



Executive Summary

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Executive Summary

INTRODUCTION

Located in the southwest of the Pacific Ocean, New Caledonia (20° - 23° S, 164° - 167° E) is part of Melanesia. The country consists of one main island, Grande Terre, surrounded by many smaller islands. Its total land area is 18,576 km² and its exclusive economic zone (EEZ) covers 1,740,000 km². New Caledonia consists of three provinces (Loyalty Islands Province, Northern Province and Southern Province) and thirty-three municipalities. As a French overseas territory with unique status, New Caledonia is currently in a process of self-determination vis-à-vis France which, as part of the Nouméa Accord, transfers its responsibilities to the government and provinces. Most environmental policies have been transferred to provinces.

With a population density of 13.2 people per km² (ISEE 2010), most of the 245,000 inhabitants live in the province Sud (Southern Province), near the capital Nouméa. New Caledonia has several ethnic groups including the indigenous Melanesian people – the Kanak – who play an important social and political role. The Kanak represent about 45% of the population and most of them live on the east coast. Traditional life is organized into tribes and clans. While income-generating activities in town and from mining have spurred migration, the Kanak maintain their relationship with the tribe and the clan of origin. The Kanak tradition nurtures a close link to land and sea from which many still partly depend for cultivated food, game and fish. Kanak culture and beliefs have many customary rules whose purpose or effect is to protect natural resources and culturally important places. These rules, which reflect a traditional attachment to the sustainable use of nature, have been challenged by the socio-economic changes of the last decades.

New Caledonia's economy is mainly based on nickel mining; the mainland has about 20% of the world's known nickel resources. Tourism is the second largest economic sector, while agriculture, fisheries and aquaculture play a significant role, including for subsistence and social life (e.g., trade, gifts) (ISEE 2009). France also provides significant funding

to local governments, especially in areas with fewer economic opportunities, such as Province nord and the east coast.

When Grande Terre split from Gondwana about 80 million years ago and from New Zealand about 55 million years ago (Kroenke 1996), complex tectonic activity resulted in rich ultramafic rocks with high nickel content. This origin stimulated the evolution of an extremely rich and highly endemic biodiversity, leading to the identification of New Caledonia as a biodiversity hotspot (Mittermeier et al. 2004) and as one of the densest regions in biodiversity (Kier et al. 2009), making it a high priority to focus conservation efforts. Out of 3,425 recorded vascular plant species, 2,541 are endemic (endemica 2012); out of 71 terrestrial reptile species, 62 are endemic (Bauer et al. 2000); out of 175 bird species, 21 are endemic (Spaggiari et al. 2007). New Caledonian fresh and salt-waters encompass a remarkable variety of species and habitats including coastal rivers, coral reefs, mangroves and seagrass beds. New Caledonia is home to the largest lagoon in the world (40,000 km²) and includes the longest barrier reef system in the world (1,600 miles), with original reef structures of double or even triple barriers which shelter 457 coral species (McKenna et al. 2011) and 1,695 species of lagoon fish (Fricke et al. 2006). The lagoons of New Caledonia were therefore included by UNESCO on the World Heritage List in July 2008. Because this status requires the preservation of the site's integrity, terrestrial buffer zones were included in order to minimize the impacts of land-based threats to the lagoon. The Mt. Panié massif, where this survey was conducted, is entirely situated within this buffer zone.

In 1950, a 5,400 hectares botanical reserve was designated at Mt. Panié, but without active conservation management. The site has however been regularly visited by hikers and biologists. In 2009, the botanical reserve was reclassified as a wilderness reserve (IUCN status Ib). As part of the establishment of the environmental code of the Province nord, a management plan (2012-2016) was developed by a partnership between Province nord, the indigenous association Dayu Biik and Conservation International.

In 2010, the management plan of the reserve identified the following:

Table 2: Number of families and species listed by the management plan of the Mt. Panié reserve.

	Number of families	Number of species
Pteridophytes	13	37
Gymnosperms	4	14
Monocots	11	110
Dicots	58	282
Total plants	86	443
Crustaceans	4	19
Fishes	9	29
Odonata	3	6
Birds	25	42
Reptiles	3	23
Bats	1	3
Total fauna	45	122

Out of the four sites visited during this RAP expedition, only La Guen is located within the reserve. The Mt. Panié RAP was therefore a pilot to test the effectiveness of the management plan for the reserve, serving as a broad taxonomic survey and to enhance local skills and capacity.

PRESENTATION OF THE RAP PROGRAM AND THE MT. PANIÉ RAP

Conservation International's (CI) Rapid Assessment Program (RAP) is a leading world expert in the collection of field data. RAP is an innovative biological inventory program designed to use scientific information to catalyze conservation action. RAP methods are designed to rapidly assess the biodiversity of highly diverse areas and to train local scientists in biodiversity survey techniques. Since 1990, RAP's teams of expert and host-country scientists have conducted over 80 terrestrial, freshwater aquatic (AquaRAP), and marine biodiversity surveys and have contributed to building local scientific capacity for scientists in over 30 countries. Biological information from previous RAP surveys has supported the protection of millions of hectares of tropical forest and oceans, including the declaration of protected areas and the identification of biodiversity priorities. Visit <https://learning.conservation.org/biosurvey/Pages/default.aspx> for more information on RAP and its methodology.

The specific objectives of the Mt. Panié RAP in 2010 were:

- Expand the existing knowledge of biodiversity in the Mt. Panié region,
- Establish a baseline to understand how the region changes in the future,
- Contribute to the scientific training of local guides,
- Support the identification of priority sites for conservation,

- Identify environmental threats.

Each site was surveyed for at least four days. The survey methods aimed at achieving the above objectives of the expedition and paid particular attention to:

- comparison between plots and between sites
- sampling completeness
- repeatability of the survey (standardized methods)
- identification of indicators for monitoring, in relation to management needs (especially regarding invasive species)

THE RAP WAS UNDERTAKEN BY SIX TEAMS

- Botany, led by Dr. Jérôme Munzinger (IRD)
- Reptiles, led by Dr. Stephen Richards (CI)
- Birds, led by Thomas Duval (SCO)
- Insects, led by Dr. Hervé Jourdan (IRD)
- Freshwater fishes and crustaceans, led by Dr. Philip Keith (MNHN)
- Odonates, led by Dr. Milen Marinov (University of Canterbury)
- Invasive mammals, led by Dr. Jörn Theuerkauf (CORE NC)

DESCRIPTION OF RAP SITES SURVEYED

Roches de la Ouaième

This site covers an elevational gradient from 100 m asl to the summit of the rocks at 980 m, consisting of dense humid forest on mixed ophiolites and micaschists with steep slopes and crags. Above 800 m, the forest is shorter and very humid, and is often enveloped in clouds. Only the eastern slope overlooking the lagoon was surveyed during the RAP. Out of respect for traditional customs, we did not survey the Tonô cliffs and southern forests, which are considered sacred. This site has been surveyed a few times by botanists and herpetologists, but apparently not in a systematic or rigorous way.

La Guen

This site lies within the Mt. Panié reserve, on the southern flank of Mt. Panié, and consists of dense humid forest on micaschist from 400 m to the summit at 1629 m, with steep, craggy slopes and waterfalls. A trail network facilitates access to a range of forest types, rivers, plateaus and ridges, including a hut (20 'beds') named after CI pioneer in Mt. Panié, Henri Blaffart. A multipest control project is planned here, focused on rats, cats, pigs and deer. Two previous short visits from botanists and two bird censuses provided preliminary data for this site.

Mt. Panié summit

At 1629 m asl, Mt. Panié is the highest peak in New Caledonia. Its vegetation changes along an altitudinal gradient (Spir 2006), growing on a geological substrate of mica schist and receiving heavy rainfall (ca. 5,000 mm/year, Météo France 2006). This site has been surveyed by botanists, herpetologists and ornithologists on several occasions but apparently not in a systematic or rigorous way. There is a high probability for new species, especially plants and insects, to be discovered near the summit. Mt. Panié summit is also of high cultural significance, including for its iconic and endemic kauri trees and two sacred places. The hut (10 'beds') is named after a New Zealand conservation organization (the Maruia Society) which supported Dayu Biik in its early years. Because of poor weather, this site was eventually not surveyed.

Wewec

On Mt. Panié's western flanks, this forest covers mica schist geological substrate from the summit reserve down to the Wewec river at 200 m, across the reserve boundaries. The owner clan is willing to include part of its traditional land within the reserve. They also own and maintain a traditional shelter for 10 persons. No biological surveys have ever been carried out in this area.

Dawenia

On the western flanks of Mt. Colnett, 10 km to the northwest of Mt. Panié, this forest covers mica schist geological substrate down to 500 m. A section of the forest occurs on a plateau with nutrient-poor soils. Preliminary bird inventories showed a fairly intact bird community, including parakeets.

RAP RESULTS BY TAXONOMIC GROUP

The Mt. Panié RAP provides the first multidisciplinary taxonomic assessment of four poorly studied sites within or near Mt. Panié wilderness reserve, providing reserve managers with a baseline and a georeferenced database available for the management of the reserve. Species richness and diversity of each site differ from one taxonomic group to another, but all exhibit remarkable features, including the presence of species considered globally threatened by IUCN.

Plants:

Sixteen 400 m² plots and 64 field surveys focused on all tree species and orchids and provided 4,516 observations, with 92.4% individuals identified to the species or sub-species level. We recorded a total of 617 taxa, including 490 species, 9 subspecies and 14 varieties validly published, and 10 temporary taxa (TT); this represents 108 families and 249 genera. Among 523 species, TT and subspecies level taxa, 404 are endemic to New Caledonia, 106 are native (but not endemic) and 12 are introduced (including 5 considered invasive). 177 species (33.8%) are on the list of protected

species by Province nord. We found 13 taxa (species or sub-species) apparently new to science, two of which (*Meryta rivularis* Lowry and *Pandanus taluucensis* Callm) have recently been described. The vegetation consisted of low and medium elevation rain forest on volcanic-sedimentary rocks, local patches of secondary vegetation, and mountain cloud forest.

Birds:

59 point counts were conducted by two local guides of the Haut-Coulna tribe. The Crow Honeyeater, a rare and Critically Endangered bird species, was observed for the first time in twelve years in the region. The team also found a large breeding colony of the Tahiti Petrel, a Near Threatened species, which appears to occur in dozens of breeding pairs at Roches de la Ouaième.

Reptiles

18 species (17 reptiles and one frog) were documented, of which the frog and one gecko are recent introductions to New Caledonia. Four species of lizards encountered are listed as Endangered by IUCN, and one as Critically Endangered. A further two species are listed as Near Threatened and one species is listed as Data Deficient. At least one, and possibly two species, are new to science, though one of these is also known from outside the Mt. Panié area. The Mt. Panié and nearby Roches de la Ouaième provide critical habitat for rare and restricted-range species reliant on humid forest including several taxa that are suffering population declines due to mining activities in other areas. Wildfires and invasive predators and pigs are potential pressures on these species within the protected areas around Mt. Panié. Two species of skink, *Marmorosphax tricolor* and *Caledoniscincus aquilonius*, were abundant and easy to sample, and therefore may provide good indicator taxa for quantifying the impacts of invasive rats and feral pigs on this group of lizards.

Freshwater fishes and crustaceans

10 species of crustaceans and 9 species of fish were collected. Only one species is introduced in New Caledonia. Considering the number of species found, crustaceans are more diverse in La Guen than in Wewec, while, on the contrary, fish are more diverse in Wewec than in La Guen. Roches de la Ouaième is the poorest site in terms of fish and crustacean richness. Species richness was relatively low compared to sites along nearby coastal rivers on the eastern side of Mt. Panié. Because all species found are diadromous amphidromous (adults reproduce in freshwater, while the larvae migrate to the sea, before returning to freshwater), they depend on conserving the intact mountain-ocean corridor to allow movements between both habitats.

Odonates

We surveyed odonates at 46 sites in north-eastern New Caledonia, including 38 primary sites in three catchments on and around Mt. Panié. A total of 23 species were recorded

during this survey, which comprises 41% of the 56 species known for the country. The lowest number of species was documented within the La Guen River catchment, where less species were found than in the Dané Yém River catchment despite only limited sampling (half a day) at this latter site. Localities within the La Guen catchment also appeared to suffer from higher disturbance compared to those in the Wewec River catchment where species richness was high. They had lower water pH, higher amounts of filamentous algae and an apparently low abundance of primary consumers (macroinvertebrates). Anthropogenic impacts, including bushfires and introduced mammals, may explain these differences. Our results suggest that odonates are useful bioindicators within the Mt. Panié area. This survey provides baseline data on species occurrence and abundance at a range of sites, and identifies several questions regarding disturbance to aquatic ecosystems that require further investigation.

Invasive mammals

The abundance of six invasive species - black rats (*Rattus rattus*), Pacific rats (*R. exulans*), rusa deer (*Cervus timorensis rusa*), feral pigs (*Sus scrofa*), feral cats (*Felis catus*), and stray dogs (*Canis lupus familiaris*) - was assessed in the Mt. Panié range in 2010, building on research conducted from 2004-2009. Black rats were heavier and more abundant at several sites around Mt. Panié than elsewhere in New Caledonia. The other five invasive species occurred at abundances similar to average populations observed elsewhere in the

archipelago. Deer abundance was highest along forest edges, where their ecological impact (browsing and bark stripping) was greatest. In the long term, the composition of forest vegetation may change, losing its most palatable species which are at risk of local extinction; the absence of regeneration could lead to significant forest degradation.

Climate analysis

We examined recent local precipitation and temperature variability, comparing it to the longer-term record. Overall, the last 20 years were relatively dry, but still within the historical range of precipitation variability. The period between 2003 and 2007 was particularly dry, reflecting the influence of larger-scale climate variability related to El Niño-Southern Oscillation (ENSO) and the Interdecadal Pacific Oscillation (IPO) on rainfall in the region. We also note a warming trend over the last several decades, which may potentially exacerbate the impacts of drought stress on vegetation in the ecosystem. These climatic stresses may have contributed to the observed die-back of the microendemic and iconic Mt. Panié kauri tree (*Agathis montana*). These climatic stressors can exacerbate the effects of soil disturbance and erosion related to the growing invasive feral pig population. The kauri die-back may be a detectable symptom of a wider conservation issue affecting topsoil in this mountain ecosystem.

Table 3: Summary of RAP survey results per site. Biological diversity is assessed using Shannon's index. For plants, the range indicates the index of the less diverse plot and the one of the more diverse plot.

	Roches de la Ouïème	Wewec	Dawenia	La Guen	Total
Species richness					
Plants	303	174	237	266	490
Birds	9	17	18	14	29
Reptiles	10	10	10	13	19
Freshwater fishes & crustaceans	6	15		14	19
Odonates		19		10	23
Diversity (Shannon)					
Plants	4.96 – 5.66	3.64 – 4.81	5.16 – 5.38	4.32 – 5.63	
Birds	2.14	2.82	2.89	2.52	
Number of species critically endangered					
Reptiles	1				1
Number of species endangered					
Reptiles	2	1	1		2
Number of species vulnerable					
Plants	3	2	2	6	8
Birds			1		2
Number of species near-threatened					
Birds	2	4	4	3	
Reptiles	2	2	2	2	2

Forest cover change

Forest cover changes were assessed within a study area of ca. 1,500 km² covering the communes of Hienghène, Pouébo and Ouégoa in north-eastern New Caledonia, including the Mt. Panié wilderness reserve and the 2010 RAP sites. Detected changes were based on image sequences from the years 1989 (Landsat TM5), 2000 (Landsat TM7) and 2008/09 (SPOT5). Field assessments of landcover representations provided an overall accuracy of 85% for the year 1989, 88% for the year 2000 and 74% for the 2008/9 maps.

The results show a forest loss of 26 630 hectares over 20 years, representing a 29.8% decline of the 1989 forest cover estimate. This deforestation appears to be more active in the period 2000-2008/9 than in the period 1989-2000, with an average annual deforestation rate of 1.9%/year. Native lowland forests are more threatened by deforestation. Deforestation mostly occurs outside mining, urban or major agricultural areas, while local evidence was demonstrated of forest destruction occurring on burnt areas by anthropogenic bushfires. Reforestation of savannah is however identified in significant extent.

CONSERVATION RECOMMENDATIONS

The RAP results demonstrate that numerous discoveries are still possible on Mt. Panié, in particular among plants and reptiles. They also underline the importance of this area for biodiversity conservation and raise several environmental issues that are the foundation for the following conservation recommendations:

Complementary surveys

Additional surveys should target priority sites to be identified after a gap analysis, taking into account data from historical inventories. Mountain ecosystems in particular would benefit from this effort, since they have been understudied. Studies on species of conservation importance, including birds (Crow honeyeater and Tahiti petrel), reptiles (*Nannoscincus exo*) and plants (*Agathis montana*, Pandanacées, Palm trees), should detail their status (distribution, abundance, threats, trends etc.) and evaluate their conservation needs. This is particularly important for the Crow honeyeater for which Mt. Panié is the only known location for the species in province Nord.

Considering the importance of the Mt. Panié streams and the disturbances observed, a specific study should look at the causes of river siltation and eutrophication; this would also support the management efforts of the buffer zone of the lagoon world heritage site. Forest resilience and recovery processes should be better characterized to inform forest restoration programs. A study on the impacts of invasive species would help to identify critical conservation needs and adaptive indicators for monitoring and evaluation.

A corridor approach coupled with a forest cover change study and an analysis of bushfire regimes would facilitate

prioritization of conservation efforts. A cultural approach is also relevant and important: the Mt. Panié reserve contains numerous vestiges of human occupation and a large number of plants hold a name in the local languages; several tales and stories are bound to particular places. Their consideration will contribute to appropriation of the project by local communities.

Long-term monitoring

Some indicators related to important species/habitats and environmental pressures (bushfires, invasive species, climate change, etc.) should be monitored over the long-term in order to assess overall management effectiveness.

Threat mitigation

Efforts to control fires should be strengthened, as fires still affect critical forest, erosion-prone areas and watersheds for provision of drinking water. Dayu Biik and Province nord awareness campaigns have contributed to a reduction in fires, but effective coordination between stakeholders should be set up, with specific and innovative resources, including reforestation activities and invasive species control. Invasive Rusa deer impacts, although still insufficiently characterized, are important and increasing and thus need to be controlled. Invasive rats and cats are also considered as major pressures on the island's ecosystems and should be experimentally controlled on Mt. Panié. Invasive species are likely to have contributed to the decline of the Crow honeyeater. La Guen is a particularly rich site for all the taxonomic groups studied. Considering this characteristic, as well as the availability of potential lodging facilities for researchers at the site, we recommend implementing a multipest control program here.

Protected Area extension

An extension of the Mt. Panié reserve northward, incorporating the sites of Wewec and Dawenia, would be justified due to the richness and uniqueness of the second site and the vegetation dynamics and cultural heritage of the first. In dialogue with relevant stakeholders, such an extension would improve management for a large portion of the Mt. Panié forest block. Because of its uniqueness, vulnerability, cultural importance, stunning landscape and ecotourism potential, we strongly recommend establishing a protected area at Roches de la Ouaième.