



# RAROTONGA CLOUD FOREST ECOSYSTEMS

SYNTHESIS REPORT, KEY FINDINGS  
AND RECOMMENDATIONS



## RAROTONGA



- 64km<sup>2</sup> and largest island in the Cooks
- Highest point is approximately 652m
- Steep mountainous interior
- One of the best areas of montane forest in all Polynesia
- Cloud forest habitats cover only approximately 150 ha (1.5 km<sup>2</sup>) of Rarotonga
- Abundance of non-vascular species (mosses, liverworts, and lichens)

### Habitats in the cloud forest support a disproportionate number of the island's endemic plant species.

- Te Manga Cyrtandra, Rarotonga Garnotia-grass – entire population in cloud forest
- Rarotonga Sclerotheca remaining known populations are in the cloud forest



Te Manga Cyrtandra is only found near the summit of Te Manga and is seriously endangered. Photo CINHP/IG McCormack



The Rarotonga Sclerotheca is seriously endangered and only found deep in the Rarotonga mountains. Photo CINHP/IG McCormack

## Rarotonga Cloud Forest Study

### WHAT

The study was done in the interior landscapes of Rarotonga looking at areas 400 metres or greater. This area is described as the cloud forest area.

The highest peak reaches to 652 metres. The study was looking at the biological diversity and updating the biological inventory of these areas. Samples of flora and fauna were collected and shipped to be named and archived at the Auckland Museum.

Although cloud forest habitats cover only 1.5 km<sup>2</sup> of Rarotonga, these habitats support a disproportionately high number of the island's endemic plant species. The objective of this activity was *"to protect and enhance the cloud forests of Rarotonga so that their indigenous ecosystems, habitats for endemic species, and water supply functions are preserved in perpetuity."*

### WHERE AND WHEN

The cloud forest field survey took place in the Rarotonga cloud forest from 6th – 22nd May 2015.

### WHO

National Environment Service in partnership with Wildlands New Zealand participated in the field survey. Joined by a member from the Secretariat of the Pacific Regional Environment Programme (SPREP) and the Samoan Ministry of Natural Resources and Environment (MNRE) in the final climb.

### WHY

The samples, photos and information gathered provides the basis for assessing the state of biodiversity in the Rarotonga cloud forest. The information can empower communities and relevant government organizations and traditional leaders to make informed conservation management and planning decisions to ensure long term conservation of cloud forest biodiversity and its essential ecological services such as high water quality.

### HYDROLOGICAL IMPORTANCE OF CLOUD FOREST

The cloud forests provide a protective cover for the steepest and wettest slopes, resulting in typically high water quality in headwater streams. However, the importance of cloud forest for the island's water supply is further increased by the structure and composition of the cloud forest vegetation itself.

Cloud forest acts not only as a protective cover, but also as a giant sponge, trapping, holding, and slowly releasing both condensation and rain. Thus the cloud forests of Rarotonga, and their abundance of non-vascular species, not only play a critical role in water quality, but also ensure the reliability of the water supply.





## ECOLOGICAL SIGNIFICANCE

Cloud forest habitats of Rarotonga are internationally significant based on an assessment of biodiversity values using recognized international criteria. Rarotonga's cloud forest can be regarded as a key biodiversity areas (KBAs) due to the following:

- Globally threatened species - Key site for eight vascular plant species that are globally threatened.
- Supports all of the global population for several land snail species and two vascular

plant species.

- One of the largest remaining areas of small-island low-altitude cloud forest which retains almost the full suite of plants restricted to cloud forest habitats of the tropical Pacific

## FIELD SURVEY

Carried out in May 2015. Target habitats were those above 400m in altitude on Maungatea, Maungaroa, Te Kou and Te Manga. Five smaller peaks that had summits of similar altitude were not surveyed.



## FLORA

One hundred and eight vascular plant species were recorded at the study sites. Eighteen endemic plant species are included on the IUCN Red List of threatened species.

## LICHENS

Lichens, liverworts, and mosses were collected and their identification is being confirmed. When this is completed, the overall report will be updated. A preliminary list of the taxa collected in 2015 is provided in the overall report. Initial identification work has indicated that the number of indigenous lichen species known to occur on Rarotonga will substantially increase. These lichens include additional species within genera previously recorded on Rarotonga (e.g. *Sticta fuliginosa*), and genera not previously recorded from anywhere in the Cook Islands (e.g. *Cladonia* sp. and *Heterodermia* sp.).

## LANDSNAILS

Indigenous landsnails confirmed as still present in cloud forest habitats include the endemics *Lamprocystis globosa* and *Lamprocystis venosa*, one or more undescribed species of endemic *Lamprocystis*, and a species of *Nesopupa*. Cloud forest on Te Kou is important for landsnail conservation on Rarotonga. No specimens were found of the endemics *Tekoulina pricei* or *Sinployea harveyensis* at their previous known locations. These two species are likely to be on the verge of extinction, or already extinct. Eight introduced landsnails were confirmed as present in cloud forest habitats.



*Te Kou Landsnail (Tekoulina pricei)* is endemic to the Cook Islands and only found on Te Ko'u. (image Gerald McCormack)



*Puaneinei or neinei (Rarotonga fitchia)* is native to the Cook Islands and is common on ridges on the Rarotonga mountains. Photo CINHP/IG McCormack



The Rarotonga *Haloragis* is only found in two small Cloud Zone sites on Rarotonga. Photo CINHP/IG McCormack



*Lamprocystis globosa* is an endemic species of snail found in cloud forest habitats on Rarotonga. Photo CINHP/IG McCormack

## HYMENOPTERA (ANTS, WASPS, BEES)

A total of 14 species of ants, wasps and the honey-bee in seven families of Hymenoptera were found during the 2015 survey of the cloud forests of Rarotonga. These are



Paper wasp *Polistes olivaceus*. Photo CINHP/IG.McCormack



White-tailed tropicbird, Photo CINHP/IG.McCormack



I'oi, Rarotonga Starling. Photo CINHP/IG.McCormack



Blue-tailed skink (*Emoia impar*). Photo CINHP/IG.McCormack

the first records of ants and wasps for the Rarotongan cloud forest, so represent a significant collection. All eight ant species found were exotic species highlighting the vulnerability of the island to invasive “tramp” species, with several of them including *Solenopsis papuana* being the first record of the species on the Cook Islands, which already had 26 recorded introduced species, all in the lowlands. A honey bee was found on Te Manga showing how mobile these bees are. The five wasp species found in the survey representing five families of wasp are significant as many of them, mostly tiny parasitic species, are possibly newly discovered species from this survey. Several of these may represent new species, some of which may turn out to be endemic to the cloud forest of the Cook Islands. Only one of these wasps is a known species, the widespread paper wasp *Polistes olivaceus*.

### FRESHWATER FISH

The summit basin of Te Kou is the only catchment within cloud forest habitats that has permanent flowing water. No fish were found in this stream by undertaking a kick-net survey. While spot-lighting at night, a mature Tuna Kavi (*Anguilla melastoma*) was found in the pool immediately below where the Te Kou track crosses the stream.

### BIRDS

Four indigenous species were seen or heard within cloud forest habitats; Rarotonga Starling, Pacific pigeon, white-tailed tropicbird, and Herald or Trindade petrel.

### HERPETOFAUNA

Two lizard species were seen in cloud forest habitats during the 2015 survey: Rarotonga tree skink and oceanic gecko. Inland blue-tailed skink (*Emoia impar*) were frequently seen sun-basking in the upper slope forest along the Te Manga track. This species is also likely to be present within the cloud forest.

## VEGETATION AND HABITAT

### Maungatea

At 480m the canopy is dominated by Neinei, Pua (*Fagraea berteriana*), and Rata (*Metrosideros collina*), with occasional Kaiatea, Karaka, Rarotonga, and Mato (*Homalium acuminatum*). These trees form a sparse canopy 3-4 m tall over a dense ground tier dominated by prickly fern (*Arachniodes aristata*), tangle fern, and kiekie, with occasional glossy tongue-fern, Nutupa (*Phaius tankervilleae*) and Malaxis orchid (*Malaxis resupinata*). Epiphytes, includes the ferns *Belvisia mucronata*, *Humata banksii*, and *Ctenopterella blechnoides*, and lichens, especially *Pseudocyphellaria homalosticta* and *Sticta caperata*, are abundant on the trunks and branches of trees.

### Te Kou

At 460-540m altitude, vegetation is tangle fern fernland, with scattered trees of Kaiatea, Pua and Rata up to 4m tall. Epiphytes are abundant, including the glossy tongue-fern and foliose lichens such as *Sticta caperata*. Along the rim of the summit valley, the vegetation is Kaiatea-Neinei treeland. Kaiatea and Neinei are common, forming a broken canopy up to 4 m tall, with occasional rata, Homalanthus (*Homalanthus nutans*), Pua, and Panga Ko'u (*Cyathea affinis*). Epiphytes include cloud grass-fern (*Radiogrammitis cheesemaniae*), which is endemic to the cloud forests of Rarotonga, *Belvisia mucronata*, *Huperzia carinata*, and abundant lichens, particularly *Sticta caperata* and *Pseudocyphellaria homalosticta*.

Along the north-eastern ridge that leads towards Te Manga, trees are more widely spaced and the ground-tier includes Polynesian blueberry, extensive swards of mosses, and patches of glossy tongue-fern, Remu Maunga (*Lycopodium cernuum*),

and prickly fern. To the east of the Te Kou track, there is an area of cherry guava scrub. At the headwaters of the stream, white-flowered ginger is dominant, with areas of *Paspalum conjugatum* grassland on the stream banks

### Te Manga

The ridgeline between Te Manga and Ikurangi, at 400-500 m altitude, is dominated by a series of steep-sided pinnacles. These pinnacles are at the lower altitudinal limit of cloud forest. The vegetation is Rata-Neinei-Kiekie shrubland, and canopy trees are very windshorn and c.3 m tall. The epiphytes are primarily mosses and lichens, with the ferns *Humata banksia*, *Belvisia mucronata*, and *Hymenophyllum sanguinolentum*. The small area of flat land at the summit is largely bare, with scattered plants of sour paspalum and elephant's foot.



## THREATS

Key threats to the Rarotonga cloud forest habitats include climate change, invasive plant species, invasive animal species, introduced pathogens, recreational use and disturbance events including fire, landslides and wind-throw. Other potential threats are clearance for agriculture and housing, road construction, hydro-electricity development and hunting.

## RESTORATION AND MANAGEMENT

Summary of proposed actions for restoration, management, and monitoring of Rarotonga cloud forest ecosystems.

Issue/knowledge gap	Proposed action/s
1. Risk of extinction for threatened endemic flora	Establish populations of threatened endemics in cultivation.
2. Establishment of additional invasive species/spread of existing invasive species	Install track signage regarding footwear/clothing/equipment hygiene. Develop biosecurity protocols for track and infrastructure users. Train staff in pest mammal sign and control.
3. Risk of fire/inadvertent damage	Install track signage regarding fire restrictions, track standards and return times, and guidelines for minimising impacts of use.
4. Unknown densities/impacts of introduced mammals, particularly rodents	Undertake baseline monitoring to determine species present and relative abundance. Assess baseline levels of seed predation for <i>Homalanthus nutans</i> . Determine location of seabird breeding colonies. Consider feasibility of pest mammal control at key sites.
5. Continued spread of invasive plants at key sites for threatened endemic fauna	Implement control of invasive plant species at Te Kou and Te Manga
6. Long term trends in vegetation composition and health unknown	Continue assessment of photopoints established in 2015 at three to five year intervals. Expand coverage to include Maungatea, lower altitudes on Te Kou, and control sites of invasive plant species.
7. Climate change leading to modification or loss of cloud forest habitats	Ensure risk posed to cloud forests by climate change acknowledged in government policy.
8. Low public profile of cloud forest ecosystem and species due to inaccessibility	Community education and advocacy.

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For detailed information and results please refer to the full report: Catchment management and restoration plan for Rarotonga Cloud Forest Ecosystems, Cook Islands.