

Working towards eradication of *Miconia calvescens* and *M. nervosa* in a tropical rainforest: history, current status and future challenges

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Summary Managing field operations that are aimed at the eradication of bird dispersed species in a tropical rainforest presents a unique set of challenges. This paper discusses the infestation history, biology, field techniques, resource requirements, environmental constraints and current status of a collaborative eradication effort of two *Miconia* species at a single location in the wet tropics region of north Queensland.

Keywords Melastomataceae, survey techniques, bird dispersal.

INTRODUCTION

Miconia calvescens DC. and *Miconia nervosa* (J.E. Smith) Triana., (Melastomataceae) originate from tropical Central and South America, where they occur as early successional species inhabiting forest gaps and margins. Both species have been observed to germinate in all light levels and flower and fruit in both open and partially shaded habitats in Australia. *M. calvescens* has a reputation as an invasive weed throughout the Pacific, particularly on the Hawaiian and Tahitian Islands where it has been deemed the greatest single (plant) threat to remaining wet forest ecosystems (Medeiros *et al.* 1997, Meyer 1998). *M. nervosa* is listed as a weed in Peru (Holm *et al.* 1979). The overseas experiences with *M. calvescens* led to all *Miconia* species being declared noxious weeds in Queensland in 1997. All *Miconia* species were then declared Class 1 pests under the *Land Protection (Pest and Stock Route Management) Act 2002*.

The program The Four Tropical Weeds Eradication Program (4TWP) commenced in late 2001. The program is nationally cost-shared, with the Department of Primary Industries and Fisheries, Biosecurity Queensland (DPI&F) the lead agency. The program targets six species from four genera (*Miconia*, *Clidemia*, *Mikania* and *Limnocharis*). A single infestation of *Miconia racemosa* (Aubl.) DC. is also included in the 4TWP. This paper focuses on two species in this program, *M. calvescens* and *M. nervosa*, which co-occur in the Whyanbeel Valley in far north Queensland. This is the only known occurrence of *M. nervosa* in Australia. *M. calvescens* was first introduced into Australia in the

1960s and as of July 2007, 37 infestations are being managed by the 4TWP.

Location Whyanbeel (16°22'S, 145°19'E) is located 15 km north west of Mossman, Queensland and is in the traditional lands of the Kuku Yalanji. The area is in the Wet Tropics Bioregion and borders the Daintree National Park, which is part of the Wet Tropics World Heritage Area. The valley (elevation 60 to 250 m) averages 3000 mm or more of rainfall per year. The major land use is lifestyle and horticultural ventures, with a small contingent of specialist organic growers of tropical fruit and produce.

Infestation history *M. calvescens* was reported to authorities in 1996 by a landholder who had previously introduced a single plant in the 1980s as part of a botanical collection. Further landholder concerns and the collection of herbarium specimens by local government officers (1999) led to limited annual survey and control by officers from the Statewide Weed Extension and Eradication Program (SWEEP). Designated 4TWP staff commenced further survey and control activities in 2003. *M. nervosa* also originated from a single cultivated specimen on the same property that was discovered during control of *M. calvescens* in 2004.

Dispersal and recruitment The propagation of the highly attractive *M. calvescens* led to its spread to new locations in Australia by plant enthusiasts. The genus is primarily bird dispersed in its native and invasive range. Most seedling recruitment occurs within 50 to 100 m of mature plants (Murphy *et al.* in press). However, the longest dispersal distance from the origin of the infestation to date is 880 m (*M. calvescens*) and 496 m (*M. nervosa*).

Survey techniques and strategies All survey at Whyanbeel is conducted on foot. Typically, new survey areas are first investigated along creeks and ravines. Boundaries are defined by establishing tracks along corresponding ridges. Core areas are clearly defined by access tracks, ridgelines and watercourses,

with superficial tracks established on smaller grids to access all of the treatment area. Systematic survey is conducted by operators evenly spaced along contours. Communications are maintained via UHF radio. Operators at either end of the line steer the survey using flagged tracks, creek lines or compass bearings as boundaries. String lines are used in dense vegetation in order to mark boundaries of consecutive survey runs. Due to the topography and density of the vegetation this is often at a pace of $<100 \text{ m h}^{-1}$.

Survey strategies utilised for *Miconia* spp. can be defined as 'core' and 'satellite'. Both survey strategies are initially defined by a buffer of 500 m, while current satellite search efforts often exceed 1000 m from a source. Search radii from point of origin are based on research on dispersal of similar sized fruits (i.e. functional groups) of native rainforest species within a rainforest landscape (Westcott and Dennis 2006). Core surveys radiate out from the location of reproductive individuals. These identify the immediate and frontal dispersal from areas of high density recruitment. Satellite search efforts concentrate on establishing spread of the outlier component of the population and aim to detect and control seedlings before new core areas are established.

Aerial detection of *M. calvescens* is possible when the canopy cover has been dramatically opened, for example by cyclones. Aerial reconnaissance may also provide valuable field information on topography and assist by identifying appropriate access into the area.

Treatment Manual removal is the primary treatment method for both species, with herbicide used on cut stumps of larger *M. calvescens* trees. Seedlings are tied with flagging tape in an exposed location away from the forest floor to desiccate. This creates a visual marker that acts as a reference on subsequent control runs, treats the plant entirely *in situ* (only reproductive material is removed from the infestation) and reduces the time and effort required to carry all plant material out of the forest.

The frequency of revisits aligns with the minimum time from seedling to reproductive adult for each species (S. Brooks pers. comm.). Revisit timelines for *M. calvescens* and *M. nervosa* are six and three months respectively. Prescribed revisit timelines allow six (*M. calvescens*) and four (*M. nervosa*) opportunities to detect plants before maturation. Due to the density of the vegetation and other environmental factors, these timelines account for a degree of human error by presuming a percentage of plants can remain cryptic and go undetected over several surveys.

Data collection Data collection has evolved with the program over the past five years. Initial records of infestations consisted of GPS locations and field notes. Data collected now exceeds the national data collection/mapping guidelines (McNaught *et al.* 2006) and is entered into the Tropical Weed Eradication (TWE) database linked to GIS.

Operational challenges There are many challenges when conducting an eradication campaign in a tropical rainforest landscape. Steep slopes, high rainfall, sheer ravines and dense vegetation hamper the efforts of staff on ground. Hazards such as slips and falls, sharp tools, stinging trees, snakes, pigs, ticks, leeches, scrub itch and pathogens (e.g. *Leptospirosis*) must be managed in order for staff to operate safely and effectively. The work is very physically demanding and retaining skilled staff to operate in these conditions is a big challenge.

Collaborations Key collaborators in the program at this location include the Douglas Shire Council, CSIRO, Natural Resources and Water, Queensland Parks and Wildlife Service (QPWS) and landholders.

Initiated in 2006 and coinciding with National Weebuster Week, the Melastome Task Force (MTF) is an annual collaborative control and data capture operation between DPI&F and CSIRO. The taskforce introduces key stakeholders to the identification, survey and control of the 4TWP's target species. Intensive survey and data collection are conducted with human resources four to five times that of normal operations. All *Miconia* spp. detected are controlled, mapped, measured (basal diameter and height) and sampled in order to determine genetic relationships within and between infestations. Genetic and spatial analysis may provide information on dispersal and recruitment and is assisting in refining models that inform where to focus survey effort and eradication efforts.

A mail out is conducted annually as part of the MTF. Information on key operational dates and extension material on the identification of both species are forwarded to affected landholders, who are also personally contacted to promote awareness and foster partnerships.

Weed spread prevention The potential spread of *Miconia* spp. both within the infestation and beyond is managed on a variety of levels. Vehicles do not enter the infestation. Survey works are conducted from areas of absence to high density to reduce the risk of spread of seed and vegetative material into non-infested areas.

Footwear and equipment are cleaned down at a designated location on exiting the infestation. Portable boot wash kits are carried in field back packs for weed seed hygiene after working in an area with a high density seed bank. Hygiene extends to vehicle wash downs to reduce the spread of localised weeds, e.g. *Brillantaisia lamium* (Nees) Benth., (Acanthaceae).

Current status Both species are currently in an active control phase as described in relation to the extirpation criterion in Panetta (2007), with control operations removing seedlings to run down the soil seed bank. The operational focus of the program has alternated between ensuring zero reproductive events in the core area and conducting systematic extended survey to establish presence/absence of satellites. This has been a key component of detecting reproductive outliers of the infestation and incorporating them into the management regimes of the core treatment area. To date this strategy has identified four new mature populations of *M. calvescens* and three of *M. nervosa*. (Mature populations have typically consisted of more than one reproductive individual.)

Since 2004 approximately 200 ha have been surveyed for both species. The current control area (area of active recruitment) for *M. calvescens* is 4.1 ha and for *M. nervosa* is 1 ha. The total number of recorded plants controlled is listed in Table 1.

Future directions On ground survey and control efforts are regularly reviewed. Development and implementation of property pest management plans for stakeholders are assisting to clearly define resource requirements and management objectives.

Research is investigating seed bank depletion, modelling of dispersal and recruitment patterns and the genetic structure of populations. Dialogue between control operators and field researchers will continue to be pivotal in refining field techniques and strategies. Determining rather than presuming the absence of satellites through targeted and methodical survey, supported by maintaining and improving core treatment strategies, will continue to be the focus of the program.

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Table 1. Control data since 2004 (source TWE database).

	<i>M. calvescens</i>		<i>M. nervosa</i>	
	mature	seedling	mature	seedling
2004 ^A	5	200+	–	–
2005	8	1,588	11	264
2006	2	996	6	695
2007 ^B	4	1,007	4	1,152

^Ano records prior to 2004.

^Bcomplete to October 2007.

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