

Progress towards the eradication of *Miconia nervosa* and *Miconia racemosa* from Australia.

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Summary The frugivore dispersed, rainforest shrubs *Miconia nervosa* and *Miconia racemosa* are each known at single locations in North Queensland and are targets of the nationally cost-shared tropical weed eradication program. Data on the progress towards eradication is presented for these persistent shrubs in complex rainforest vegetation.

Keywords tropics, eradication, rainforest, *Miconia*, delimitation, extirpation.

INTRODUCTION

The National Tropical Weeds Eradication Program (NTWEP) is a national cost-shared program which includes single infestations of *Miconia nervosa* (SM.) Triana, and *Miconia racemosa* (Aubl.) DC. These two *Miconia* species are invasive, shade tolerant, frugivore dispersed shrubs and occur in complex tropical rainforest vegetation. The infestation of *M. racemosa* is on the northern side of Kuranda in the Wet Tropics of Queensland. It was identified in 2002 and partly overlaps with a large *Miconia calvescens* DC. infestation around Kuranda, this tree is also a target of NTWEP (Brooks and Erbacher 2022). The *M. nervosa* infestation was identified in 2004 in the Whyanbeel Valley in the Wet Tropics of Queensland, this infestation is surrounded by a large *M. calvescens* infestation (Whyanbeel) (Brooks and Erbacher 2022, Jeffery and Brooks 2016). The *M. nervosa* infestation occurs on private land and the Daintree National Park. The single infestations of *M. racemosa* and *M. nervosa* in Queensland are their only known occurrences outside of their native ranges in Central and South America.

The NTWEP also targets multiple infestations of *Limncharis flava* (L.) Buchenau and *Mikania micrantha* Kunth. Reporting processes and progress summaries were documented for the three NTWEP target weeds at multiple infestations (Brooks and Jeffery 2018, Brooks and Erbacher 2022 and Brooks *et al.* 2022). The historical and practical field aspects of *M. racemosa* and *M. nervosa* infestations, and measures of eradication progress, were presented by Brooks *et al.* (2009). Subsequent changes in the

NTWEP are documented in internal reports or presentations and updates to *M. nervosa* and *M. racemosa* eradication progress data follow below.

ERADICATION FIELD METHODS

Field crews concurrently survey and control plants in private gardens and intact forest types around 400 m from waypoints known or suspected to have had at least one mature plant recorded. Different portions of infestations are surveyed on different days or months, but usually all areas are covered twice annually. Intervals below a year allow opportunities to detect a small proportion of fast-growing plants before they mature. Maturity size and seasonality is an area of ongoing field and glasshouse research which includes field crews recording basal diameters and heights of large plants with and without reproductive material present. Field surveys are conducted by Biosecurity Queensland staff, with in-kind support from local governments and Queensland Parks and Wildlife Service.

ERADICATION REPORTING METHODS

Weed presence or absence is derived from field data collected at waypoints within infestations. For the purposes of program reporting, site records (waypoints) are aggregated into static one-hectare cells (100 m x 100 m), generated as a 'grid layer' across each infestation. These cells are used in NTWEP reporting as a 'management area' and are not survey units. From 2010, eradication progress reporting changed from an infestation-based system (Brooks *et al.* 2009) to the grid-based system of management areas. Field data collected from 2002 to 2010 was re-analyzed on the finer reporting scale. The management area system allows all program reporting to be spatially consistent over time.

Every six months, point records are summarized to allocate a 'control phase' status where plants are present, or 'monitoring phase' status where plants are absent for each management area. Management areas only enter a monitoring phase when absence data is recorded in the last 2 x 6-month periods; progression is via evidence of absence. The time that

management areas have been in the monitoring phase is categorised to an annual value of ‘years in monitoring phase’.

If plants are recorded in a management area which is in the monitoring phase, then it reverts to a control phase, for a minimum of 12 months. The number of years of monitoring before a reversion is tallied to determine ‘monitoring reversion’ data. Management areas that do not have a visit recorded in the previous 6 months default to the control or monitoring status that they were in the previous reporting period. The status of management areas remains in control phase (default) until there are absence records, but years in monitoring phase can accrue between visits. The allocation to control and years in monitoring status is updated every 6 months.

NTWEP has used the ‘time since last reproduction’ as a measure of eradication progress (Brooks and Jeffery 2018). This measure is less relevant and consistent for single infestations with frugivore dispersed seeds and is not presented. The reporting focusses on seed production events (reproductive escapes) in known management areas. Mature plants can have fruit or flowers present or be larger plants that may have previously reproduced.

Analysis of progress towards eradication data is updated every six months. The data presented are to the end of June 2025 and examples from this analysis may be used for reporting to cost-share partners at the end of each financial year.

ADDITIONAL SPATIAL ANALYSIS

Management areas that are not in the previous six-monthly reporting are new and are categorised by the distance to management areas or points discovered (known) in an earlier financial year. The categories are, sharing a boundary or corner with a known management area, less than 200 m away from a previously known point but not adjacent to a known management area, and 200 to 500 m away from a known point. Additional categories are 500 to 1000 m away, more than 1000 m, and new infestations more than 2000 m away from a known point. The later categories (500 m+) are not currently applicable to single infestations of *M. racemosa* and *M. nervosa*.

Table 1. Counts of new management areas categorised by the relative location to known points from previous financial years.

Category	<i>Miconia nervosa</i>	<i>Miconia racemosa</i>
Share boundary	42	42
Less than 200 m	3	3
200 to 500 m	6	9

TRENDS IN MANAGEMENT AREA DATA

Discovery To June 2025 there were 56 *M. nervosa* and 64 *M. racemosa* management areas, the six-monthly discovery of management areas are shown in Figure 1. The gradual accrual of new management areas in Figure 1 is primarily from local recruitment in adjacent management areas (Table 1), and all are within 500 m of known management areas. An additional 10 *M. racemosa* and 5 *M. nervosa* management areas were identified on discovery in 2002 and 2004 respectively and formed the new infestations which are not shown in Table 1.

Control phase is the 0 years monitoring in Table 2. Control phase results from new management areas (Figure 1) that are active for at least a year, management areas with longer term continuous presence records and reversions from the monitoring phase. To June 2025, 57.1% of *M. nervosa* and 45.3% of *M. racemosa* management areas were in the control phase (Table 2).

Table 2. Summary of years in monitoring phase for *Miconia nervosa* and *Miconia racemosa* management areas as of June 2025.

Years	<i>Miconia nervosa</i>	<i>Miconia racemosa</i>
0	32	29
1	7	8
2	1	2
3	8	5
4	1	0
5	1	1
6	2	1
7	1	1
8	0	0
9	0	0
10	0	2
11	0	6
12	0	6
13	0	1
14	0	2
Total	56	64

Monitoring phase The data in Tables 1 and 2 and Figure 1 could only be analysed after management areas became the reporting scale, and allocation to monitoring status is evident in Figure 1 a and b from 2011 onwards. The 1+ years in monitoring in Table 2 result from progression through absence, and continued absence records. A 5-year rolling mean of % management areas in monitoring (not shown) is an annual key performance indicator. Progression to monitoring for both *Miconia* shrubs are routinely offset by reversions. The monitoring profile for *M. nervosa* in Table 2 is not advanced enough to

consider eradication declaration criteria related to reversion and seed longevity.

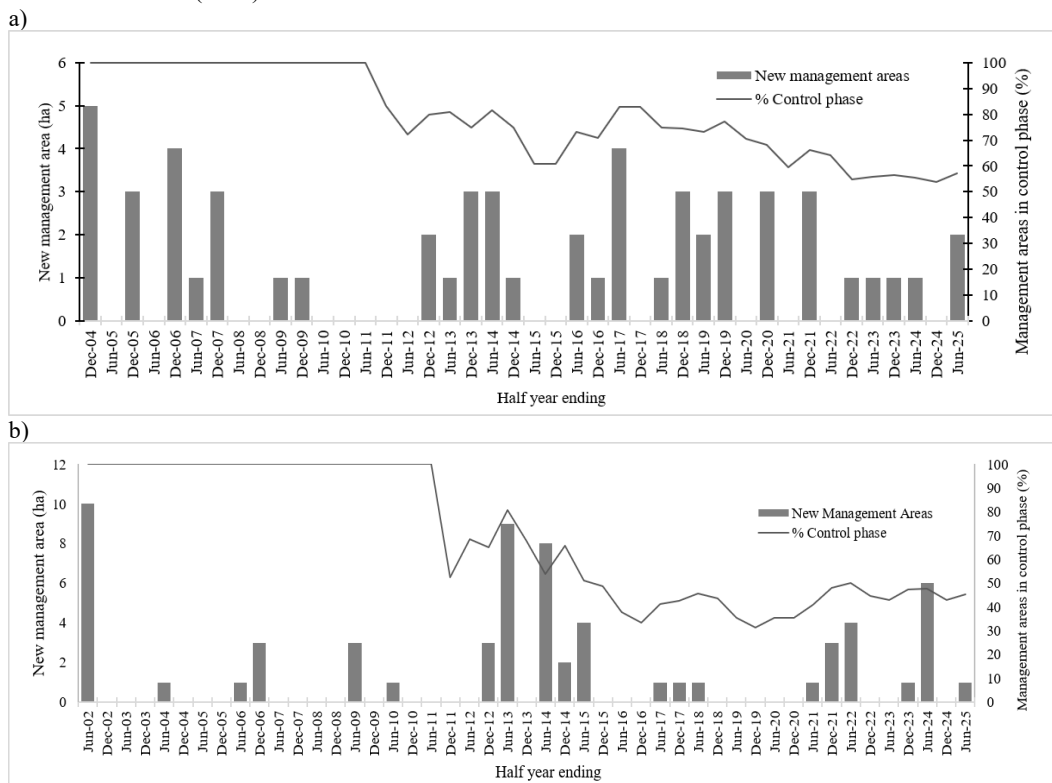
The *M. racemosa* control phase percentage (Table 2) reflect the intermittent discoveries (Figure 1), long-term seed bank persistence and reversions to control phase from monitoring (six in the six months to June 2025).

Reproduction Research and field crew data show that both shrubs form persistent soil seed banks and can mature in approximately a year. Both infestations also have persistent long-term active (control) management areas. Particularly in the *M. nervosa* infestation this is driven by a high and variable rate of reproductive relapses in known management areas (Figure 2a). There was an improvement between

2019 and 2023 with a greater search frequency and closer survey lines, but this is resource intensive in a challenging labour market. With *M. nervosa* plants often found with no reproduction evident, the guidance on the size and seasonality of potentially mature plants is less clear and many are included in the program reporting and survey calculations on suspicion. The 5-year rolling mean for reproductive relapses (Figure 2) is an annual key performance indicator, this data is also used in annual reports.

Reproductive relapses for *M. racemosa* have been zero or one for nine of the last ten financial years (Figure 2b). These can also suppress management areas progressing to monitoring.

Figure 1. Management area discovery and percentage control phase for a *Miconia nervosa* (n=56) and b *Miconia racemosa* (n=63). Note x - axis scales are different.



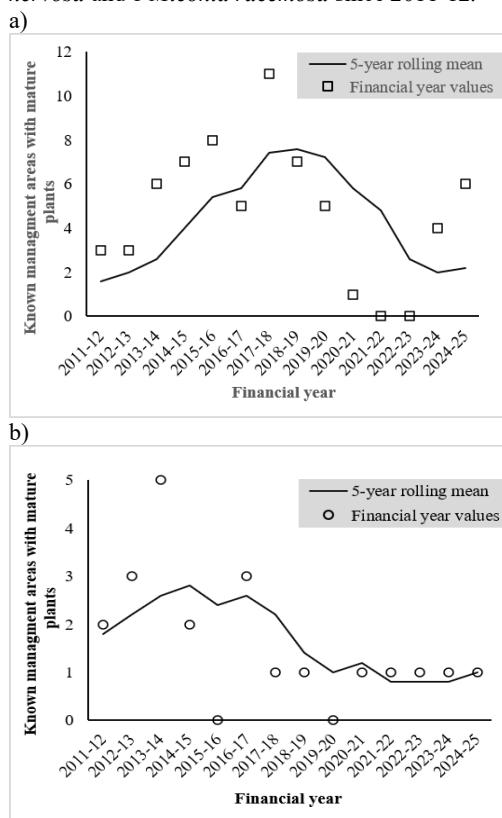
DISCUSSION

Eradication The discovery of new management areas close to known ones and broader areas of overlapping, lower frequency searches for *M. calvenscens* by the same field crews all increase confidence in the extent of both infestations. Table 1 provides a better general indication of infestation delimitation than the area analysis in Brooks *et al.*

(2009). After 2010, the management area also allows for consistent and detailed tracking of control and monitoring phases within single infestations. Monitoring profile data (Table 2) is used to draw a last detection histogram (Brooks *et al.* 2022) and provide a spatially and temporally consistent measure of extirpation, without relying on reporting variable annual populations (Brooks *et al.* 2009).

Higher frequencies of reproductive relapses can be addressed with greater search extents, frequency or accuracy. Assuming effective control measures and fewer issues with the extent of searches for both species, the frequency and accuracy of searches need to be analyzed. Research is planned on detection rates by field crew ground surveys. Shade tolerant, *Miconia* shrubs in the rainforest understory are not detectable from aerial platforms.

Figure 2. Counts and 5-year rolling mean of known management areas with mature plants a *Miconia nervosa* and b *Miconia racemosa* since 2011-12.



Four eradication criteria were foreshadowed for the other NTWEP target weeds by Brooks and Jefferey (2018), Brooks and Erbacher (2022) and Brooks *et al.* (2022). The initial criterion of reversion to control phase rates has been constructed for *M. racemosa* and *M. nervosa* using a small sample size and are not presented. The second criterion relies on estimates of an appropriate 'time since last reproduction or discovery'. This is currently less applicable to *M. racemosa* and *M. nervosa*, as seed input events (Figure 2), and ongoing seed longevity research make partitioning seed bank effects difficult. Particularly for *M. nervosa* which has the

highest percentage of 'control phase' management areas and seed relapse events of the five NTWEP target weeds. Further proposed spatial and search criteria are also less applicable to the smaller single infestations of both *Miconia* shrubs. Many control phase management areas adjoin the areas in longer term monitoring. As management areas are not survey units there are no current opportunities to reduce survey extent or frequency to longer term *M. racemosa* areas in monitoring. The application of eradication criteria being developed for the multi-infestation NTWEP targets are less suitable for the more active single infestations of *Miconia* shrubs.

The processing of eradication progress data is similar for all NTWEP targets, and it is desirable to use the reporting data for the five weeds similarly. However, this is problematic for the less advanced monitoring profiles of both *Miconia* shrubs and with ongoing longevity and maturity research.

Summary Compared to the multi-infestation target weeds in the NTWEP, the progress towards eradication of both *Miconia* shrubs is impeded by higher proportions of active control areas, the re-occurrence of plants in areas from which they were previously absent, and post-discovery seed input events. The management area scale used by NTWEP since 2010 provide better measures of delimitation and extirpation within single infestations. However, finding the *Miconia* shrubs in dense tropical rainforests and permanently removing them will be a long-term endeavour, but bring permanent environmental benefits to rare native understory plants in the Wet Tropics World Heritage rainforest.

ACKNOWLEDGMENTS

We are grateful to all NTWEP field officers, Local Government and Queensland Parks and Wildlife Service (QPWS) officers for their efforts in the field.

REFERENCES

- Brooks, S.J., Erbacher, K. and Maher, J. (2022). Progress in the eradication of *Limnocharis flava* from Australia. Proceedings of the 22nd Australasian Weeds Conference, pp. 262-65.
- Brooks, S.J. and Erbacher, K. (2022). Progress in the eradication of *Miconia calvescens* from Australia. Proceedings of the 22nd Australasian Weeds Conference, pp. 63-66.
- Brooks, S.J. and Jefferey, M. (2018). Progress in the eradication of *Mikania micrantha* from Australia. Proceedings of the 21st Australasian Weeds Conference, pp 350-3.
- Brooks, S.J., Panetta, F. D. and Sydes, T. A. (2009). Progress towards the eradication of three melastome shrub species from northern

Australian rainforests. *Plant Protection Quarterly* 24, 72-8.

Jeffery, M. and Brooks, S.J. (2016). Eradication in the tropics: constantly changing and adapting.

Proceedings of the 20th Australasian Weeds Conference, pp. 23-7.