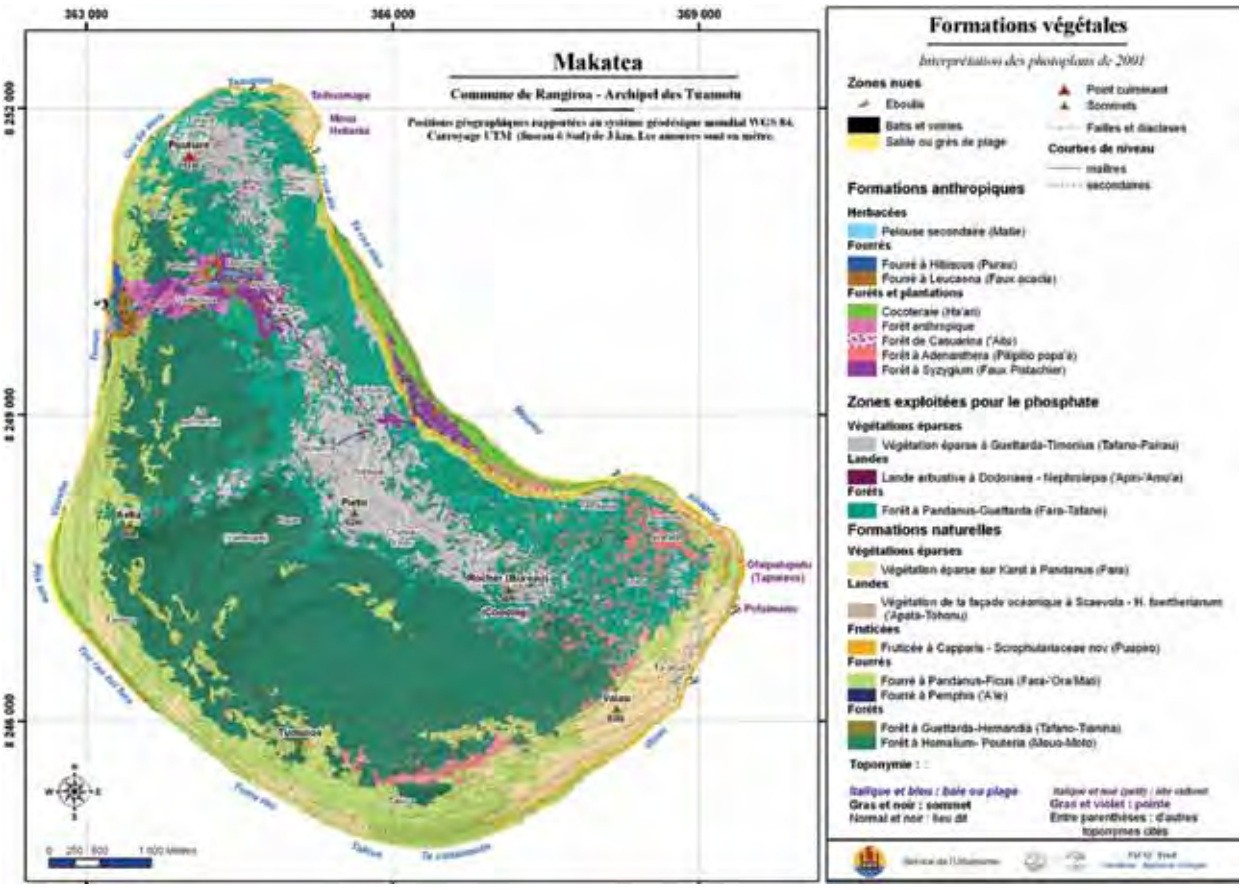

Fig. 3. Distribution of the different vegetation formations of Makatea (Jacq and Butaud 2009).

3.4.3 NATIVE BIRDS

The island of Makatea is one of the 32 IBA (Important Bird Area) of French Polynesia (ZICO n° PF 23) and a 'site Alliance for Zero Extinction' (AZE). Moreover, it is an Endemic Bird Area (EBA n° 214). It hosts at least two species of concern, the Makatea Fruit-dove *Ptilinopus chalcurus* (VU) and the Polynesian Imperial-pigeon *Ducula aurorae* (EN) and an additional endemic sub-species, the Tuamotu Reed-warbler *Acrocephalus atiphus eremus* (Cibois et al. 2007).

The species present on Makatea are the following (Thibault and Guyot 1987; Albar et al. 2009):

NATIVE LANDBIRDS

- Polynesian Imperial-pigeon *Ducula aurorae*
- Makatea Fruit-dove *Ptilinopus chalcurus*
- Tuamotu Reed-warbler *Acrocephalus atyphus eremus*
- Pacific Reef-Egret *Egretta sacra*

INTRODUCED LANDBIRDS

- Domestic Red Junglefowl *Gallus gallus*
- Silvereye *Zosterops lateralis*

SEABIRDS (NESTING)

- White tailed Tropicbird *Phaeton lepturus*
- Brown Booby *Sula leucogaster*
- Red-footed Booby *Sula sula*
- Brown noddy *Anous stolidus*
- Black noddy *Anous minutus*
- White tern *Gygis alba*
- Audubon's Shearwater *Puffinus lherminieri*

VISITORS

- Lesser Frigatebird *Fregata ariel*
- Great Frigatebird *Fregata minor*
- Red tailed Tropicbird *Phaeton rubricauda*
- Great Crested-tern *Sterna bergii*
- Sooty tern *Sterna fuscata*
- Bristle-thighed Curlew *Numenius tahitiensis*
- Pacific Golden-plover *Pluvialis fulva*
- Wandering Tattler *Tringa incana*
- Long-tailed Cuckoo Eudynamis taitensis.

3.4.4 OTHER NATIVE FAUNA

To date, no studies have been carried out on the biodiversity of small vertebrates and invertebrates of Makatea, with the exception of the coconut crab Birgus latro and the mollusc group.

The Coconut crab (locally called 'kaveu') is classified as 'Data Deficient' (previously 'Vulnerable') on the IUCN Red list. This species is one of the main food and economic resources of Makatea. However its exploitation seems small enough to maintain the species and the resource (Lagouy 2007).

Makatea is a very important site for the diversity of molluscs in French Polynesia, especially with two genus and 25 species endemic to the family Endodontidae. Field surveys from 2005 helped to add 19 new species for science (Gargominy et al. 2006).

3.4.5 NON-NATIVE ANIMALS

During 2009 survey, a rat-trapping survey was carried out on the island. 282 night-traps were conducted using VICTOR snap traps and coconut as a bait and 17 rats were caught in the traps (Albar et al. 2009). This campaign confirmed that both species Pacific rats Rattus exulans and Black rats Rattus rattus are now present on Makatea.

No mice were observed or mentioned by locals.

A number of domestic animals are confined to the village of Makatea, such as domestic fowl Gallus gallus, dogs and pigs. A few domestic cats were also observed in the village, and feral cats Felis catus are believed to be present in the other areas of the island.

The introduced bird species Silvereye *Zosterops lateralis* is also present on Makatea.

4. THE TARGET SPECIES, IMPACTS AND BENEFITS OF ERADICATION

4.1 Target Species

4.1.1 PACIFIC AND BLACK RATS

For both species, distribution and densities are unknown in Makatea, but considering number of rats trapped during 2009 survey, it seems that both species were present at low densities at this time of the year. However rat densities vary according to climate: severe drought that occur periodically in Makatea might reduce rat densities. It is assumed that their breeding season occurs year-round as on most of tropical islands.

4.1.2 CATS

Domestic cats are present in the village, and it is believed that feral cats Felis catus are present on the rest of the island. Domestic cats should be tagged and spayed, and feral cats will have to be eradicated by trapping and/or poisoning.

4.2 Impacts

4.2.1 PACIFIC AND BLACK RATS

Rats are the invasive species that have the biggest impact on the seabird population because they occupy 90% of the world's islands (Towns et al. 2006). Three species have been introduced in the Pacific islands: the Pacific rat Rattus exulans, the Norway rat Rattus norvegicus and the Black rat Rattus rattus. With respect to these invasive species, bird vulnerability can be affected by several factors such as bird and egg sizes and nest positions (Atkinson 1985). According to this same author, black rats, because of their climbing ability, are more problematic for tree-nesting birds whilst Pacific rats are more predatory towards ground-nesting birds. On the other hand, any type of rats is likely to attack burrow-nesting birds such as Hydrobatidae (storm-petrels) and Procellariidae (petrels and shearwaters) (Jones et al. 2008; Atkinson 1985).

The black rat is known particularly for its attacks on eggs and chicks, thus reducing the birds' breeding success (Pascal et al. 2004).

Rats also eat plants, fruit and seeds, affecting flora organization and damaging nesting birds' natural habitats.

Finally, they have an impact on crops and food/ water supplies, electrical or building infrastructures, leading to economic loss but also health problems due to diseases such as leptospirosis.

4.2.2 CATS

Bonnaud et al. (2011) and many other studies have shown that cats are among the most successful and damaging invaders on islands and a significant driver of extinction and endangerment. They feed on a wide range of species from large birds and medium sized mammals to small insects. The entire fauna of Makatea, particularly birds, would benefit from the eradication of cats.

4.3 Benefits of eradication

Eradication of rodents and cats from Makatea would have environmental benefits, including:

- An increase in specific vegetal diversity.
- An increase in the endemic bird populations.
- An increase in the population and breeding success of seabirds.

To have a weighty argument for the possibility to translocate Tahiti monarch and Tuamotu Kingfisher. Economical and health benefits would also result from rat eradication on Makatea:

- Improved fruits and vegetables harvest.
- Improved ecotourism.
- Decrease in leptospirosis and other zoonoses.

5 CAN IT BE DONE?

5.1 Technical approach

Proposed method: Considering the size (2820 ha), topography, steep terrain and dense vegetation of the island, a ground-based operation is not feasible. An aerial application with a helicopter guided by GPS-determined tracks will be the most efficient way of removing rats from Makatea. This option requires technical experts and sufficient funds but it appears to be the only reliable option. However, eradicating rats from Makatea depends on biodiversity benefits relevance, funds available, biosecurity and local engagement and agreement. The presence of the human population and domestic animals is a very significant factor in proceeding with an aerial application on the island as humans and animals will have to be kept away from poison and buildings will have to be hand-treated.

5.1.1 METHOD AND ISSUES WITH THE PROPOSED METHOD:

TIMING

Compromises will have to be made concerning the timing of the operations. The dry season (July-September) would be the best choice to eradicate rats as it ensure that bait will remain in good condition to be available to rats. However, the East trade wind (Mara'amu) occurs from May to October including this period and can be problematic for both boat navigation andhelicopter flying: wind speed cannot exceed 15 knots (K. Hawkins, pers.comm.) for helicopters to be operational.

Risks for non-target species are negligible (see § 5.5) and will not impact the timing of the operation.

As recommended in the PII Guidelines on Rodent Bait and Baiting, two bait applications will be required. The time interval between the two broadcasts is ideally 7-10 days, but would largely be determined by the weather.

LOGISTICS

TRAVEL, ACCOMMODATION

All personnel can fly from Papeete to Rangiroa with Air Tahiti. Staff will then be transferred from Rangiroa to Makatea by boats piloted by fishermen. The journey requires about 4 hours depending on sea conditions. A house on-site can be lent by the Mayor of Makatea.

BAIT

Due to its efficiency in many eradication operations, Pestoff ® rodent bait 20R (0,002% Brodifacoum as active ingredient), a second-generation anticoagulant, would be used. This cereal based composite pellet bait is manufactured by Animal Control Products Ltd in Wanganui (New Zealand).

A sowing rate of 14 kg/ha applied in two applications (8kg/ha for the first treatment and 6kg/ha for the second treatment) is recommended. Crab interference is expected and justifies the higher rate of bait application.

BAIT TRANSPORT

Approximately 45 tons of bait would be required. It will be send from Animal Control Products Ltd manufactury in Wanganui (New Zealand) to Auckland's port by land-freight, and from Auckland to

Papeete by ship freight. Transport from Tahiti to Makatea will be with the inter-islands freighters Mareva Nui or St Xavier Stella.

The precise bait transport and others logistic aspects will be developed in an operationnal plan.

5.2 Sustainable

A biosecurity plan will have to be developed for the operation itself and for post-operational biosecuity requirements. Biosecurity requirements during the field operation include:

- Commercial vessels (bait transport) are free of rodents;
- Landing vessels are clean and free of rodents, invertebrates including ants, seeds;
- Clean and sealed poison containers;
- Clean and sealed food and equipment containers;
- Personal gear and clothing checked for invertebrates and seeds.

Makatea Island is far from other islands (the closest, Rangiroa, is located at about 80 km) and rats will not able to re-invade the island by swimming.

However, shipping in French Polynesia is an important activity, and risks of accidental re-invasion should not be excluded. Mareva Nui and St Xavier Maris Stella are the two supply boats that serve Makatea (each one travels once a month). These boats land only on the wharf and, if rat eradication takes place on the island, biosecurity measures will be required there. Permanent bait stations could be installed on this wharf.

Information and cooperation have to be obtained from ship owners to implement biosecurity measure aboard such as rat guards and pest control.

Prevention strategies against re-invasion are not only the ship owners' duty but also the whole communities' to adhere to biosecurity measures. At the moment, Makatea's inhabitants are not sufficiently involved or informed enough to ensure compliance.

This biosecurity issue must be resolved before any eradication operation to ensure that the project will be sustainable.

5.3 Socially acceptable

To ensure the success of a restoration project, stakeholders' engagement is critical from the beginning (feasibility) to the end (implementation of the project) and on going after the project to ensure sustainability (biosecurity measures).

During a survey in 2009, a public information meeting was organized and held at the city hall of Makatea, with the help of the Mayor, in order to encourage inhabitants to sustainably manage their environment and to gather their opinions about the possibility of a rat and cat eradication. Only nine people attended this public information meeting, which represents 15 percent of the population and reveals the lack of commitment of Makatean residents, and maybe does not indicate the majority of the residents' opinions.

All the members of the scientific team briefly presented the purpose of their work on the island, and explained the possible future actions in order to protect the heritage and environment of Makatea, especially the importance of eradicating cats and rats from the island. They then gathered

feedback from residents. Although residents seemed to be very interested and concerned about their heritage and biodiversity, they were generally reluctant to the idea of eradicating these mammals from the entire island (Albar et al. 2009).

Other key stakeholders still need to be identified.

5.4 Politically & legally acceptable

The restoration of Makatea requires different permits and consents.

A permit for the importation of bait is required by SDR (Service du Développement Rural). A permit from several Administrative Service of Haut-Commissariat (Custom Service, Immigration Service) is required for the entrance of the helicopter and the shipon to French territory.

Moreover, permits from French Civil Aviation Authority will be required to operate a helicopter in the area. Pilots will need to hold the correct documentation.

5.5 Environmentally acceptable

The table below gives a summary of the non target-species, the pathways of poisoning and the poisoning risk level for each of them.

Table 1: Non-target species and risks

Non-target species	Primary poisoning	Secondary poisoning	Risk
Makatea fruit-dove, Polynesian Imperial pigeon, Tuamotu Reed-warbler	Yes	No	Low
Frigatebirds	No	Scavenging dying/ dead rats	Low
Tuamotu Reed-warbler, Wandering tattlers, Bristlethighed Curlew, Pacific Golden-plover, Pacific Reef-egret	Yes	Eating shellfish, reptiles and insects	Low
Pigs	Yes	No	Medium
Dogs and domestic cats	Yes	Eating dying/dead rats	High
Reptiles	Yes	No	Low
Humans	Yes	Eating poisoned pigs, Eating crabs	Low High

The Makatea fruit-dove, the Polynesian Imperial pigeon and The Tuamotu Reed-warbler could accidently consume small quantities of poison but the risk is considered low as the two first species feed mainly on fruits and the third one on insects.

Seabird species will not be affected by bait since they feed exclusively at sea. The only one that could possibly eat dying rats is the frigatebird, but the risk is considered low at the population level and will be outweighed by the benefits of the operation. Frigatebirds are widespread in French Polynesia and elsewhere in the world.

Shorebirds could be affected by bait since they forage on the ground or be exposed to secondary poisoning eating shellfish or reptiles. However, these species are also widespread and the risk for global population is very low and outweighed by long term-positive effects on global bird community.

For the same reasons, the impact of the toxin is considered to be of low concern for reptiles (lizards and geckos).

Invertebrates, including crabs, won't be affected by poison (the toxin specifically affects the blood clotting mechanisms of warm-blooded animals) but can be a source of secondary poisoning.

The most problematic group are the mammals, as pigs and pets belong to people. Risks of poisoning these animals and the subsequent risk of human consumption of poisoned livestock are the largest issue and cannot be neglected.

Brown (2007) suggests that lethal dose for a dog can be as low as 250 g of bait and the toxic dose for sheep is between 7,5 and 37,5 kg of bait. Considering the bait application rate, pigs and pets could easily ingest enough toxins to be exposed to a lethal dose.

Thus, specific mitigation measures are needed to reduce this risk of exposure of animals to the bait:

- Companion animals such as dogs and cats should be kept confined.
- With respect to pigs, a solution would be to negotiate with people to hunt their animals prior to the bait application, so that there is no risk of human poisoning from meat consumption.
- With respect to crabs (especially Coconut crabs), the local community will have to agree with stop hunting and consuming them for a year.

These measures are very difficult to implement and may be problematic for the local community. The residents are not currently aware of these constraints and they will probably not agree with following them, especially the stopping of coconut crabs hunting which is one of the main food resources of the island.

5.6 Capacity

SOP Manu is a small organisation with a staff of 5 people. Rodent eradication experience is limited to the use of bait stations and hand broadcasting operations on small islands. In partnership with Manu are a range of partners with extensive eradication experience including Pacific Invasives Initiative and Birdlife International. The NZ Department of Conservation Eradication Advisory Group is available to review plans and advise on the project but is unlikely to be available for any fieldwork.

Additional skills and training are required for an aerial operation. It will be important that the project manager providing the team leadership has experience in helicopter based rodent eradications and has ready access to specialist advisors throughout the planning and implementation process. Helicopter pilots with the appropriate experience in rodent eradications and operating from ships will be critical to the success of the project. Pilots will need to hold all the correct qualifications to operate legally within French Polynesia. The helicopters are likely to be foreign registered (either NZ or USA). This means that engineering support for the helicopters will have to be suitably qualified and the pilots hold the appropriate licence to operate those aircraft.

5.7 Affordability

The cost estimate still need to be completed, but due to the fact that an aerial operation is required, costs are anticipated to be very high.

6. CONCLUSION

THE PROJECT IS FEASIBLE

The island of Makatea hosts a very high plant and bird biodiversity. It has been classified as one of the 15 « important conservation sites » of French Polynesia (Meyer et al. 2005). Cibois et al. (2011) stressed the importance of the conservation of bird populations, and several scientists have suggested setting a legal protection of the island (Gargominy et al. 2006; Jacq & Butaud 2009) in order to conserve its high biodiversity.

The eradication of introduced predators from the island would provide significant conservation benefits for the entire ecosystem including a number of forest and bird species.

Moreover, a site like Makatea would provide an opportunity to safeguard a number of globally threatened species. Makatea presents a suitable habitat for a population of Tahiti Monarch Pomarea nigra and the Tuamotu Kingfisher Todiramphus gambieri. Both of these species are classified as Critically Endangered by the International Union for the Conservation of Nature, and they are each restricted to only one island (Tahiti and Niau respectively). If cats and rats were removed from Makatea, it could then be possible to consider the translocation of these two species. This very interesting potential for a rescue strategy reinforces the importance of restoring Makatea.

Considering previous paragraphs, the restoration of Makatea island by the eradication of cats and rats is broadly deemed to be feasible.

Remote islands with very few visitors make biosecurity measures managable and safety issue solvable, and the aerial broadcasting technique has achieved success in the past on other similar islands that are comparably remote and much larger.

However, managing pigs and handling domestic animals during the eradication operation will be very complicated and will require a careful methodology.

Most of all, the terrain of Makatea is particularly challenging due to its geology and the consequences from past phosphate exploitation. Only one eradication project has occurred on anisland with similar features. This operation took place in 2011 on Henderson island, Pitcairn Group, South Pacific Ocean. We recommend to wait to confirm the success of this operation in order to implement a similar operation on Makatea and ensure a higher chance of success.

Finally, eradication of rats and cats from Makatea remains a large, complex, and expensive undertaking. Some major obstacles could compromise the project, especially the social and affordability issues.

These key issues need to be resolved which would prevent the project from proceeding and being succesful. They are summarized in the table below and discussed in the following paragraph.

Table 2: Key issues to solve for a successful project

Issue	Recommendation
Social obstacle to remove rats and cats from Makatea	Continuous consultation with the local community
Affordability	Identify, search and secure all fundings needed
Capacity development	Collaborate with experts
Contingency plan for reinvasion or reintroduction of predators	Extensive consultation and public awareness campaign, creation of a natural reserve (post-eradication biosecurity measures?)
Sustaining the project with any rat reintroduction in the future	

SOCIAL ASPECT

The 2009 survey raised the importance of implementing awareness in the local community as several people among the population were unaware of the importance of their island in terms of biodiversity. The residents expressed interest and concern about protecting their natural heritage. However, the community as yet does not support an eradication of rats and cats as they would need to cease harvesting coconut crabs (a major income source) for some months after a bait operation.

Such issues are not insurmountable and through consultation and appropriate incentives livelihood solutions can be addressed.

AFFORDABILITY

SOP MANU is currently studying different possibilities with boat and helicopter companies to proceed with a similar project (on Gambier and Vahanga islands) at the lowest cost. When this cost study will be completed, it will be used to estimate the cost of a similar operation on Makatea.

Then different source of fundings will have to be foreseen and considered, and grants will have to be written in order to secure all the fundings needed.

CAPACITY

SOP Manu has already established contacts with eradication experts from Birdlife International, Pacific Invasive Initiative and the Department of Conservation from New-Zealand. The SOP team will improve its capacity in the coming years as a similar project (on Gambier and Vahanga islands) is under way.

It is recommended to first complete this current project and use the knowledge and experience gained from it in order to carry out a successful operation on Makatea.

SUSTAINABILITY

The sustainability of the project is a major issue as the mayor has mentioned future industrial and infrastructure plans. Indeed, the building of an airport, a port and industrial area, a cement plant, the operation of a limestone quarry are being considered (Gargominy et al. 2006). Managing the sustainability of an eradication operation would be impossible if such projects were to be implemented, considering the importance of the biosecurity measures to which people will have to adhere. Moreover, the threats that could rise from such projects on the biodiversity of the island would be dramatic (Gargominy et al. 2006).

It has already been suggested to classify the island as a protected area according to the Environmental Code of French Polynesia, which represents an area of habitat and species management (category IV) allowing interventions such as the control of invasive species (Jacq and Butaud 2009). Indeed the richness of this heritage, particularly the natural forests and cliffs of the island, largely justify its classification as a natural reserve or protected reserve.

The debate about the legal protection of Makatea has been sparked with the Regional Directorate for the Environment, and this should be continued with the government and other stakeholders.

In conclusion, the restoration project of Makatea is considered valuable and feasible, but we suggest that all the recommendations mentioned above should be followed and the problems resolved before considering the implementation of such a project.

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ADDITIONAL ANNEX

Inventaire et cartographie des intérêts patrimoniaux (flore et avifaune) de l'atoll soulevé de Makatea

JACQ F. ET BUTAUD J.F., 2009 [PDF, 20MB]

LINK: CEPF/16/16-Makatea-Annex-Jacq-et-Butaud-2009.pdf

INCLUDES ANNEXES:

Annexe 1 : Glossaire;
Annexe 2 : Dynamique de 1981 à 2001 la végétation sur les zones exploitées pour le phosphate par type de formation végétale;
Annexe 3 : Echantillons d'herbier récoltés en 2009;
Annexe 4 : Flore de Makatea en 2009;
Annexe 5: Guide de reconnaissance de la flore locale de l'atoll soulevé de Makatea;
Annexe 6 : Atlas de la végétation de 2001 de l'île de Makatea;
Annexe 7 Cartes du présent rapport en noir et blanc;
Annexe 8 : Liste des données cartographiques utilisées ou consultées;
Annexe 9 : Complément d'inventaire faunistique.

CEPF Small Grant Final Project Completion Report

Makatea, a site of major importance for endemic birds

Organization Legal Name

Société d'Ornithologie de Polynésie

Project Title

Makatea, a site of major importance for endemic birds

Date of Report

13 February 2012

Report Author and Contact Information

Thomas Ghestemme, tghestemme@manu.pf

CEPF Region

Polynesia-Micronesia Hotspot

Strategic Direction SD-2

Strategic Direction 1: 'To prevent, control and eradicate invasive species in key biodiversity areas' and in particular 1.2. 'Control or eradicate invasive species in key biodiversity areas, particularly where they threaten native species with extinction.'

Grant Amount

17 657 USD

Project Dates

1 May 2010 – 31 October 2011

Implementation Partners for this Project

Please explain the level of involvement for each partner

The Government of French Polynesia through the Regional Directorate for the Environment DIREN: Claude Serra has helped in communicating with the local community.

Municipality: the mayor of Makatea has contributed to hold a public meeting on the state of the island natural heritage.

Pacific Islands Conservation Research Association: Dylan Kesler has done the evaluation of endemic populations of birds and assessed the feasibility for the reintroduction of the Tuamotu Kingfisher.

Jean-François Butaud: as a consultant in botany, he assessed the importance of vegetation of Makatea.

Fred Jacq is a botanist specialized in GIS. He has helped with the inventory of the vegetation and has mapped the remarkable vegetation of Makatea.

Conservation Impacts

Please explain/describe how your project has contributed to the implementation of the CEPF ecosystem profile

The project has contributed to the implementation of the CEPF ecosystem profile, especially Strategic Objective 2.1 «Development and management of conservation areas for priority sites which are not yet protected, in particular safe place for species such as large forest zones and habitats which are free of exotic species, which are vulnerable». Indeed, the remote island of Makatea holds a forest with has the richest flora of all the Tuamotu Archipelago and three endemic and threatened bird species, but the area is not protected. This project has helped spark the debate about a legal protection of the territory.

The development of a Plan of Action for the two endemic species and a feasibility study for the eradication of rats are part of Strategic Objective 3.1 «Development and implementation of restoration plans for critically endangered species which require targeted actions, in particular for those which have received little attention so far.

Please summarize the overall results/impact of your project against the expected results detailed in the approved proposal

Please refer to detailed project outcomes in Part I of this report.

Please provide the following information where relevant

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

Describe the success or challenges of the project toward achieving its short-term and long-term impact objectives

The project has provided and updated valuable scientific knowledge about plants and birds.

It has included the evaluation of the introduced species including the discovery of the presence of Black Rats *Rattus rattus* that was not believed to be present, and it has identified the main threats for birds, that are invasive plants and introduced mammals.

This project was particularly successful in achieving some additional outputs such as the evaluation of the reintroduction of Tahiti Monarch and the Tuamotu Kingfisher.

The different results collected have conducted to the development of a Plans of Action for the two endemic species and a feasibility study for the eradication of rats from the island.

The collaboration initiated with Pacific Islands Conservation Research Association (Dr Dylan Kesler) has developed capacity building in the SOP team and helped design replicable methods to evaluate bird populations.

Community awareness has been successfully implemented, as two actions aimed at informed the local population about the importance of Makatea according to the richness of its biodiversity. The residents expressed interest and concern about protecting their heritage.

All data, information and recommendations have been compiled in various reports that will enable government management of the island and inform other stakeholders about the importance of the island.

Were there any unexpected impacts (positive or negative)?

One of the impact objectives of the project was to implement biosecurity measures in order to protect the island from the invasion of Black rats Rattus rattus. However, the presence of this former species on Makatea has been discovered during the study. As a consequence, our team could not implement biosecurity measures and plan the reintroduction of other threatened species such as the Tuamotu Kingfisher or the Tahiti Monarch.

Furthermore, the long-term objectives had to be changed. The alternative solution was to assess the feasibility study for the eradication of rats from the entire island, in order to protect the flora and the birds. The feasibility study has been written but needs peer-reviewed.

The positive impact about the involvement of the population of Makatea was the interest from the Mayor who supported the entire team and showed interest in hosting future scientific teams.

The associate negative impact was that it turned out that it was irrelevant to train a local to implement biosecurity measures as it was initially planned.

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.

The difficulty of the fieldwork was perhaps slightly underestimated during project planning. Indeed, the geology of the island makes the fieldwork very difficult to be processed, and as a consequence only a small surface of the island could be surveyed.

Black Rats were believed to be absent from the island according to observations from previous surveys. However, this species was found during the rat-trapping campaign. The lesson learned from this unexpected detail is that rat-trapping and species identification should always be performed in order to confirm the rats species.

The project raised the importance of implementing awareness to the local community as several people among the population were unaware about the importance of their island in terms of biodiversity.

Because of the remoteness and inaccessibility of the island, the visitors are scarce. We learnt that it is crucial to listen and pay attention to the community opinion and develop good relations with the residents in order to make them support the scientific work and management actions.

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

The design of the project meant that it was successfully implemented, although we recommend a lengthier fieldwork period for the future in order to increase the relevance of data collected.

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

Collaborations initiated during project planning were comprehensively developed and broadened during the implementation of the project. These collaborations contributed to the success of the project.

Good relationships were developed with the community during the course of the survey.

Other lessons learned relevant to conservation community:

N/A

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.

Donor	Type of funding*	Amount	Notes
French Polynesia Government	A	US$ 17000	1.600.000 XPF

**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.)

Sustainability/Replicability

Summarize the success or challenge in achieving planned sustainability or replicability of project components or results.

Methods used to assess the population of birds can be replicable and will help compare results over the years. The Polynesian Imperial-pigeon and the Makatea ground-dove populations could be monitored every 4 years using these methods.

A Plan of Action for the Makatea ground-dove, Polynesian and Imperial-pigeon was developed, and a clear strategy was described on those species along with a long-term management, which will allow to thwart industrial projects planned by some investors.

The main conservation action that needs to be implemented on Makatea was identified and its feasibility was evaluated (rat eradication).

The debate about a legal protection of the territory has been sparked with the Regional Directorate for the Environment.

Summarize any unplanned sustainability or replicability achieved.

N/A

Safeguard Policy Assessment

Provide a summary of the implementation of any required action toward the environmental and social safeguard policies within the project.

The richness of this heritage, particularly natural forests and cliffs of the island, largely justify its classification as a natural reserve or protected reserve. Protected areas of the proposed zoning would cover about 60% of the surface of the island, mainly corresponding to non-exploited areas.

It is also proposed to classify this area under a protected area according to the Environmental Code of French Polynesia, which represents an area of habitat and species management (category IV) allowing interventions such as the control of invasive species.

Additional Comments/Recommendations

The eradication of introduced predators from the island would provide significant conservation benefits for a number of forest and seabird species (as well as other biodiversity) but remains a large, complex (and expensive) undertaking. Nevertheless, there are no large mammalian free islands in French Polynesia thus a site like Makatea would provide an opportunity to secure a number of globally threatened species. However, the community as yet does not support such a concept primarily as they would need to cease harvesting coconut crabs (a major income source) for some months after a bait operation. Such issues are not insurmountable and through consultation and appropriate incentives livelihood solutions can be addressed. Restoration of the island is considered to be broadly feasible and the issues necessary in taking an eradication forward are being outlined in the feasibility document.

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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Performance Tracking Report Addendum

CEPF GLOBAL TARGETS

Provide a numerical amount and brief description of the results achieved by your grant. Please respond to only those questions that are relevant to your project.

PROJECT RESULTS	If relevant, provide your numerical response for results achieved during the annual period.	Provide your numerical response for project from inception of CEPF support to date.	Describe the principal results achieved throughout the project.
1. *Did your project strengthen management of a protected area guided by a sustainable management plan? Please indicate number of hectares improved.*	2800 ha	2800 ha	Plan of Action for the two endemic species of the island of Makatea (2800 ha).
2. *How many hectares of new and/or expanded protected areas did your project help establish through a legal declaration or community agreement?*	N/A	N/A	N/A
3. *Did your project strengthen biodiversity conservation and/or natural resources management inside a key biodiversity area identified in the CEPF ecosystem profile? If so, please indicate how many hectares.*	2800 ha	2800 ha	Plan of Action for the two endemic species of the island of Makatea (2800 ha).
4. *Did your project effectively introduce or strengthen biodiversity conservation in management practices outside protected areas? If so, please indicate how many hectares.*	N/A	N/A	N/A
5. *If your project promotes the sustainable use of natural resources, how many local communities accrued tangible socioeconomic benefits?*	N/A	N/A	N/A


Manu

CONSERVATION INTERNATIONAL

Pacific Islands

BIODIVERSITY CONSERVATION LESSONS LEARNED TECHNICAL SERIES

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