

Attempting the Eradication of *Miconia calvescens* in a Comprehensive Strategy to Control Invasive Species in New Caledonia

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Abstract

New Caledonia is recognized as a biodiversity hotspot in the Pacific region because of its rich and unique fauna and flora, which have been shaped by a peculiar geological history. This biota is under numerous and increasing anthropogenic pressures, one of which is invasive alien species. In 2004, a “New Caledonian Invasive Species Group” composed of representatives of the central Government, the three Provinces, and research and management bodies was created. In 2005, an international scientific panel on biological invasions in New Caledonia was commissioned to assess the scope of the current situation. At the same time, an action plan to control the small tree *Miconia calvescens* was set up following a field review conducted in 2005. Indeed, this species, introduced in a private botanical garden near Nouméa (Province Sud) in the 1970s, has started to invade the surrounding valleys and is considered a major and serious threat to New Caledonian rainforests. Because there was only a single population known and it was located in a small restricted area (144 ha, at 100-640 m elev.), with a low density of mature plants, an eradication program was set up. More than 165,000 plants were removed during 2006-2009, including 590 mature and juvenile trees in 2009. The *Miconia* Action Plan is included in a larger invasive species management program in New Caledonia that develops awareness campaigns, staff training, new regulations and risk assessments.

Introduction: The Geographical and Ecological Context of New Caledonia

New Caledonia is located in the Southwest Pacific, about 1,200 km east of Australia and 1,500 km northwest of New Zealand. This French overseas territory is formed by three politically autonomous regions: Province Nord and Province Sud on Grande Terre and the Loyalty Islands (Figure 1), with an overall population of about 246,000 people (2007 census). Grande Terre is a large (18,575 km²) continental island, 400 km long and 70 km wide, which separated from Australia about 65 million years ago and drifted to its current position. During the Tertiary Age, submersion episodes occurred and ultramafic/ultrabasic rocks were subducted on top of Grande Terre. Serpentine ultramafic soils (very poor in mineral elements such as N and K and with high concentration of Mg and toxic metals such as Ni, Co and Cr) now cover one-third of the land surface. A mountain range divides the Grande Terre lengthwise and its highest peak, Mount Panié, culminates at 1,628 m. Five major plant ecosystems are recognized depending on the climate, soil and topography: dense rainforests, “maquis” (a kind of scrubland growing on ultramafic soils), dry forests, wetlands and mangroves. A total of 3,261 native vascular plant species, 75% endemic, are reported (Jaffré *et al.* 2001). New Caledonia is one of the richest regions per unit area in the world for its endemic angiosperm flora (Kier *et al.* 2009). Very high rates of endemism can be found even in groups such as reptiles, insects and molluscs. Myers *et al.* (2000) have included New Caledonia on the list of the 34 biodiversity hotspots for conservation priority. The New Caledonian lagoon (24,000 km²) is the second largest in the world; two-thirds of it was designated a World Heritage Natural Site in 2008, the first in all of the French overseas territories.

Figure 1. Map of New Caledonia and its three Provinces



Invasive Species in New Caledonia: First Assessment and Inventory

The four main recognized threats to terrestrial ecosystems and biodiversity in New Caledonia are fires, the mining industry (nickel), urbanization, and invasive alien species (Pascal *et al.*, 2008). While the first three are relatively conspicuous and have been well understood as threats by politicians, NGOs and the civil society for a long time, invasive species have only been considered as a threat to economic development and to the environment for the past 10 years. The destruction of lowland dry forests by feral deer (*Cervus timorensis russa*) and of agricultural crops by feral pigs, the colonization of wetlands by aquatic weeds, and the abandonment of coffee plantations because of the little fire ant (locally called “fourmi électrique” (*Wasmannia auropunctata*)) triggered the Government and the three Provinces to set up in 2004 a “New Caledonian Invasive Species Group” formed by representatives of the Government, the three Provinces, and research and management bodies. In 2005, the group commissioned through the Institut de Recherche pour le Développement (IRD) an international scientific panel (“Expertise Collégiale”) on biological invasions (Beauvais *et al.*, 2006) in order to determine priorities and to benefit from methods and tools developed in other countries before taking action.

***Miconia calvescens* Invasion in New Caledonia**

At the same time that local authorities realised that *M. calvescens*, one of the most invasive plants in Pacific Islands, was present in New Caledonia, a field-review conducted in February 2005 revealed that the species had begun to spread aggressively in the rainforest (Meyer 2005). *M. calvescens* was introduced from Tahiti as an ornamental plant by a horticulturalist named Lucien Lavoix in his private property near the town of Nouméa (Province Sud) in the 1970s. This private botanical garden of about 800 ha was created in 1957 and is located between 500 and 700 m elevation (Table 1). The mean annual rainfall is between 1,700 and 2,000 mm and soil is developed on sedimentary rocks (Sautter 1981). Lucien Lavoix’s son,

Raymond Lavoix, wrote in the 1990s that “*the population is not very abundant and propagates very slowly*” (Meyer 1994). The *M. calvescens* population was checked in 1996 by J.-C. Pintaud, a botanist at IRD in Nouméa. He only found a single mature tree and several seedlings between 1-2 m tall, located around the mature tree, but did not survey the entire botanical garden.

In 2005, *M. calvescens* trees (up to 15 cm dbh), saplings and seedlings were observed in Lavoix’s property near roadsides, along trails, near waterfalls and rivers, and more rarely in the understory of dense rainforests characterized by a tall (15-25 m) closed canopy. *M. calvescens* was absent in adjacent *Dicranopteris linearis* fernland. A map of *M. calvescens* infested area made in 2004 by the Direction des Affaires Vétérinaires, Alimentaires et Rurales of New Caledonia estimated that *M. calvescens* was covering 120 ha and ranged between 250 and 550 m elevation. About 30 ha were considered to have a medium plant density and 1-2 ha to have a high density where *M. calvescens* was forming dense stands (Figure 2).

Because the main infestation was located far from the main roads and houses, it is probable that nobody realized the gravity of the situation until this time. The species is currently restricted to this single area, but it is possible that some *M. calvescens* plants were sold/given to people or that local inhabitants took some plants from the forest. Moreover, the invaded site is near three protected areas (Parc Provincial de la Rivière Bleue, Parc Provincial de la Thy, and Réserve Intégrale de la Montagne des Sources) and one of the largest native rainforests in the Province Sud. A predictive model shows that miconia could invade up to 25% of Grande Terre rainforests (i.e. 4,000 km²) on sedimentary soils, mainly on the rainy east coast of Province Nord (Meyer *et al.* 2006).

Action Plan to Eradicate *M. calvescens* in New Caledonia

A decision for urgent intervention was made in 2005 and an action plan for the next 10 years was developed in 2006. The plan was funded by the Province Sud, especially its Direction de l’Environnement, which is in charge of all environmental issues in this region.

The control priority was given to “adult” large trees (including reproductive plants) and to the most infested areas. Chemical control consists of Glyphosate 50% (and Triclopyr Genoxone® in 2009) sprayed on notches on the tree trunk (or directly on the bark in 2009). The “Service des milieux terrestres” staff of the Direction de l’Environnement first worked in the field with temporary young workers. In 2008 and 2009 they contracted a private company. More than 165,000 plants were removed on 144 ha (Table 1), including 590 mature and juvenile trees in 2009 (Anonymous 2010). The current *M. calvescens* distribution ranges between 100 and 640 m elevation.

A large mass media campaign on Grande Terre was launched to inform people and to help them to recognize the plant (Figure 3). Several conferences and interviews on TV were conducted. The president of the Province Nord, who went to Tahiti and was very impressed by the invasion by *M. calvescens*, is now quite aware of the situation.

Many phone calls were received, and for every call, field surveys were made by the staff to verify the species identification. None were *M. calvescens* except one reported in 2006 in Hienghène in the Mount Panié area (Province Nord) 450 km from Nouméa. It was a small plant cultivated in a woman’s yard, given to her by her sister, who found it in the forest in the only known *M. calvescens* invaded area near Nouméa.

Field surveys are still being conducted by the Direction de l'Environnement's staff to precisely determine the extent of *M. calvescens* and to make sure that no reproductive trees remain. In 2006, a regulatory text was legislated, and it is now forbidden to sell, keep, transport, import and buy *M. calvescens* in Province Sud and Province Nord.

Table 1. Results of the control efforts between 2006 and 2009

Year	2006	2007	2008	2009	Total
Treated area (ha)	1.1	1	2.07	140	144.17
Seedlings	12,819	7,000	75,219	39,342	134,380
Saplings and small trees	4,895	3,000	16,442	1,595	25,932
Large trees (including reproductive)	2,857	1,000	350	590	4,797
Total plants destroyed	20,571	11,000	92,011	41,527	165,109
Control duration (months)	4	1	3	2	10
Control team (number of people)	5	4	4	5-9	-
Cost (US\$)	30,000	20,000	80,000	38,400	168,000

Figure 2. Map of *M. calvescens* infestation site. In red: areas of high plant density; in pink: of medium or low density

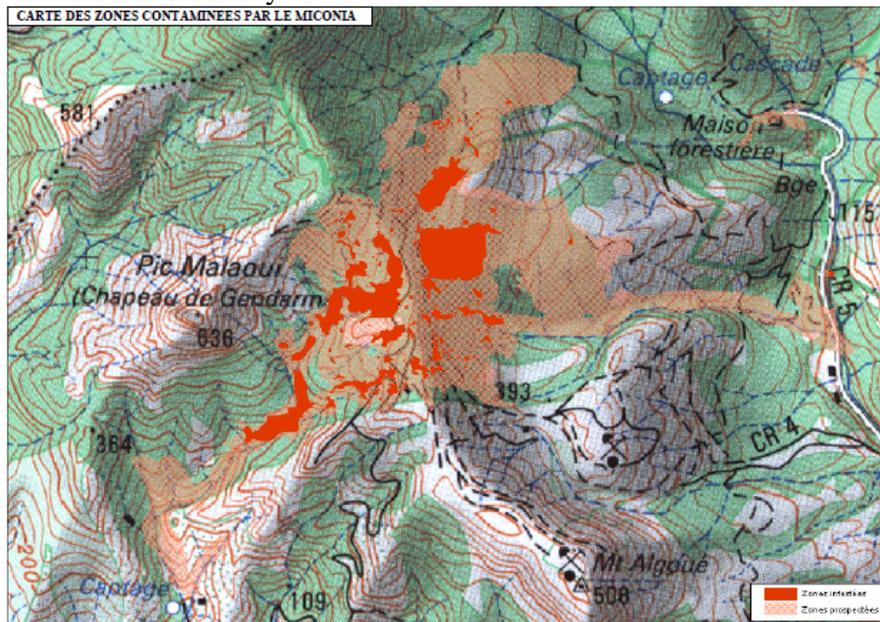


Figure 3. Flyer “Let’s get rid of miconia” published by the Province Sud.



New Regulations and Awareness Campaigns on Invasive Species

After working on the potential impacts of two major invasive species, namely *Cervus timorensis* (deer) and *M. calvescens*, the “New Caledonian Invasive Species Group” started to enlarge its action plan to other invasive species. A second regulation was adopted in 2008 by the Province Nord and in 2009 by the Province Sud, called “Code de l’Environnement” which has an entire chapter dedicated to the issues related to invasive plant and animal species (including possession and trade). People are vulnerable to expensive monetary fines and can have liability for restoring the ecosystems damaged by invasive species they have introduced.

Communication is essential to help people understand and accept the new regulations. An awareness campaign was organized for different target audiences (farmers, professionals such as horticulturalists and gardeners, schoolchildren, and people from villages and “tribes”). Involvement in regional and international collaboration programs on invasive species (“Pacific Invasives Learning Network” (PILN) and the “Pacific Invasives Initiative” (PII)) was strengthened.

A risk assessment system, as well as a surveillance and monitoring system in areas of highest risk (harbours, airports) and of great ecological value (protected areas), is being developed. The action plans set up for the management of protected areas now includes the management of invasive species.

However, the rapid detection and response system still needs to be improved and reinforced. As an example, the discovery of a cane toad (*Bufo marinus*) in February 2009 highlights the fact that constant vigilance is needed. This particular event demonstrated strengths and weaknesses in the current biosecurity system in New Caledonia.

Conclusions and Future Prospects

The positive points of *M. calvescens* control are that people at the political level are now aware of the problem and take it into consideration. There also is an increasing public awareness. From a practical point of view, there is currently only one infested site. By learning from the experience of other invaded Pacific islands, the standard control methods for *M. calvescens* in response to the plant life cycle are now known and efficiently used. It seems that the species is less invasive in New Caledonia than elsewhere, probably because it grows under a tall canopy; its growth rate seems slower and mature trees flower less frequently (once a year) than in Hawai'i or Tahiti.

However, there also are four negative points: (1) the climate is highly favourable to *M. calvescens* development; (2) the oldest mature plants are at least 10 years old and the soil seed bank may be important; (3) an extensive rainforest of great biodiversity value surrounds the infested site; and (4) frugivorous birds (such as the endemic fruit dove *Drepanoptila holosericea*, the large pigeon *Ducula goliath*, and the white-eye *Zosterops xanthochrous*) and fruit bats, all suspected of disseminating miconia seeds, are present on the site.

An applied research program to understand the capacity of adaptation of *M. calvescens* to ultramafic soils and a better knowledge of the biology of *M. calvescens* in New Caledonia (e.g. reproduction phenology) is currently conducted by IRD in Nouméa. After four years of action, *M. calvescens* eradication still appears to be a possible goal, but will be very challenging and expensive to achieve.

A *M. calvescens* control plan cannot be separated from the broad invasive species global picture: communication, staff training, regulations, risk assessments, and field surveys are essential. The dynamism initiated with the conclusions and recommendations of the international scientific panel report and the positive collaborations implemented by the "New Caledonian Invasive Species Group" should be maintained.

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