WEEDS OF
NATIONAL SIGNIFICANCE

Madeira Vine

(*Anredera cordifolia*)

Strategic Plan
2012 to 2017

ISBN: 978-0-9803249-6-9

Supporting information about the Australian Weeds Strategy, Weeds of National Significance and progress to date may be found at www.weeds.org.au**,** where links and downloads provide contact details for all species, their management committees and copies of the strategy.

This strategy was developed under the leadership of the National Madeira Vine and Cat's Claw Creeper Coordinator, Biosecurity Queensland, Department of Agriculture, Fisheries and Forestry QLD, with full cooperation of all the States, Territories and Commonwealth of Australia.

Comments and constructive criticism are welcomed as an aid to improving the process and future revisions of this strategy.

Published by: Australian Weeds Committee, Canberra

For further information contact:
Secretariat
Australian Weeds Committee
[*Insert contact details of AWC*]

Publication date: March 2013

Preferred way to cite this publication:

Australian Weeds Committee (2013) *Weeds of National Significance, Draft Madeira Vine Strategic Plan.* Australian Weeds Committee, Canberra*.*

Cover design by: TBA

Cover image: Madeira vine inflorescence, Sheldon Navie.

CONTENTS

EXECUTIVE SUMMARY

Madeira vine (*Anredera cordifolia*) is one of Australia's worst environmental weeds and in 2012 it was listed as a Weed of National Significance. It is particularly abundant in the biodiverse coastal and hinterland regions between central Queensland and central New South Wales; however it has the potential to spread elsewhere, with naturalised populations in all States and Territories other than the Northern Territory. When growing in favourable conditions, Madeira vine can smother and collapse native vegetation. Habitats most at risk are riparian and rainforest environments, including a number of endangered coastal and forest ecosystems.

Madeira vine was introduced from South America as a garden ornamental. Naturalised populations have been recorded from as early as the 1880s and the species was first declared in NSW in the 1920s. Although no longer part of the nursery trade, it is widespread in urban, peri-urban and rural areas and continues to invade bushland. Dispersal is primarily via tubers, which either fall to the ground or are carried by flowing water or as contaminants of green waste. Tubers can remain viable for up to 15 years and have viability rates of up to 70 per cent.

This document provides a strategic framework to reduce the spread and impacts of Madeira vine throughout Australia. Nationally coordinated implementation of this plan will ensure better protection of priority assets by providing tools and information, identifying management priorities, and fostering partnerships that lead to more strategic, collaborative management.

The Strategic Plan aspires to deliver the following Goals and Objectives:

Goal 1. New infestations of Madeira vine are prevented from establishing:

1. Invasion vectors, sources and pathways are identified and managed to prevent or reduce spread
2. Surveillance and response mechanisms are ensuring timely detection of infestations
3. Priority outlier infestations are contained or eradicated, and spread from core infestations is prevented

Goal 2. Existing infestations of Madeira vine are under strategic management:

1. Priority assets are benefitting from long term strategic weed control programs
2. Integrated weed management practices are improving natural resource condition

Goal 3. Capability and willingness to manage Madeira vine is increased

1. Infestations are mapped to national standards and to a level sufficient to inform decision making
2. Best practice management delivers efficient, effective and long-term control of Madeira vine
3. Capability and motivation to manage Madeira vine is enhanced by education and awareness
4. Research priorities for Madeira vine are identified, promoted, addressed and informing management
5. Local to national planning incorporates strategic Madeira vine priorities
6. Appropriate policies, codes of practice, legislation and enforcement are supporting strategic management objectives
7. Stakeholders are committed to the implementation of the Strategic Plan
8. The National Strategic Plan is relevant and effective.

This plan complements the Australian Weeds Strategy. Both documents are aspirational and do not specifically address resource requirements. However, the plan fosters a shared approach, and identifies efficiencies and collaborative actions that will help ensure existing resources can be allocated to achieve improved, strategic management outcomes. The plan outlines measurable, targeted actions to allow progress towards the objectives over the next 5 years.

Vision / Aspirational Goal

The spread of Madeira vine is contained and Australia's valuable natural assets are protected from its impacts for the benefit of current and future generations.

1 THE CHALLENGE

Madeira vine (*Anredera cordifolia*), also known as 'lamb's tail vine' or 'mignonette vine', is a semi-succulent climbing vine from South America. It is a serious environmental threat in Australia because of its wide distribution, capacity to degrade native forests and the difficulties associated with its management.

Madeira vine typically invades riparian vegetation, the edges of rainforests, tall open forests and mesic (damp) sclerophyll forests (Csurhes & Edwards 1998). In Australia it is traditionally considered a tropical and subtropical species, however its world-wide distribution also includes mild temperate climates (Vivian-Smith et al. 2007) and climatic tolerance models suggest that it has a high potential for spread (refer to section 6.3). Current populations of Madeira vine are most highly concentrated in coastal and hinterland regions of central and northern New South Wales and South East Queensland (Figure 1). However its distribution extends as far north as the Atherton Tablelands in Queensland and as far south and west as Eden and Albury in New South Wales. It has also naturalised in Victoria, Tasmania, South Australia and Western Australia where isolated populations are expanding (Vivian-Smith et al. 2007).

Canopy-dominant weeds (such as Madeira vine) are among the most serious of the environmental weeds because their invasion has led to significant structural changes in Australian ecosystems (Swarbrick 1991). Based on an assessment of invasiveness and impact, Madeira vine was ranked 5th out of1060 naturalised plant species in south-east Queensland (Batianoff & Butler 2002); and was ranked as the worst environmental weed affecting biodiversity in NSW (Downey et al. 2010). It is one of the key species included in the NSW exotic vines and scramblers key threatening process listing (NSW Environment and Heritage 2006) and threatens a number of endangered ecological communities listed under the NSW *Threatened Species Conservation Act 1995.*

Management of Madeira vine is challenging. It is prevalent in many urban areas, where spread through improper green waste management is a problem. Control options are limited – only a few herbicides are effective and these are expensive and labour intensive to apply. Physical removal of the plant often causes fragmentation and further spread of the reproductive tubers and stem fragments. Despite these issues, there are good opportunities for strategic management of Madeira vine in Australia. There are numerous community and local government groups actively working to control the spread and impact of this weed and because long distance spread is predominantly human-mediated, the potential for national-scale containment is good.

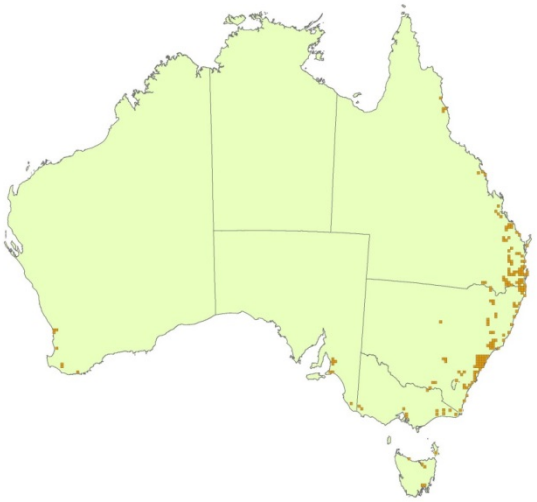


Figure 1. *Distribution of known Madeira vine infestations (2013).*
Note: Madeira vine is also present on Lord Howe Island.

2 INTRODUCTION

This strategic plan is specific to Madeira vine; however, many of the actions and management needs are common to a range of invasive vines and scramblers. These species have similar impacts, invasion dynamics and research needs and there are efficiencies to be gained through a collaborative approach to strategic management. Consequently, the strategic plans for cat's claw creeper (*Dolichandra unguis-cati*) and the *Asparagus* spp., which were also listed as WoNS in 2012, were developed in conjunction to achieve synergies across common actions. National coordination of these WoNS is expected to provide broader benefits for the management of other invasive vines and scramblers.

2.1 Principles underpinning the plan

This plan provides an overarching framework for the management of Madeira vine in Australia. Although it is considered to be an 'aspirational' strategy, all objectives and actions have been carefully vetted to ensure they are both reasonable and achievable given the five-year timeframe. However, this is a collaborative plan and the active involvement of all stakeholders, at all levels (national, state, regional and local) is necessary to ensure success.

While the plan is national in scale, regional benefits are expected through a range of outcomes including increased community awareness and knowledge, spread prevention or the protection of priority assets that are valuable to the national and local community. The fine detail of local and regional cat's claw creeper management cannot be captured here but this should not preclude or dissuade groups from planning and undertaking management actions at a more local scale for regional benefit.

In addition, this plan recognises that cat's claw creeper management alone will rarely, if ever, result in ecosystem recovery and it is important that site management plans are designed and delivered in an holistic manner, with the emphasis on site recovery rather than weed removal alone.

The WoNS Program

The Weeds of National Significance (WoNS) Strategic Plans provide a framework for the coordinated management of the 32 Weeds of National Significance. These plans represent the shared vision of all States/Territories and the Australian Government and form a critical component of the national weed management effort.

The WoNS program establishes national priorities and facilitates action where there is a significant national or cross-jurisdictional benefit to be gained. These strategic plans do not specifically address resourcing; however, they aim to identify efficiencies and ensure existing resources can be allocated to achieve the most strategic management outcomes.

The WoNS Strategic Plans are based on the recognition and acceptance of seven principles outlined in the Australian Weeds Strategy (Natural Resource Management Ministerial Council 2006):

1. Weed management is an essential and integral part of the sustainable management of natural resources for the benefit of the economy, the environment, human health and amenity.

2. Combating weed problems is a shared responsibility that requires all parties to have a clear understanding of their roles.

3. Good science underpins the effective development, monitoring and review of weed management strategies.

4. Prioritisation of and investment in weed management must be informed by a risk management approach.

5. Prevention and early intervention are the most cost-effective techniques for managing weeds.

6. Weed management requires coordination among all levels of government in partnership with industry, land and water managers and the community regardless of tenure.

7. Building capacity across government, industry, land and water managers and the community is fundamental to effective weed management.

In addition to the AWS, WoNS strategic plans are also aligned to the 2012 Intergovernmental Agreement on Biosecurity (IGAB; COAG 2012), which outlines national invasive species management objectives. IGAB aims to enhance Australia's biosecurity system by fostering a collaborative approach to minimise the impact of pests across the biosecurity continuum, including 'a national management framework to ensure that nationally significant pests and diseases established in Australia are contained, suppressed or otherwise managed.' WoNS can contribute to this aim by facilitating coordinated, strategic management of nationally significant weeds.

IGAB principles highlight the importance of managing invasive species across the biosecurity continuum. The 'One Biosecurity' report (Beale et al. 2008) also recognises that weeds and other invasive species are biosecurity threats that are most effectively managed in a collaborative manner across this continuum. This includes a 'spatial continuum' of pre-border, border and post-border, as well as a 'management continuum' that spans prevention, eradication, containment and asset protection, depending on the scale of weed invasion.

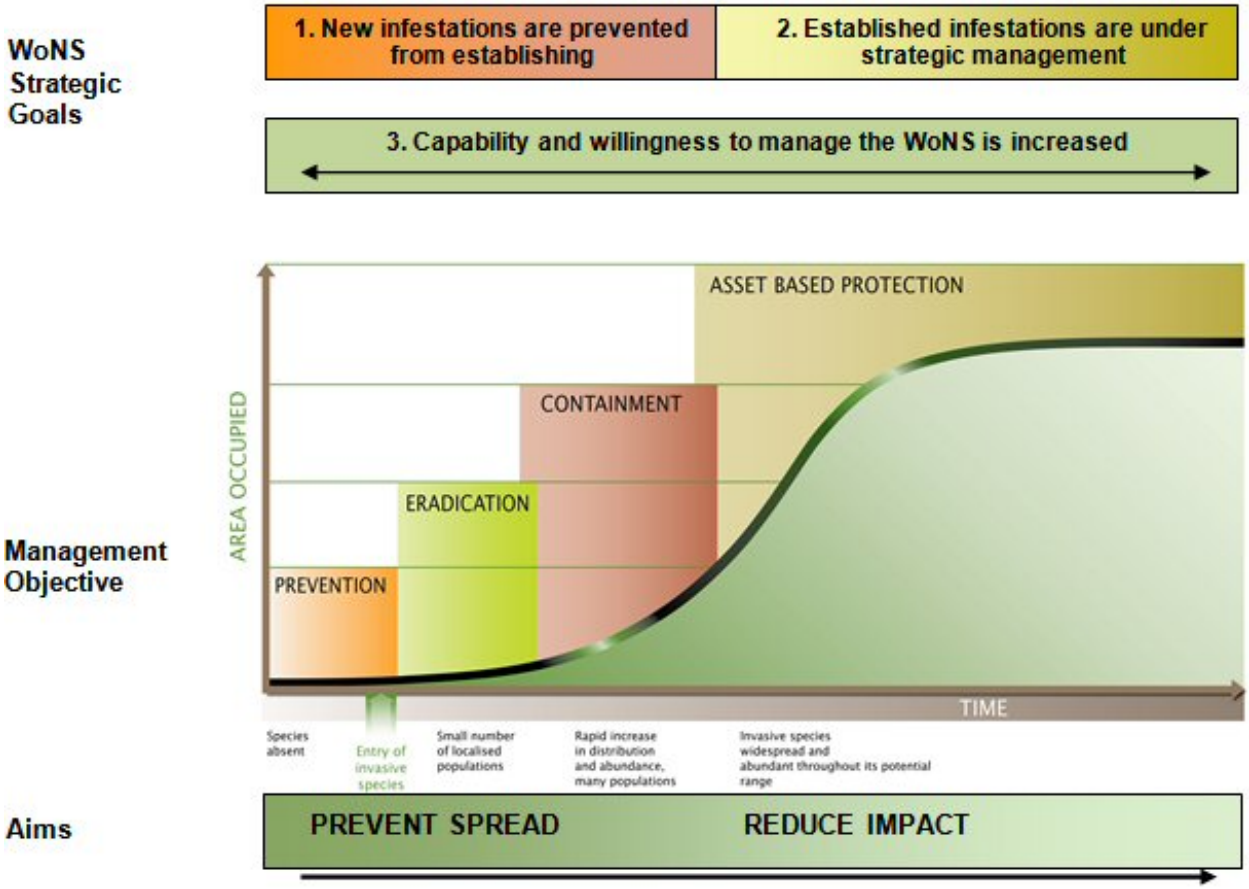


Figure 2. *Stages of weed invasion with corresponding goals, management objectives and actions at each stage. Modified from Hobbs and Humphries (1995) and Department of Primary Industries (2010).*

In most instances complete control (or eradication) of widespread weeds is unachievable. However, well researched, strategic and coordinated management can reduce current and potential impacts and provide a good return on investment. This includes spread prevention practices and eradication of outliers to protect environments where the weed is absent, establishment and defence of containment areas to halt or reduce the rate of spread, and the identification and protection of key environmental, social and economic assets in areas where the weeds are widespread. Underpinning all of this is the need for strong education, extension, capacity building and support mechanisms to ensure on-ground outcomes are achieved.

2.2 The current situation

Madeira vine was introduced to Australia more than 100 years ago (Mulvaney 1991). It was first recorded (as *Boussingaultia baselloides*) in Queensland as early as 1883 (Bailey 1883) and declared in the Sydney region in the Municipalities of Ashfield in 1920 (NSW Gov. Gazette 46, Folio 1386), Enfield in 1921 (NSW Gov. Gazette 37, Folio 1736) and Leichhardt in 1924 (NSW Gov. Gazette 44, Folio 1776). Folklore

suggests it was commonly planted outside toilets due to the laxative qualities of its leaves; however it was probably more commonly planted in gardens for its attractive, fragrant flowers.

Today, Madeira vine is most prevalent in tropical and subtropical regions of Queensland and New South Wales where it has spread from backyards into a range of natural ecosystems. Its world-wide distribution suggests it might establish in mild temperate climates and the control or containment of naturalised infestations in Victoria, Tasmania, South Australia and Western Australia may play an important role in reducing the risk of spread. Currently Madeira vine is declared in Queensland and parts of New South Wales; and is prohibited entry to Western Australia (see section 6.7). In addition, the Invasion and Establishment of Exotic Vines and Scramblers has been listed as a key threatening process (NSW Environment and heritage 2006) under the NSW *Threatened Species Conservation Act 1995*, with Madeira vine considered a species of special concern. Madeira vine has also been included in the New South Wales Biodiversity Priorities for Widespread Weeds Statewide Framework (NSW DPI and OEH 2011).

Although declaration restricts trade and distribution, there are few requirements for active management. Some Local Governments are investing in more intensive management where the weed is considered to be new and emerging but there is currently no consistency across jurisdictions, with the result that local efforts toward containment or exclusion may be undermined. Consequently, there is significant room for improvement through the identification (and where possible) legislative support of containment zones and the management of high-priority outliers.

Another key barrier to effective management is poor community awareness and/or commitment to the management of this weed. Madeira vine is common in many urban and peri-urban areas and although it is usually considered a pest in these backyard situations, community complacency is high and current green-waste management practices are suspected of spreading the weed. Communication and extension programs associated with the delivery of the Madeira Vine Strategic Plan will be challenged by the large number of stakeholders that need to be engaged and the fact that Madeira vine causes its greatest impacts in environmental systems away from public view.

Madeira vine is no longer commonly sold by horticultural groups in Australia and the nursery industry may be an important ally in the delivery of educational information and programs such as the Grow Me Instead initiative. Other key stakeholders that need to be engaged are the Natural Resource Management Groups, State and Local Governments which have roles in education and the coordination of on-ground management programs and Biosecurity or Weed Authorities that are responsible for weed management legislation and the development of environmental management frameworks (see section 4 Stakeholder Roles and Responsibilities for further information).

Finally, although Madeira vine has been recognised as a weed in some regions of Australia since the 1920s, there are still significant gaps in our knowledge of the plant's biology and ecology and factors that could affect or improve management outcomes. There is some disagreement over the best approach to managing this vine and considering the sensitivity of the ecosystems it invades, research into alternate herbicides and the comparative costs/benefits with regard to ecosystem impact and recovery is warranted. There is also considerable scope for the development of restoration guidelines and integrated management tools that are applicable to the management of other weedy vines or scramblers and which take into account the natural successional processes associated with commonly invaded systems (also see section 6.6 Identified research gaps and priorities).

2.3 Strategic plan development

This document was prepared by the National Madeira Vine and Cat's Claw Creeper Coordinator. Its content is based on current literature, discussions with operations, scientific and policy staff from government agencies, representatives of other research groups, NRM organisations, community groups and individuals involved in the management of cat's claw creeper and other invasive vine and scrambler species.

Significant effort was made to contact stakeholders from across the country to ensure that the plan provides an accurate reflection of the requirements (and limitations) of land managers and administrators in all jurisdictions. More than 20 WoNS stakeholder meetings were held and Madeira vine and cat's claw strategic priorities were collected from all States and Territories where the vines grow. A feedback form was emailed to groups and individuals that the Coordinator was unable to meet with directly.

The Plan was submitted to the Australian Weeds Committee for comment by all jurisdictions in July 2012 and further public comment was sought via a 30-day public consultation period in September / October 2012. The final version will be submitted to the Standing Council on Primary Industries for endorsement in 2013.

2.4 Relevance to other strategies

The Australian Weeds Strategy (AWS) provides national direction on weed management. WoNS are a significant component of the AWS and objectives and actions in the Cat's Claw Creeper Strategic Plan are aligned with AWS objectives. While this plan directs national action for one species, the objectives are common to all WoNS.

Other complementary linkages can be found in a range of existing resource management initiatives at all jurisdictional levels (Table 1). Successful implementation of this plan relies on alignment and support of actions in national to local level strategies and plans. As strategies and plans are developed or reviewed, relevant actions from this and other WoNS Strategic Plans should be considered, and where possible, incorporated.

Table 1: Policy and strategy linkages

Scale	Natural Resource Management	Weed Management
National	National Strategy for the Conservation of Australia's Biological Diversity 2010 Native Vegetation Policy 2001 National Strategy for Ecologically Sustainable Development 1992	Intergovernmental Agreement on Biosecurity (IGAB) Australian Weeds Strategy 2007 Weeds of National Significance Strategic Plans
State	State Biodiversity and Natural Resource Management Strategies Forest policies National Parks management plans	State agency pest management and invasive species plans and strategies Biosecurity strategies National Parks weed management plans
Regional or Catchment	Regional NRM and Catchment Management Plans Conservation corridor plans	Regional pest management strategies Regional weed management plans
Local	Landcare plans Sub-catchment and riparian vegetation management plans Bushcare and Coastcare plans	Local Government Pest Management Plans Local and community weed control plans
Property	Property Management Plans	Property Pest Management Plans

3 STRATEGIC GOALS AND OBJECTIVES

Uniform strategic goals have been established for all WoNS and include three primary outcomes: (1) prevent new infestations, (2) manage and reduce the impacts of existing infestations, and (3) engage the community to maximize assistance.

The objectives and strategic actions in this plan are generalized as it was considered premature to identify specific strategic management targets, research objectives and extension products. There is scope for refinement as our knowledge of this weed, its impacts and community-needs develop. To provide detail, a number of supporting documents are suggested:

1. A five year National Invasive Vines and Scramblers Research Framework, which outlines research needs and priorities, and provides an implementation framework for research

2. A National Invasive Vines and Scramblers Communications Plan (aligned to the WoNS Communications Plan)

3. Annual national priority management maps and spreadsheets (by NRM region), and

4. An annual monitoring, evaluation, reporting and improvement (MERI) plan.

Collaborative decision making by responsible partners

The aspirational objectives in this plan are supported by strategic actions that identify how the objectives can be achieved. In most cases, further work will be needed to refine the actions and/or develop the best approach to implementation. This work should be done in a consultative manner with all responsible partners.

While national coordination can assist with strategic direction and collaboration, partners will need to ensure actions are relevant to them and determine how to implement those actions at an appropriate scale (e.g. local, regional, catchment, jurisdictional). Thus, it is important that the correct partners be identified and included in the decision making process and, where appropriate, that those partners identify an appropriate level of participation for implementing actions.

It is suggested that decision-making processes regarding national priority actions should be led by a national management group, in collaboration with responsible partners and other relevant stakeholders. Many of these decisions will rely on further collation of distribution data, risk assessment and due consideration of relevant legislation and policy. Final endorsement of priority actions will occur via the Australian Weeds Committee.

GOAL 1: New infestations of Madeira vine are prevented from establishing

Prevention and early detection are the most cost-effective forms of weed management and this goal includes a number of actions to slow, or where possible, stop the spread of Madeira vine. This includes identifying and managing pathways of spread, determining risk of future invasion and implementing targeted hygiene and surveillance programs. Goal 1 also contains actions to address new incursions and outlier infestations, as well as preventing spread from core infestations, through eradication or containment programs.

Madeira vine has a history of horticultural use and the majority of long-distance dispersals occur as a result of dumping of garden waste and unofficial sale or distribution between home gardeners. Because spread is primarily human-mediated, containment is highly feasible; however, the success of this goal is strongly reliant on increased community awareness and compliance with weed spread legislation and protocols, i.e. linkages to Goal 3.

Table 2. Goal 1 objectives and strategic actions

Objectives	Strategic Actions	Priority*	Responsible Partners†
1.1 Invasion vectors, sources and pathways are identified and managed to prevent or reduce spread	1.1.1 Identify/confirm the major reproductive and spread mechanisms for Madeira vine; including seeding potential and presence/ absence of *Anredera cordifolia* (subsp. *gracilis*) which is known to reproduce sexually	1	National coordinator/s, State/Territory agencies, Research groups
	1.1.2 Undertake analysis of invasion vectors and pathways using available tools to inform and guide surveillance activities	2	
	1.1.3 Improve catchment (or sub-catchment) management planning for better spread prevention of Madeira vine	1	National coordinator/s, Local gov., Community members
	1.1.4 Improve green waste management and other spread prevention guidelines and practices to reduce the spread of Madeira vine	1	
1.2 Surveillance and response mechanisms are ensuring timely detection of infestations:	1.2.1 Utilise and/or refine predictive models of Madeira vine spread examining flood impacts and under current and climate change conditions	2	National coordinator/s, National mgt group, State/Territory agencies, Research groups
	1.2.2 Identify priority regions/landscapes (including niche environments) to inform	1	National coordinator/s, National mgt group,

* Priority

1 = critical to the success of the strategic plan

2 = highly beneficial and will contribute significantly to success of the strategy

3 = desirable, still beneficial, but not critical to success of the strategy

† Responsible partners (also see section 4)

NRM Groups = Natural Resource Management Groups (incl. Catchment Management Authorities)

Biosecurity/Weed authorities = statutory agencies/groups responsible for weed management. These vary across jurisdictions (e.g. at state gov level in QLD, local gov. level in NSW and regional NRM level in SA, etc.)

	surveillance activities – link to 1.1.2		State/Territory agencies, Research groups
	1.2.3 Establish and/or promote early detection and reporting mechanisms outside containment zones	1	National coordinator/s, National mgt group, State/Territory agencies, Local gov., Conservation and NRM groups
	1.2.4 Develop and/or make use of enhanced technology for early detection e.g. integration of GPS, smart phone capability, photos, email and mapping; as well as citizen science initiatives to assist with surveillance and early detection	3	National coordinator/s, State/Territory agencies, Research groups
1.3 Priority outlier infestations are contained or eradicated and spread from core infestations is minimised	1.3.1 Identify, delimit and prioritise outlying infestations based on risk of further spread, potential impact and feasibility of control	1	National coordinator/s, National mgt group, State/Territory agencies
	1.3.2 Develop and/or coordinate cooperative programs to defend containment zones	1	National coordinator/s, National mgt group, Biosecurity/Weed authorities, Local gov., Conservation and NRM groups, Land managers
	1.3.3 Develop and/or adopt standardised processes for determining feasibility of eradication or containment, and for prioritisation of sites for control, at appropriate scales	2	National mgt group, WoNS Coordinator roles, research organisations
	1.3.4 Undertake or coordinate priority management (and eradication where feasible) of new and outlying infestations	1	State/Territory agencies, Biosecurity/Weed Authorities, Local gov., Conservation and NRM groups, Land managers

GOAL 2: Existing infestations of Madeira vine are under strategic management

Madeira vine causes significant impacts within its core distribution. Unfortunately, broad scale control is not feasible or practical, due to the highly resilient nature of the population and its sheer size. A more realistic objective is to apply existing resources in a strategic manner to reduce impacts, increase the efficiencies of management and protect priority assets.

Currently there is limited information on the holistic management of vine species and the ecosystems they invade. The achievement of this goal will require support for research and the development of more cost-effective management approaches; as well as community capacity-building, i.e. linkages to Goal 3.

Table 3. Goal 2 objectives and strategic actions

Objectives	Strategic Actions	Priority	Responsible Partners
2.1 Priority assets are benefiting from long-term strategic weed control programs	2.1.1 Identify and document priority assets (environmental, economic and social) and high priority sites at risk from Madeira vine to guide investment within core infestations	1	All stakeholders
	2.1.2 Collate information on priority assets, assess level of risk posed by Madeira vine and identify national management priorities	1	National coordinator/s, National mgt group, State/Territory agencies
	2.1.3 Engage and support stakeholders to develop and implement management plans to protect high priority assets from Madeira vine	1	National coordinator/s, State/Territory agencies, Local govt, Conservation and NRM groups
2.2 Integrated weed management practices are improving natural resource condition	2.2.1 Build the capability of land managers to implement landscape restoration in areas impacted by vines and scramblers, including through the provision of best practice tools and advice	1	National coordinator/s, State/Territory agencies, Local govt, Conservation and NRM groups
	2.2.2 Establish baseline data and undertake or coordinate monitoring activities to determine the long-term effectiveness of containment, outlier management and asset protection programs	1	State/Territory agencies, Local govt, Conservation and NRM groups, Land managers
	2.2.3 Support, coordinate and/or implement collaborative, tenure-free management of Madeira vine and associated weeds in line with agreed national strategic priorities	1	National coordinator/s, National mgt group, State/Territory agencies, Research groups
	2.2.4 Support the adoption of best practice and integrated management of Madeira vine, including rearing and distribution of biological control agents, (sub) catchment planning, monitoring and restoration	1	All land managers

GOAL 3: Capability and willingness to manage Madeira vine is increased

Madeira vine is a serious environmental weed which continues to spread from urban areas. However, within the broader community there is very little awareness of its impacts or motivation to actively participate in its control. Consequently, significant effort needs to be invested in building capacity and commitment to reduce the impacts of this weed.

The actions identified below provide the background information and support systems required to deliver the Strategic Plan. This includes the development and maintenance of adequate mapping resources; investment in priority research; development of strategic planning tools and more effective management approaches; development and delivery of best practice extension information and communication plans; and effective legislative, policy and governance frameworks.

Table 4. Goal 3 objectives and strategic actions

Objectives	Strategic Actions	Priority	Responsible Partners
3.1 Infestations are mapped to national standards and to a level that is sufficient to inform decision making	3.1.1 Establish and/or maintain centralised state and national databases for storing mapping information	1	Australian gov., State/Territory agencies
	3.1.2 Collate and contribute mapping information to centralised state and national spatial databases	1	National coordinator/s, National mgt group, State/Territory agencies, Local gov., Conservation and NRM groups, Land managers
	3.1.3 Identify and record / map national strategic management zones and priority assets	1	National coordinator/s, State/Territory agencies
	3.1.4 Strengthen existing distribution data sets - priority placed on the delimitation of outliers, definition of containment lines/zones and mapping of Madeira vine infestations (including upper extents of infestations) which threaten priority assets	2	State/Territory agencies, Local gov., Conservation and NRM groups, Land managers
	3.1.5 Support development and promote use of national weed information and mapping systems. Provide training where necessary	2	National coordinator/s, National mgt group, all stakeholders
3.2 Best practice management delivers efficient, effective and long-term control of Madeira vine *(Actions included here are specific to the development of best practice resources – dissemination and training is included under 3.3)*	3.2.1 Collate and refine information on existing Madeira vine control options	1	National coordinator/s, National mgt group, State/Territory agencies, Industry bodies, Research groups
	3.2.2 Facilitate and/or contribute to the development of best practice extension information relevant to invasive vine weeds (including a best practice management resources)	1	National coordinator/s, National mgt group, State agencies, Australian gov.
	3.2.3 Maintain/support development of off-label permits and/or registrations for effective herbicides as identified through best practice	1	State agencies, Industry bodies

	trials		
	3.2.4 Support the establishment of rearing and release facilities for Madeira vine biological control agents	1	Vines Coordinator, State agencies, Industry bodies, Community groups
	3.2.5 Facilitate and/or contribute to the development of support tools including: ~ restoration guidelines for riparian systems affected by invasive vines and scramblers ~ biological control rearing and release information ~ monitoring and reporting tools to assess the success of a control program ~ surveillance and containment program guidelines ~ site management protocols and management plan templates	2	Vines Coordinator, National mgt group, State/Territory agencies, Industry bodies, Research groups
	3.2.6 Assess adoption of best practice tools and techniques and identify barriers to uptake	2	National mgt group, research organisations, NRM groups, State/Territory govt
	3.2.7 Identify and promote novel control techniques which have proven effectiveness	3	National coordinator/s, National mgt group, State/Territory agencies, Industry bodies, Local gov., Conservation and NRM groups
3.3 Capability and motivation to manage Madeira vine is enhanced by education and awareness	3.3.1 Develop and/or implement a National Vines and Scramblers Communications Plan (aligned with the WoNS Communications Plan)	1	National coordinator/s, State/Territory agencies, Local gov., Industry groups, Conservation and NRM sector
	3.3.2 Facilitate development and delivery of education and awareness resources for Madeira vine including: ~ information on the impacts of Madeira vine ~ identification tools to increase capacity for early detection (priority – areas outside the defined containment zones) ~ green waste and hygiene protocols	1	National coordinator/s, National mgt group, State/Territory agencies, Local gov., NRM groups
	3.3.3 Build community capacity through delivery of best practice management information and training	1	National coordinator/s, State/Territory agencies, Local gov., Conservation and NRM groups
	3.3.4 Annually update and publish the Priority Management Action spreadsheet identifying national strategic priorities by NRM region	1	National coordinator/s, National mgt group

	3.3.5 Identify and promote community use of existing support systems e.g. Weed Spotters and spatial data/mapping systems – link to 3.1.2	2	National coordinator/s, State/Territory agencies
	3.3.6 Encourage better management of urban Madeira vine plantings through the promotion of non-weedy replacements (Grow Me Instead campaigns) and improved garden waste disposal protocols.	2	National mgt group, Nursery Industry, State, Territory and local govt, gardening interest groups
	3.3.7 Provide advice to community groups on strategic alignment of funding applications	3	National coordinator/s, NRM groups
	3.3.8 Maintain Madeira vine management networks for communication of updated information and strategy developments	2	National coordinator/s, National mgt group
3.4 Research priorities for Madeira vine are identified, promoted, addressed and outcomes are informing management *(Also see section 6.6)*	3.4.1 Identify knowledge gaps and opportunities for improved weed management	1	National coordinator/s, National mgt group, State/Territory agencies, Research groups, weed managers
	3.4.2 Develop, prioritise and maintain a 5-year National Invasive Vines and Scramblers Research Framework	1	
	3.4.3 Develop and maintain partnerships with research organisations (including international groups) and promote research needs	2	National coordinator/s, National mgt group, State/Territory agencies, Research groups
	3.4.4 Coordinate and undertake research to address critical information gaps and management barriers for invasive vines and scramblers	1	
	3.4.5 Facilitate a two-way flow of information on vine management and research needs/solutions between researchers and land managers	1	National coordinator/s, National mgt group, Researchers, Weed managers
3.5 Local to national planning incorporates strategic Madeira vine priorities	3.5.1 Identify local to national plans relevant to vine/scrambler management	1	National mgt group, National coordinator/s
	3.5.2 Integrate WoNS strategic priorities into State, regional, catchment and local level management plans; and/or encourage other stakeholders to do so during weed mgt planning processes	1	National coordinator/s, National mgt group, Australian gov., State/Territory agencies, Biosecurity/Weed authorities; Local govt, Conservation and NRM groups
3.6 Appropriate policies, codes of practice, legislation and enforcement are supporting strategic management objectives	3.6.1 Enforce national importation restrictions on Madeira vine	1	Australian govt (DAFF Biosecurity)
	3.6.2 Introduce and/or enforce appropriate state and territory legislation with a minimum requirement to ban the sale and distribution of Madeira vine	1	Biosecurity/Weed authorities
	3.6.3 Provide legislative and/or policy support for agreed containment and asset protection objectives	2	Biosecurity/Weed authorities

	3.6.4 Encourage and promote nursery, garden and landscaping industry codes of practice that support Madeira vine / WoNS objectives	3	National coordinator/s, National mgt group, Industry groups
3.7 Stakeholders are committed to effective delivery of the Strategic Plan	3.7.1 Establish a national committee to provide advice and oversee implementation of the national plan	1	National coordinator/s, Host Agency (Qld DAFF)
	3.7.2 Communicate Madeira Vine National Strategic Plan (2012-17) goals, objectives and actions to all stakeholder groups and their members	1	National coordinator/s, National mgt group, State/Territory agencies, Local govt, Conservation and NRM groups
	3.7.3 Provide information and advice to encourage participation in collaborative action to address priority management and surveillance activities	1	National coordinator/s, State/Territory agencies, Local govt, NRM groups
	3.7.4 Recognise and promote local weed management successes; and the groups and individuals that drive them	3	National coordinator/s, Weeds Societies, NRM groups, Landcare groups
3.8 The National Strategic Plan is relevant and effective	3.8.1 Develop and implement a Monitoring, Evaluation, Reporting and Improvement (MERI) strategy for the Madeira Vine National Strategic Plan (2012-17)	2	National coordinator/s, National mgt group
	3.8.2 Coordinate, monitor, review and implement the Strategic Plan annually	1	National coordinator/s, National mgt group, States & Territories (phase 3)
	3.8.3 Collate information (with contributions from all partners) and communicate progress and evaluation outcomes to the Australian Weeds Committee and other key stakeholders	1	National coordinator/s, National mgt group, States & Territories (phase 3)
	3.8.4 Facilitate a comprehensive review of progress toward Strategic Plan objectives in 2017	2	Australian Weeds Committee
	3.8.5 Identify sources of funding and allocate resources to high priority management and research projects	1	All stakeholders

4 STAKEHOLDER ROLES AND RESPONSIBILITIES

The effective implementation of this Plan requires the involvement of all land owners and managers affected by Madeira vine. Stakeholder responsibilities may vary between jurisdictions: some actions may be optional while others are prescribed by legislation. The successful achievement of strategic objectives relies on the development and maintenance of partnerships between community, industry and government, and recognition of the roles of each stakeholder. Suggested responsibilities to assist in achieving these are:

Australian Weeds Committee

- Provide a mechanism for identifying and resolving weed issues at a national level
- Provide advice to the Natural Resource Management Ministerial Council on weeds issues
- Provide planning, coordination and monitoring of the implementation of the Australian Weeds Strategy
- Facilitate coordination between the Australian Government and State and Territory governments on weed management policy and programs
- Provide governance processes for the effective delivery of the WoNS initiative
- Oversee the implementation of the activities described in the WoNS strategies
- Promote the importance and benefits of the WoNS program to all levels of government

Australian Government

- Ensure quarantine controls to prevent importation (DAFF Biosecurity)
- Promote the status of Madeira vine as a WoNS, its impacts and the importance of management
- Undertake strategic Madeira vine control on all Australian government managed lands

State and territory agencies

- Maintain appropriate legislation and policies to achieve state and territory based objectives for managing Madeira vine
- Administer and enforce legislation where applicable
- Coordinate Madeira vine control and management at a jurisdictional level to complement the management and delivery of the Madeira vine National Strategic Plan.
- Work with NRM groups, local governments, communities and other stakeholders to prevent and minimise Madeira vine impacts.
- Identify strategic management areas and associated objectives
- Promote consistency with this Strategy in jurisdictional pest management plans
- Facilitate the inclusion of strategic Madeira vine management in pest management planning processes
- Contribute to priority weed research initiatives
- Source funding for strategic management programs and research
- Implement monitoring and reporting protocols in line with the MERI plan and provide relevant information to the National Invasive Vines and Scramblers Taskforce (NIVaST) and/or Australian Weeds Committee
- Develop and implement communication and extension tools, where appropriate
- Undertake any necessary planning and mapping and contribute to national mapping initiatives
- Ensure, where appropriate, participation on the National Management Group or similar national WoNS taskforce

- Improve knowledge of the identification, impacts and best practice management of Madeira vine
- Identify Madeira vine and other weeds threatening public lands
- Implement weed hygiene and other best practice management to minimise spread of Madeira vine

National management group – National Invasive Vines and Scramblers Taskforce (NIVaST), including the Madeira Vine Strategic Plan Committee

- Ensure a diversity of community and agency views are represented and contribute to effective Strategic Plan implementation
- Provide guidance, direction and policy advice for Madeira vine management through the delivery of the Strategic Plan
- Monitor, evaluate, report and improve Strategic Plan implementation
- Assist in the development and implementation of programs and initiatives that support strategic actions
- Maintain and build partnerships with key stakeholders to improve strategic Madeira vine management
- Support and recognise achievements in Madeira vine management
- Identify funding sources and provide independent advice on development of projects that support WoNS strategic actions.

Research institutions (e.g. CSIRO, Universities, government agencies)

- Undertake appropriate research to address priority national strategic requirements
- Identify research gaps and seek innovative solutions for the management of Madeira vine
- Seek new and on-going funding and support for research requirements

Local governments

- Incorporate Madeira Vine Strategic Plan objectives in relevant pest management plans and monitor implementation
- Administer and enforce legislation where applicable
- Undertake surveying and mapping particularly in relation to outlying Madeira vine infestations
- Establish local management policies to contribute to strategic control, containment and/or asset protection objectives
- Improve community awareness of impacts and identification; and promote early detection
- Strategically control Madeira vine on local government managed or owned land
- Facilitate the removal of urban plantings of Madeira vine in strategically important areas
- Source funding and/or contribute to strategic control programs

Natural resource management groups / catchment management authorities

- Administer and support legislation where applicable (e.g. in South Australia)
- Source funding and/or contribute to strategic control programs
- Improve regional awareness of impacts and identification and promote early detection.
- Contribute local and regional perspectives to Madeira vine management
- Contribute to the development, implementation and/or review of local and regional pest management plans
- Incorporate Madeira vine actions in relevant pest management plans and monitor implementation

- Promote and contribute to local and regional containment and/or management programs in partnership with relevant stakeholders
- Support and/or develop Madeira vine projects consistent with national priorities and seek funding to implement projects
- Participate in local and regional mapping initiatives and contribute to state, territory and national map production
- Promote awareness and best practice management through event coordination and product distribution.

Community, conservation and other interest groups

- Contribute local and regional perspectives to Madeira vine management, including community perspectives
- Contribute to the development, implementation and/or review of local and regional pest management plans
- Support and/or develop Madeira vine projects consistent with national priorities and seek funding to implement projects
- Participate in local and regional mapping initiatives and contribute to state, territory and national map production

Industry

- Promote and adopt best practice management of Madeira vine
- Contribute to research and development of management practices to support industry members
- Ensure awareness of sale and movement restrictions of Madeira vine within industry members
- Improve community awareness of impacts and identification; and promote early detection, hygiene protocols and discourage use of Madeira vine

Private land owners

- Manage and control Madeira vine on private lands in accordance with State/Territory or local government legislation and policy
- Improve knowledge of the identification, impacts and best practice impacts of Madeira vine
- Identify Madeira vine and other weeds threatening the property
- Undertake any necessary planning and mapping
- Implement best practice management
- Implement weed hygiene and other management practices to minimise spread of Madeira vine.

5 MONITORING EVALUATION REPORTING AND IMPROVEMENT

This monitoring, evaluation, reporting and improvement (MERI) framework lists the **minimum** reporting information that should be collected for the life of the Strategic Plan – including during phase 3 delivery (see section 7.3). This will ensure that sufficient data is collected to identify successes and failures and provide the opportunity for improvement where outcomes are not being achieved. Additional annual MERI plans should be developed to follow individual activities in more detail.

5.1 Targets and Measures

Table 5. MERI progress assessment

Strategic Plan Goals	Key Evaluation Questions	Data/Evidence Required	Consider
1. New infestations are prevented from establishing.	To what extent have new infestations been prevented from establishing?	<u>1.1 National distribution data</u> • Has the national distribution map been reviewed and/or updated? • Has the Priority Management Action spreadsheet been updated?	• Are these documents publicly available? • Have stakeholders been advised of any changes? • Where is this data/info stored? • Do they capture national priorities?
		<u>1.2 New infestations</u> • Number of new outlier infestations[1] recorded. • Percentage of known infestations actively controlled. [1] New infestations should be an outlier, outside existing Madeira vine distribution	• Are any new outlier infestations occurring in areas identified as a high priority in the national strategy / annual work plan? • How infestations were detected (passive or active surveillance, community reporting etc)? • Have high risk pathways been adequately identified? And threats minimised?
		<u>1.3 Eradication & containment programs</u> • Percentage of eradication and/or containment programs being maintained	• What percentage of the programs identified in the national strategy / annual work plan are being actively managed? • Is there a plan in place for ongoing management? • How is progress being monitored and reported to stakeholders? • Can include examples using case studies.

		1.4 Legislation • Has a need for legislative change been identified by stakeholders? • Have there been any legislation or policy changes for this species?	• Are minimum requirements being maintained (e.g. ban on sale, trade, movement?) • Is control required throughout or in part of the jurisdiction? • Is compliance actively enforced?
		Overall progress rating	
2. Existing infestations are under strategic management.	To what extent is integrated weed management effectively managing core infestations?	2.1 Integrated Weed Management • How effective are IWM programs?	• Are existing tools providing adequate control of Madeira vine? • Have new advances/technologies been developed and are they incorporated into BPM information? • Are there barriers to adoption of best practice management? • Are research programs addressing any observed gaps (e.g. herbicide trials, biocontrol, restoration requirements post control)?
	To what extent are assets being protected through strategic management?	2.2 Asset protection • Have prioritisation processes been implemented in all jurisdictions to identify assets 'at risk' from Madeira vine? • Percentage of priority assets being protected (e.g. assessed against relevant Threat Abatement Plans)? • Percentage of state/regional invasive species plans that identify priority assets at risk from Madeira vine?	• Response should include status report on progress towards asset protection programs. • Methods by which assets are being protected (e.g. targeted annual spray programs, high risk pathway surveillance, strategic plans). • Are long term monitoring programs in place to detect change? • To what extent is management leading to an improvement in asset condition?
		Overall progress rating	
3. Greater capability and commitment to manage Madeira	To what extent has the capability and commitment to manage Madeira vine increased?	3.1 Community engagement & awareness • What is the status of best practice information? • Are partnerships being maintained to	• Is best practice information up-to-date and readily available? • Is this information and/or advice being targeted to priority regions?

vine		ensure collaboration on Madeira vine projects? • Number and type of media activities.	• Is training being delivered to meet the needs of weed managers (including the community)? • Are networks/groups being supported (e.g. through dissemination of research outcomes, funding opportunities, control options etc)? • Has awareness and engagement in WoNS management been raised effectively?
		3.2 Resourcing • From what sources are programs being funded?	• Number of projects funded by Commonwealth, jurisdictions, industry, etc
		3.3 Policy & Planning • Are the objectives of the strategy being integrated into commonwealth/state/ regional plans, policies and programs? • Has cross border collaboration occurred?	• How are priorities being reflected in planning and policy approaches? e.g. weed risk assessment/management, invasive species plans, asset protection plans, district plans, weed spread prevention activities, management programs, incentive programs, state working groups. • How are national priorities being maintained? E.g. containment lines, eradication targets, training & awareness raising, research projects.
		Overall progress rating	
Continuous improvement	Are there any unexpected outcomes that have been identified through implementation of strategy?	4.1 Barriers • Have any other management issues or impediments been identified?	

How to score progress rating

1- Insufficient evidence to score

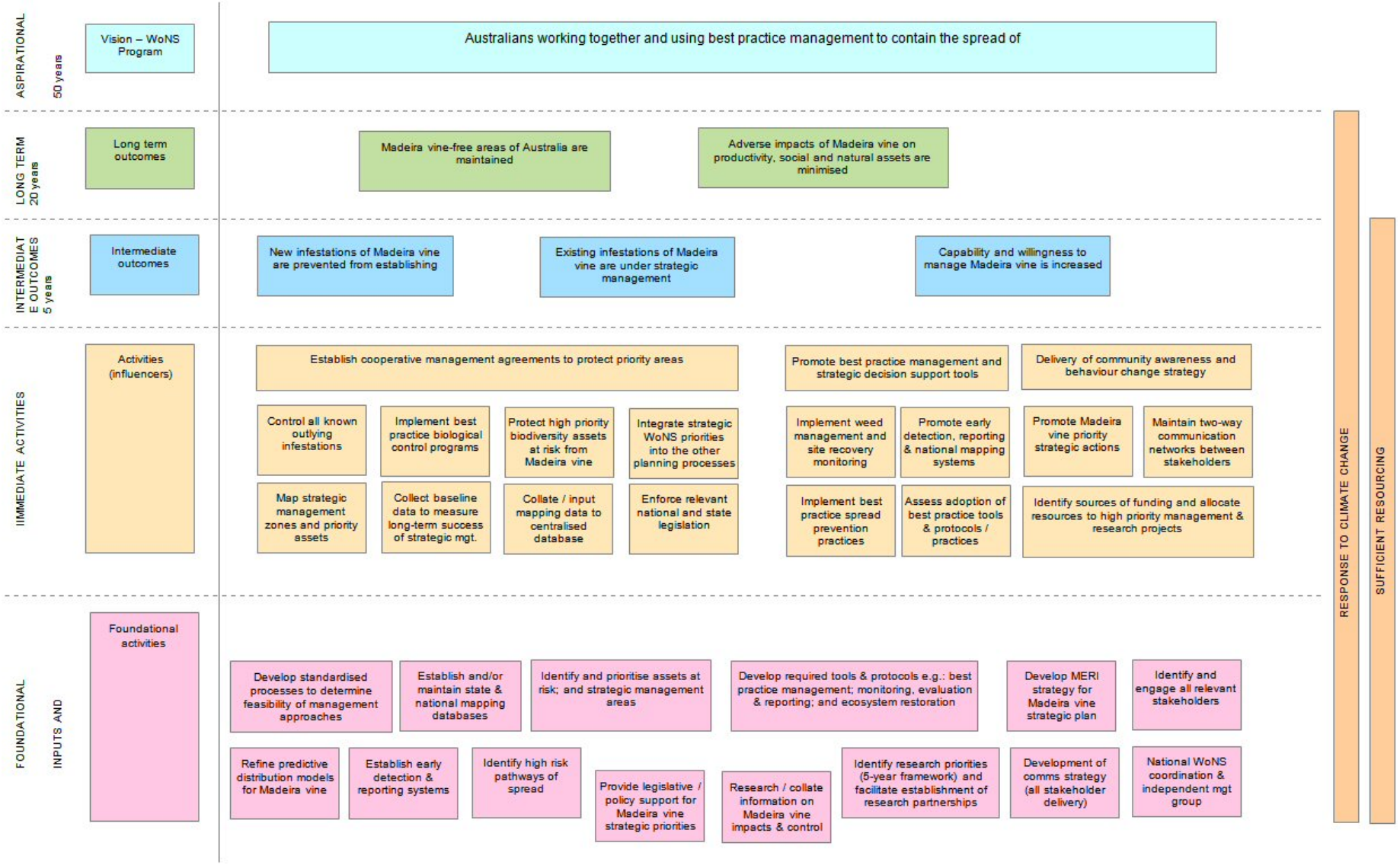
2- No progress against goal

3- Limited progress is being made against this goal

4- Reasonable progress is being made against this goal

5- Excellent progress is being made against this goal

5.2 Program Logic Model



6 Technical Background

6.1 Madeira vine identification

Figure 3. (a) Waxy-green heart-shaped leaves and immature inflorescence spikes; **(b)** Lambs tail-like Madeira vine inflorescences; **(c)** Large clumps of aerial tubers (these may appear as small individual tubers); **(d)** Madeira vine inflorescence showing individual flowers (Photos: (a) – Biosecurity Queensland; (b-d) - Sheldon Navie)

Madeira vine has green, waxy and semi-succulent heart-shaped leaves that are usually 4-5 cm but can range from 1-15 cm in length and 0.8-11 cm in width (Figure 3(a)) (Vivian-Smith et al. 2007). It has slender, twining and hairless stems up to 30 m long which are initially herbaceous and green-pinkish-red in colour, but become brown, exfoliated and woody with age and reach 2-3 cm in diameter (Vivian-Smith et al. 2007). The inflorescence is fragrant, greenish-white to cream-white and resembles a 'lamb's tail', with numerous small flowers along a drooping, central stem that is 6-65 cm long (Figure 3 (b) & (d)) (Vivian-Smith et al. 2007). Madeira vine produces a large number of 5 mm to 25 cm aerial tubers which are light brown or green and 'warty' in appearance (Vivian-Smith et al. 2007) (Figure 3 (c)). The vine also produces 'potato-like' subterranean tubers which can grow up to 20 cm in diameter and at depths of up to 1 m (Vivian-Smith et al. 2007).

The presence of large vines is usually more easily identified by a mass of sprouting tubers at the base of the tree; or the cream panicles of flowers visible amongst the canopy during flowering season. There are no similar flowering species at this time of year (S. Lymburner *pers. comm)*.

The only related species found in Australia are Ceylon or Malabar spinach (*Basella alba* or *Basella rubra*). These species are members of the same family which have been introduced to south-east Queensland as non-commercial garden vegetables and may be found in urbanised or market garden areas. They have similar leaves but the inflorescences are less conspicuous and form as a simple spike with small pinkish white flowers that are followed by hard black seeds (Palmer 2009).

Native species that can be confused with Madeira vine include the native Hoya (*Hoya australis*), snake vine (*Stephania japonica*), giant pepper vine (*Piper hederaceum*), round-leaf vine (*Legnephora moorei*), pearl vine (*Sarcopetalum harveyanum*) and native *Muehlenbeckia* spp.

6.2 Madeira vine biology and ecology

Madeira vine is native to South America, ranging from Paraguay to Southern Brazil and northern Argentina (Wagner et al. 1999; Xifreda et al 1999). However it has been cultivated as an ornamental plant and now has a world-wide distribution. The *Anredera* genus (family Basellaceae) includes up to 14 species of perennial vines (Sperling 1995). There are no native Australian species and Madeira vine is the only member of the family naturalised in Australia.

Madeira vine grows poorly under low-light conditions; however it will aggressively exploit canopy openings and forest fringes (Floyd 1985; Dunphy 1991). In high light environments it will grow at rates of up to 1 m per week and in areas of significant infestation, it can climb 40 m into the canopy, smothering and collapsing mature trees (Floyd 1989; Stockard et al 1985). When unsupported, it forms thick mats of ground-cover that overwhelm low-lying vegetation and inhibit natural regeneration (Stockard et al 1985; Anon. 2005)

Morphological and chromosomal studies carried out by Xifreda et al (1999) identified two subspecies: *Anredera cordifolia* subsp. *cordifolia* and *Anredera cordifolia* subsp. *gracilis.* Subspecies *cordifolia,* described as the more extensively cultivated herb with prolific tuber production was found to be autotriploid; producing abnormal pollen grains with fertility levels of 15-24 percent. The authors concluded it was virtually sterile. Subspecies *gracilis* is common within the native range and demonstrated no irregularities, with pollen fertility of 84-97 percent and evidence of fruit production. This subspecies is distinguished by smaller flowers. There is no information on the presence or absence of this subspecies in Australia.

For many years it was believed that Madeira vine did not produce viable seed in Australia; however, seedling production was recorded in the late 1990s (Swarbrick 1999) and in subsequent research, up to 5 percent of dried flowers collected from southeast Queensland were found to contain germinable seed (Vivian-Smith et al unpublished data). It is speculated that seed set and germination may only occur under ideal environmental and seasonal conditions (Swarbrick 1999). Never-the-less, as flower production is prolific, seed input into the environment could be significant and this mechanism of spread warrants further investigation.

The more commonly recognised means of reproduction for Madeira vine is via asexual tubers formed on the roots and stems or vegetative spread by shooting from sections of severed vine. Prolific numbers of aerial tubers are produced throughout the year, which drop to the substrate when mature or in response to stress. These provide an extremely effective means of reproduction, with more than 1500 tubers / m^2 recorded under heavy infestations in Australia (Floyd 1985; Stockard 1983; Stockard et al. 1985) and 7.5 tonnes of tubers removed from two sites over a four year eradication attempt on Raoul Island, New Zealand (West 2002). The potato-like subterranean tubers can grow up to 20 cm in diameter and are found at depths of up to 1 m (Vivian-Smith et al. 2007; Muyt 2001) Research indicates that aerial tubers can persist for 2-15 years and subterranean tubers for 5-10 years, with tuber germination rates of up to 70 percent. As a result, management can be a difficult and long-term undertaking.

Madeira vine has a number of physiological and structural advantages that enable it to out-compete native species. The subterranean and aerial tubers not only act as reproductive bodies, but provide the plant with a carbohydrate source that enables it to survive through difficult times (Osunkoya et al. 2010). It also demonstrates a high investment of resources in the rapid production of above ground biomass and more efficient resource use than natives, allowing it to succeed in a wider range of environments (Vivian-Smith et al 2007; Osunkoya et al. 2010). Morphological plasticity also provides competitive advantages. Anatomical and morphological analysis of Madeira vine leaves show little evidence of structural elements (bundle sheath cells and sclerenchyma), suggesting an adaptation to low cost construction which may aid in invasive capacity, as well as comparatively higher numbers of stomata on the underside of the leaves when grown in high-light conditions which may be an evolutionary trait that supports increased carbon fixation without dramatic losses of water (Boyne et al. *in press*). A recent study conducted under glass house conditions also demonstrated that Madeira vine

seedlings grown in competition with other plants produce more biomass than those grown without competition (Watts & Smith 2012).

Madeira vine can also tolerate a range of adverse conditions including drought, snow and frost by dying back to the subterranean tubers and relying on stored carbohydrate resources. As a demonstration of its flexibility, Madeira vine has been found growing in areas as diverse as rainforest and riparian fringes, rocky outcrops and frontal dunes (Blood 2001).

6.3 Madeira vine distribution and spread

Madeira vine is widely naturalised around the world, with records from all continents except Antarctica (Lawson 1999). In addition to Australia, it is a serious invasive species in New Zealand, Africa, North America, Spain, China, Hawai'i and a number of other Pacific Nations (ISSG Database 2012; Star et al. 2003; PIER 2012; Vivian-Smith et al 2007).

In Australia populations of Madeira vine have naturalised in all States and Territories except the Northern Territory (Blood 2001) but are concentrated in the coastal and hinterland regions of central and northern New South Wales and South East Queensland. In these States populations are also found as far north as the Atherton Tablelands in Queensland and as far south and west as Eden and Albury in New South Wales. In Western Australia, Madeira vine has naturalised around urban lakes (Csurhes & Edwards 1998) and around the Canning River in Perth (Lloyd 2006). Occurrences are less common in Victoria, Tasmania and the ACT, although it is considered a serious threat to rock outcrop vegetation in Victoria (Carr et al. 1992) and has a significant presence in the East Gippsland area (Bill Peel pers. comm), the river systems in and near Melbourne and in cultivation in other regions such as Horsham (Kate Blood pers. comm).

Dispersal is believed to occur primarily via human spread (cultivation for ornamental purposes, disposal in green waste, or spread by machinery and/or gravel during road construction); via gravity and water movement from ridges and down watersheds (Dunphy 1991); or under flood conditions. There has also been some speculation that mammals and birds may play a minor role in localised spread of tubers (McFadyen 2011). Experimentation indicates that long-distance dispersal in water is possible, but (with the exception of flood situations) would only occur occasionally as the majority of tubers sink within 24 hours and only 2 of the 375 tubers tested remained floating and viable over a 30 day period (Vivian-Smith & Panetta 2002).

Climatic tolerance modelling of Madeira vine suggests it has the potential for further spread in Australia. Madeira vine is generally considered a tropical and sub-tropical species; however its world-wide distribution includes mild temperate climates (Vivian-Smith et al. 2007) and there is general consensus that it has the potential to spread further in Victoria, Tasmania, South Australia and Western Australia. The irrigation parameter of CLIMEX indicates that the distribution of Madeira vine may also extend into more arid regions if there is sufficient water, such as along watercourses and in irrigated areas (Lawson 1999).

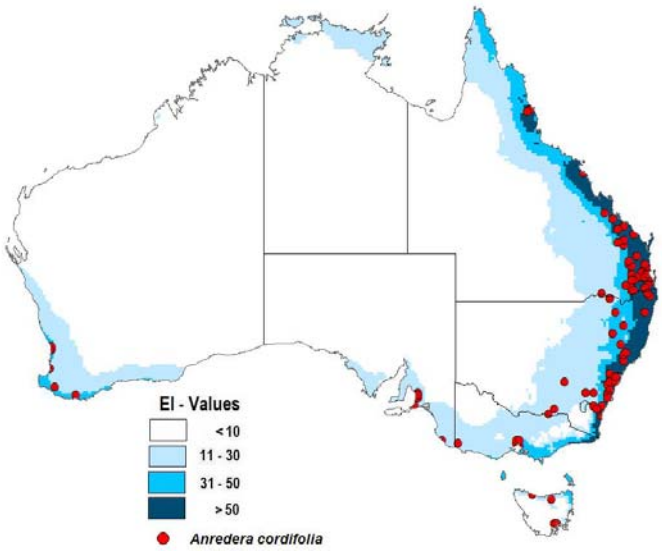


Figure 4. *Potential distribution of Madeira vine - CLIMEX (Palmer 2009)*

A number of climatic models have been produced for Madeira vine (e.g. Figures 4 & 5) and it will be important to determine which is most accurate or whether there is a need for further refinement of the models.

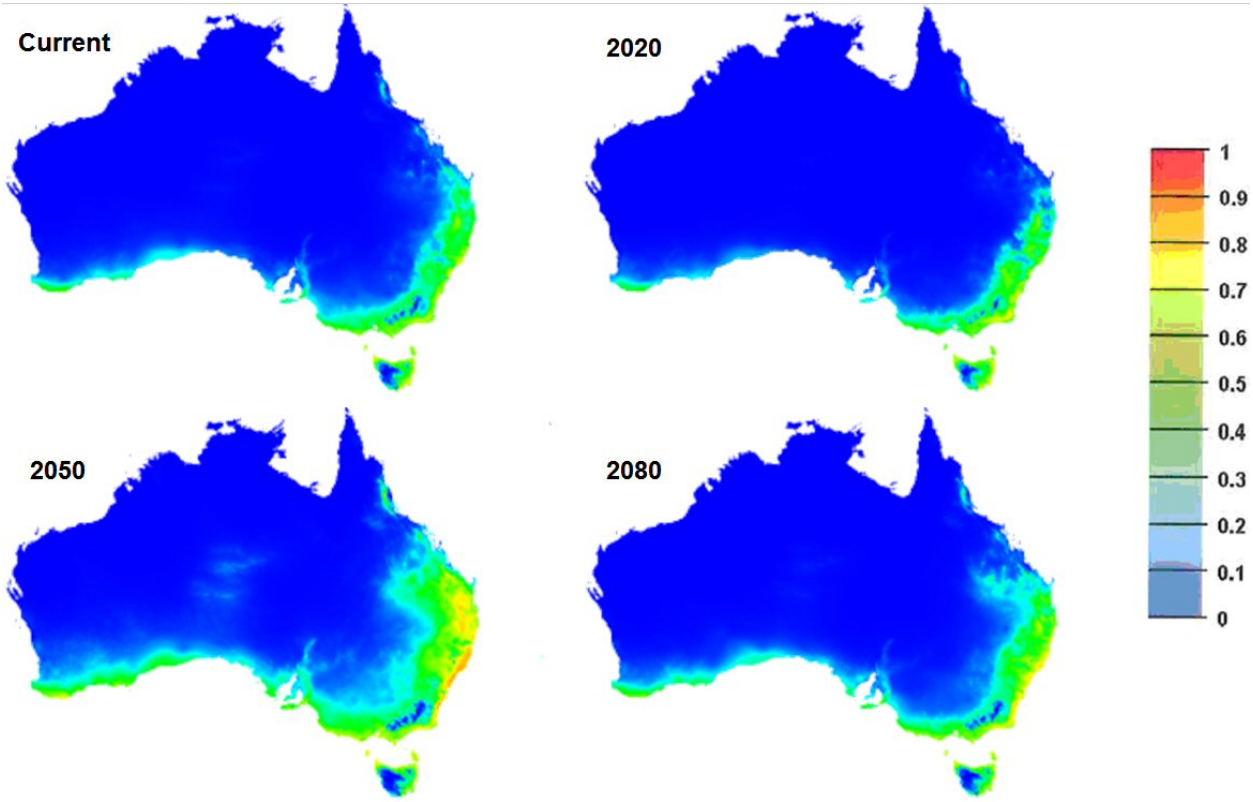


Figure 5. *Potential distribution of Madeira vine under climate change scenarios – MaxEnt Modelling Software (Wilson et al. 2010)*

6.4 Summary of impacts

Certain exotic vines and scramblers have been described as “transformer species” (Swarbrick 1991; Ernst & Cappuccino 2005, Blood 2001), because they alter the nature of the environment where they are dominant. They smother canopy and ground-level vegetation, reducing light access and suppressing regeneration of native species. Madeira vine is particularly problematic because the weight of its semi-succulent stems and foliage can cause total canopy collapse (Harden 1988; Harden et al. 2004).

Exotic vines and scramblers may also affect the abundance and diversity of plant-dwelling invertebrates (Ernst & Cappuccino 2005), restrict the movement and water access of some native fauna and/or favour other species (including pest animals) by providing protective shelter (NSW Environment & Heritage 2006).

Madeira vine typically invades riparian vegetation, the edges of rainforests, tall open forests and mesic (damp) sclerophyll forests (Csurhes & Edwards 1998). These ecosystems include some of Australia’s most biodiverse regions and the spread of a weed like Madeira vine poses substantial risks to the continued function of these environments. Further research is required to identify the full suite of species and ecosystems impacted or at risk from Madeira vine, but it has already been included as one of the key species in the NSW exotic vines and scramblers key threatening process listing (NSW Environment & Heritage 2006) and is known to threaten a number of critically endangered and endangered species and ecological communities listed under the NSW *Threatened Species Conservation Act 1995,* the Queensland *Nature Conservation Act 1992* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (Coutts-Smith & Downey 2006).

Coutts-Smith & Downey (2006) list Madeira as the most invasive of the garden plants in New South Wales. Endangered flora, fauna and ecological communities that are impacted by Madeira vine include the Nielsen Park she-oak (*Allocasuarina portuensis*), the Illawarra socketwood (*Daphnandra sp. C Illawarra*), the Lismore muttonwood (*Rapanea sp. A Richmond River*), Coxen’s fig parrot (*Cyclopsitta diophthalma coxeni*), Littoral rainforest, Riverflat eucalypt

forest on coastal floodplains, and Swamp sclerophyll forest on coastal flood plans (Coutts-Smith & Downey 2006).

Madeira vine also adds to infrastructure damage during flood periods by causing either bank destabilisation as a result of the death of riparian vegetation; or creating increased resistance to flood waters which can uproot trees that would otherwise have remained intact.

6.5 Control options

Successful management of Madeira vine requires exhaustion of the tuber bank; however, this can be a long-term endeavour. The longevity of buried tubers has not been determined but anecdotal reports of Madeira vine growth from tubers exposed by the erosion of road works dating back 30 years were collected during consultation for this strategy.

Tubers are most commonly spread through poor green waste management or via gravity and water movement from ridges and watersheds or during floods. Consequently, catchment and sub-catchment planning is an important component of the strategic management process. Good distribution mapping and an awareness of high risk spread pathways enable the identification of high priority management zones to more effectively manage existing infestations and reduce spread.

A management plan should be carefully designed and include a commitment to regular, long-term follow-up control. The disturbance caused by control work stimulates particularly vigorous vine growth and if management isn't carried out appropriately may lead to an even bigger problem. Plan to:

1. **Prevent Madeira vine spread**
   Where possible keep uninfested areas free of Madeira vine. Identify isolated plants or sparse populations and control these first. These populations are relatively easy to tackle and early management can significantly reduce future impacts. Also consider the topography of the landscape and prioritise isolated infestations on high ground or at the top of catchments as gravity, surface water movement and flooding can spread tubers from ridgelines down gullies and along water courses.

2. **Reduce established infestations**
   Develop and implement a long-term weed management plan for each site. It is important to identify all plant species (weeds and natives) and map their distribution and density (including potential sources of reinvasion). Mature infestations of Madeira vine are most readily identified during the flowering season (late summer through autumn).

   Weed strategically, protecting the better quality native vegetation first e.g. treat Madeira vine infesting trees that are still living. Where possible, work from the edge of the infestation toward the core – the exception may be where you need to protect isolated areas of high biodiversity value.

3. **Follow-up, rehabilitate and monitor**
   The size of the area targeted at each stage should be manageable enough to enable thorough follow-up control two to three times a year. Follow-up work in the first year is particularly delicate as care must be taken to treat the Madeira vine seedlings amongst native seedling recolonisation.

   Include monitoring of native plant regeneration, as well as weed response to management. Highly degraded sites may require active replanting and early detection of invasion by other weed species is critical to ensure the long-term recovery of the site.

6.5.1 Biological control

The leaf feeding beetle, *Plectonychna correntina* has recently been approved for release in Australia. Both the adult and larval stages feed on the leaves of Madeira vine, reducing photosynthetic capacity and thereby depleting food resources stored in the tubers. Significant defoliation should also promote canopy recovery in host plants. Releases have occurred in New South Wales and Queensland. At many of these sites the agent has established and significant leaf damage has been observed.

6.5.2 Physical control

Physical removal is difficult because of the number of aerial and subterranean tubers and ease of fragmentation of the vine and root system. However this may be practical at smaller or immature infestations or as a follow-up approach to remove persistent tubers. Cutting and pulling the vines from the canopy is not generally recommended because it results in a rain of viable tubers and may be dangerous if dead and dying branches are pulled down with the vine. Never-the-less, this may be necessary where there is extreme stress on the host plant – in this case, tarpaulins should first be laid on the ground to collect as many of the aerial tubers as possible.

Tubers and vegetative material must be disposed of appropriately, as they will shoot in contact with moist soil. The most effective form of disposal of tubers is via incineration; however facilities for this are rarely available. Alternatively, tubers and vines may be composted on-site to reduce the risk of further spread. Composting sites should be established somewhere away from other vegetation where any re-growth can be easily and frequently foliar sprayed. The vines and tubers may be contained under black plastic to aid in breakdown and reduce the risk of spread by small mammals and ground dwelling birds. If on-site composting is not possible, plants and tubers may be double bagged in non-biodegradable rubbish bags and disposed of in landfill waste for burial. Do not dispose of Madeira vine in green waste bins as this may spread the weed.

6.5.3 Chemical control

Herbicides can be effective, providing they are carefully chosen and selectively applied. The main herbicide application techniques used are scrape and paint and foliar spray because they enable better translocation of herbicides to the aerial tubers. Stem injection, cut stump and basal barking techniques are less commonly used.

The best results will be achieved during the warmer months, however Madeira vine grows year-round and some managers find that a primary herbicide application during late winter knocks the plant back enough to gain easy access and achieve better control during the following spring and summer months.

Remember to always follow label and permit directions when using herbicides.

Table 6. Madeira vine management summary

Growth form	Most effective treatment approach
Seedlings and ground runners	Foliar application of herbicide[†].
Small to medium sized vines that have begun to attach/climb host	Pull juvenile vines away from host if possible, curl and spray with herbicide[†]. If the vine can't be removed from host – scrape and paint with concentrated herbicide (more time consuming).
Well established vines growing into canopy	Scrape and paint with concentrated herbicide (time consuming) Alternately, some managers use cut stump and accept the 'tuber rain' because foliar spray of ground-level regrowth and juvenile vines is more cost effective.

[†] Some residual herbicides may not be suitable where there is the potential for run-off into waterways or where there could be a long-term impact on native species recruitment. Non-residual and waterway compatible herbicides are available,

Scrape and paint application (suitable for medium to large basal stem sizes)

This approach provides the safest management option in sensitive environments but is extremely labour intensive as every vine must be treated individually.

Scrape sections of the vine down to the white fibrous layer and immediately paint the exposed area with concentrated herbicide (as per label instructions). Repeat the process as high up the stem as can be reached, and where possible, scrape areas on both sides of the stem. Be careful not to ringbark the stem as this will halt the spread of herbicide through the plant.

Foliar spray

Traditionally, foliar spray has been used as a secondary treatment to manage prostrate growth and seedlings once the primary stems have been treated using scrape and paint techniques. However, some practitioners now recommend the use of foliar spray as the primary treatment (followed by scrape and paint of remaining living stems), or as a stand-alone method of treating the plant. This approach has been developed to increase the cost effectiveness of management but does carry the risk of off-target damage. Decisions on the applicability of this management approach should be made on a site-by-site basis, considering the vegetation composition and sensitivity of the site, as well as the skills of those applying the herbicide.

Hand-held equipment (handgun and hose or knapsack) is useful to spot spray prostrate stems, seedlings and regrowth. Some selective herbicides can be used to treat vines climbing over non-susceptible (or weedy) host plants; however, extreme care must be taken.

Registered herbicides for Madeira vine

The most commonly used herbicides are described here, however further research is needed to determine the comparative effectiveness and off-target impacts of many of these herbicides and care must be taken to ensure conditions are suitable for their use.

Fluroxypyr and picloram gel (the latter under the definition of 'rhizomatous plant') are registered Australia-wide for use on Madeira vine and there are a number of minor use permits current for Queensland and New South Wales for herbicides including glyphosate, metsulfuron-methyl and triclopyr + picloram (± aminopyralid). These permits are either issued specifically for Madeira vine or under the definition of environmental weeds. For more details on the current status of pesticide permits go to www.apvma.gov.au.

For scrape and paint or cut stump techniques, glyphosate (360 g/L) is generally applied at a ratio of 1:1.5 mixed with water. Some managers also suggest the inclusion of 1.5 g of metsulfuron-methyl/10 L of water to increase the impact on aerial tubers.

For spot spraying of regrowth and seedlings with glyphosate (360 g/L) mixed with water at a ratio of 1:100; or fluroxypyr (200 g/L) mixed with water at rates of 500 – 1000 mL/100 L may be used. As neither herbicide is residual, they will not provide on-going control of tuber germination and a site may require additional follow-up applications (compared to residual herbicides) to exhaust the soil tuber bank. As glyphosate is a non-selective herbicide, indiscriminate spraying may kill desirable groundcover and native seedlings, opening up bare ground for opportunistic weed invasion. Therefore, extreme care must be taken to avoid contact with desirable species.

Foliar spraying of Madeira vine with 1.75 g of mesulfuron-methyl in 10 L of water plus penetrant (e.g. Pulse®) has also proven successful at controlling Madeira vine infestations, and may provide longer-term control because of its residual nature.

More selective and residual herbicides such as triclopyr (300 g/L) + picloram (100 g/L) at mix rates of 200 – 400 mL/100 L of water may provide better long-term results for foliar spray because of the impact on tubers. This includes improved movement of herbicide into aerial tubers. Grasses, ferns, rushes and sedges should be unaffected at these usage rates, but this herbicide will have an impact on other woody plants and vines, particularly in the immature stages. Until further trials assess the long-term impacts on germination of native species, the use of these residual herbicides should be avoided in more sensitive sites. However, residual herbicides may provide a better control option in degraded and heavily infested sites where recolonisation of native species from adjacent areas or active revegetation will be required regardless.

The application of both selective and non-selective herbicides must be done with extreme care, following label or permit instructions and by an experienced operator. The use of a dye is recommended to enable managers to identify which areas have been treated. Off-target spraying has the potential to significantly deplete the native seed bank and may jeopardise long-term recovery of the site.

Identified research gaps and priorities

Potential research requirements were compiled from stakeholder feedback (Table 7). These have been categorised and linked to existing actions in the Plan, but are not prioritised. The development of a National Invasive Vines and Scramblers Research Framework (Action 3.4.2) is recommended in association with relevant research groups (local and international) and land managers. This framework should identify priorities and establish a cohesive structure, sequence and time frame within which to address research and management requirements. It should also establish communication networks (linkages with the Vines and Scramblers Communications Plan) to promote an ongoing dialogue between researchers and land managers.

Table 7. Preliminary identification of Madeira vine research gaps

Category	Possible research areas	Background / benefit	Strategic Plan linkages
Biology / ecology	Vegetative vs. sexual reproductive mechanisms	Seed production was described for the first time in Australia in 1999 (Swarbrick 1999) but is considered rare in this country. Seed production is common in the species' native range but does not occur in New Zealand (Esler 1988) or China (Shu 2003 and Hawaii (Starr et al 2003). Xifreda et al (1999) suggests two subspecies exist: *gracilis* and *cordifolia.* Subsp. *gracilis* produces viable pollen and fruit, while *cordifolia* produces abnormal pollen grains and is virtually sterile. More information is needed to determine the prevalence of seed production in Australia, potential for long-distance dispersal and implications for control and containment programs.	1.1.1
	Limiting/promoting factors for spread and establishment	Potential for better identification of ecosystems at risk of invasion and better information to contribute to predictive modelling	1.1.2
	Predictive modelling – high risk invasion pathways	Identification of priority surveillance zones	1.1.2 1.2.2 1.2.3
	Develop local / site-specific protocols for estimating abundance and links to biomass	This information is required to quantitatively gauge the efficacy of management methods e.g. biocontrol impacts	2.2.2 2.2.4 3.4.4
Ecosystem restoration	Guidelines for ecosystem restoration following vine management	Compilation of existing knowledge and identification information gaps – lead to development of restoration guidelines	2.2.1 3.2.3
	Better integration of vine and other weed species management	Information required on other typical weed invaders, successional and regeneration processes, management/promotion of native species	2.2.1 3.2.3
Improved	Costs/benefits of residual	Recent research suggests residual	3.2.1

herbicide control	and selective herbicides and other additives such as fulvic acid	herbicides are more effective in the management of Madeira vine and its tubers than the more commonly used glyphosate. What are the potential impacts of residual herbicides on sensitive ecosystems and are the impacts of an uncontrollable Madeira vine infestation greater than those of the residual herbicides? Are there other additives that may provide a better long-term outcome? Are recommended concentrations appropriate (some research suggests lower concentrations effective with fewer off-target impacts (T. Scanlon pers. comm.)	
	Mechanisms, including physiology, of herbicide uptake, sequestration and/or long-term effects on aerial and subterranean tubers	Tuber persistence is seen as the major barrier to successful control of Madeira vine. Understanding herbicide translocation and sequestration mechanisms may provide management solutions	3.2.1
Eradication/ containment feasibility	Identify key factors that determine eradication and containment feasibility of Madeira vine	This information is valuable for the identification of strategic management priorities	1.3.2 1.3.3
Biological control	Maintain efforts to research and distribute biological control agents	The first biological control agent for Madeira vine was released in Queensland and New South Wales in 2011-12. Depending on the level of success, further biological control research may be required to support the program	2.2.4 3.4.1
	Monitoring of biological control impacts	Standardised biological impact monitoring protocols should be established and promoted	2.2.2 2.2.4
Impacts / costs	Accurate accounting of the environmental, economic and social cost of Madeira vine	A good knowledge of the impacts of Madeira vine is required to ensure priority assets are protected and as a motivational tool to encourage broader community involvement in Madeira vine management	3.3.2
	Quantify control costs and benefits of different management approaches	Costs and benefits of control form a valuable component of the decision making process	3.3.2
Social research & extension technologies	Peri-urban and urban community weed management perceptions and drivers	Social / behavioural research to provide a foundational understanding of public perceptions and better target education, awareness and best practice application	3.3.1
	Communication / extension technologies that encourage community involvement in weed surveillance and management	Peri-urban and urban communities are difficult to engage with. New, exciting and easy-to-use reporting and information-access technologies could provide an important impetus for involvement	3.3.1

6.6 Quarantine and legislation

The import of Madera vine (both *Anredera cordifolia* and *Anredera baselloides,* including their seeds or reproductive material) into Australia is prohibited by legislation administered by DAFF Biosecurity (formerly the Australian Quarantine and Inspection Service). Table 8 provides a list of the relevant State and Territory Legislation and the declaration status of Madeira vine at the time of writing.

Table 8. State/Territory declaration status for Anredera cordifolia

	Legislation		
o *Queensland*	*Land Protection (Pest and Stock Route Management) Act 2002*	Class 3 (Environmental Weed) State-wide	The plant and its reproductive material cannot be sold or distributed. Control may be required for the protection of environmentally significant areas.
New South Wales	*Noxious Weeds Act 1993*	Class 4 noxious weed in selected Local Control Areas (see NSW DPI website for details)	In these areas the growth of the plant must be managed in a manner that reduces its numbers, spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed.
Northern Territory	*Weeds Management Act 2001*	Not currently declared	
Western Australia	*Biosecurity and Agriculture Management Act 2007*	Not currently declared	
South Australia	*Natural Resource Management Act 2004*	Not currently declared	
Victoria	*Catchment and Land Protection Act 1994*	Not currently declared	
Tasmania	*Weed Management Act 1999*	Not currently declared	
ACT	*Pest Plants and Animal Act 2005*	Not currently declared	The ACT Weeds Strategy 2009-2019 states: “Included in the declaration schedule are those pest plants that have been determined to be WoNS and that are either established in the ACT or have the potential to establish”.

7 Appendices

7.1 Weed control contacts

State	Department	Phone	Email	Website
ACT	Environment and Sustainable Development Directorate	132281	environment@act.gov.au	www.environment.act.gov.au/environment
NSW	Biosecurity NSW, NSW Dept of Primary Industries	1800 680 244	weeds@industry.nsw.gov.au	www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds
NT	Dept of Natural Resources, Environment, The Arts and Sport	08 8999 4567	weedinfo.nretas@nt.gov.au	www.nt.gov.au/weeds
QLD	Biosecurity Queensland, Dept of Agriculture, Fisheries and Forestry	132523	callweb@dpi.qld.gov.au	www.biosecurity.qld.gov.au
SA	Biosecurity SA, Dept of Primary Industries and Regions SA	08 8303 9620	nrmbiosecurity@sa.gov.au	www.pir.sa.gov.au/biosecuritysa/nrm_biosecurity/weeds
TAS	Dept of Primary Industries, Parks, Water and Environment	1300 368 550	www.dpipwe.tas.gov.au/weeds scroll to the bottom of the page and click on “weeds enquiries”	www.dpipwe.tas.gov.au/weeds
VIC	Dept of Primary Industries	136186	customer.service@dpi.vic.gov.au	http://new.dpi.vic.gov.au/agriculture/pests-diseases-and-weeds
WA	Dept of Agriculture and Food	08 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au
Australia wide	Australian Pesticides and Veterinary Medicines Authority	02 6210 4701	contact@apvma.gov.au	www.apvma.gov.au

7.2 Other information sources

Information on all the WoNS species, as well as contact details for the Coordinators is available on the Weeds Australia website at www.weeds.org.au/WoNS. This site acts as a hub for published strategic plans, extension resources, mapping information, priority action tables (annual priorities mapped to regional scale); and monitoring, evaluation and reporting information. The Strategic Plan support documents (see Section 3) will be published here.

7.3 The WoNS Program and its phases[§]

In 2007, an independent review of the WoNS program concluded that the nationally strategic approach of WoNS was highly successful in leveraging consistent multi-jurisdictional activity on high priority weed species. This initial review was followed by a detailed review of the inaugural WoNS species by the Australian Weeds Committee (AWC) in 2009-10. The AWC reviewed the implementation of the 20 WoNS national strategies and, in light of achievements for these 20 species, considered the capacity for national coordination of additional WoNS species.

Following the reviews, the Natural Resource Management Ministerial Council (Resolution 15.7, 21 May 2009) endorsed a three-phased approach to national management of WoNS species (Figure 6). This 'phased approach' aims to provide the most cost-effective use of limited 'national coordination' resources.

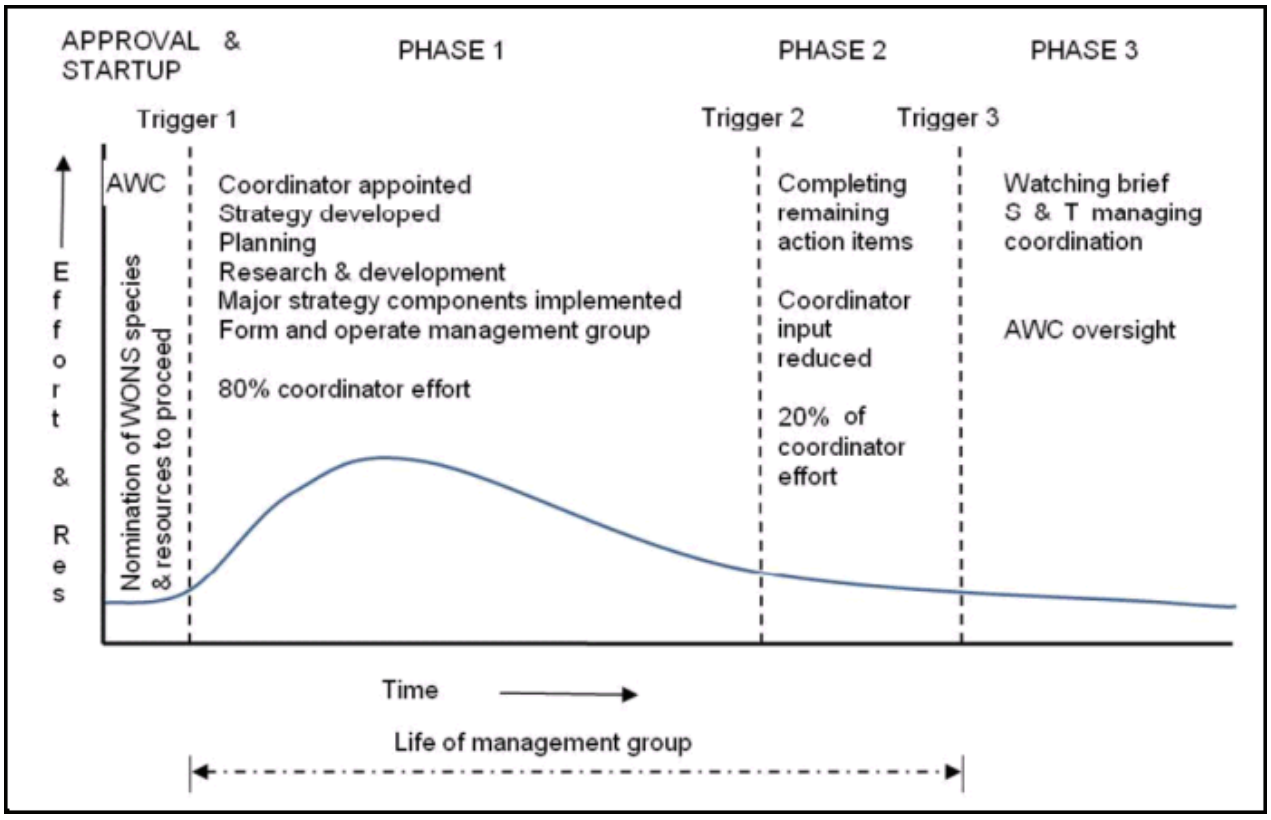


Figure 6. *Australian Weed Committee diagrammatic representation of coordinator effort and resource use when implementing a Weeds of National Significance strategy*

The phased approach recognises the need for reduced national coordination ('phasing down') of WoNS species that are under effective national management, and allows for further weed species to be nominated for consideration as additional WoNS. The AWC is implementing these reforms, and national coordination of the inaugural 20 WoNS species has already transitioned to Phase 2 or 3, depending on the species. No species have yet been removed from the WoNS list. The AWC is developing a protocol to guide future decisions about when this should occur on a case by case basis.

In 2010, jurisdictions nominated additional candidate WoNS species. Theses species were independently assessed and the AWC endorsed twelve additional 'species' to be listed as WoNS. The AWC Chairman, Dr Jim Thompson, announced these additional plant species as WoNS on 20 April 2012. Additional information on the selection of these species and the phased approach is available on www.weeds.org.au/WONS.

[§] Adapted from Thorp 2012 "Additional List of Weeds of National Significance – April 2012" www.weeds.org.au/WoNS.

7.4 Glossary and Acronyms

Asset protection – A weed management approach to reduce impact or threat to a high value asset (environmental, economic or social) e.g. at a national scale this may include the protection of EPBC listed species or ecosystems.

AQIS – Australian Quarantine and Inspection Service.

AWC – Australian Weeds Committee.

AWS – Australian Weeds Strategy 2007.

Biosecurity / Weed Authorities - statutory agencies/groups responsible for weed management. These vary across jurisdictions (e.g. at state government level in QLD, local government level in NSW and regional NRM level in SA, etc.).

Citizen science – scientific research conducted by amateur or non-professional scientists. This typically includes detection and mapping of weeds and monitoring of management outcomes.

Containment – A weed management approach that aims to prevent an increase in the current distribution of a weed, by using weed control procedures to reduce the density of existing infestations and limit the dispersal of propagules through the establishment of management or enforcement regions e.g. containment lines and zones. Highly effective containment programs can actually result in a decrease in the current distribution of a weed.

Coordinated control – A strategic weed management program that enables joint, cross-tenure action to ensure the application of weed control procedures towards a specific end (e.g., eradication or containment).

Core infestation – weed infestation which are relatively abundant and widespread or in difficult to access areas where management is not feasible.

Eradication -The elimination of every single individual of a species from an area to which recolonisation is unlikely to occur, including propagules (Myers et al 1998).

IGAB – Intergovernmental Agreement on Biosecurity.

NIVaST – National Invasive Vines and Scramblers Taskforce (includes Madeira Vine Strategic Plan Committee).

NRM Groups – Natural Resource Management groups (including Catchment Management Authorities).

Outlier – A satellite weed infestation separate from the core. This could be managed through a localised containment or eradication program.

Partner – Person, group or organisation actively supporting/participating/investing in weed management/ WoNS strategy implementation / responsibility / contribution.

Priority assets – high value (environmental, primary production, cultural and social) assets determined to be at risk – can be applied at varying scales.

Priority outliers – outliers which are feasible to eradicate, contain or reduce / prevent spread.

Stakeholder – person, group or organisation interested in or concerned about weeds and or their management.

WoNS – Weeds of National Significance.

7.5 References

Anonymous 2005, *Weeds of the Blue Mountains bushland. Garden plants going wild – a guide to identification and control,* viewed June 2012, <www.weedsbluemountains.org.au/madeira_vine.php>.

Batianoff, GN & Butler, DW 2002, 'Assessment of invasive naturalized plants in south-east Queensland', *Plant Protection Quarterly*, vol. 17, pp. 27–34.

Beale, R, Fairbrother, J, Inglis, A, & Trebeck, D 2008, *One Biosecurity: a Working Partnership*, Commonwealth of Australia, Canberra.

Blood, K 2001, *Environmental weeds: a field guide for south-east Australia,* CH Jerram and Associates – Science Publishers, Mt. Waverley, Victoria.

Boyne, R, Osunkoya, O & Scharaschkin, T, *In press,* 'Variation in leaf structure of the invasive Madeira vine (*Anredera cordifolia*, Basellaceae) at different light levels', *Australian Journal of Botany,* submitted 23 March 2013.

Carr, GW, Yugovic, JV & Robinson, KE 1992, *Environmental Weed Invasions in Victoria – conservation and management implications,* Department of Conservation and Environment and Ecological Horticulture, Victoria.

COAG (Council of Australian Governments) 2012, *Intergovernmental Agreement on Biosecurity: An agreement between the Commonwealth of Australia, state and territory governments to strengthen the national biosecurity system,* COAG, Canberra, viewed 6 August 2012, <www.coag.gov.au/node/47>.

Coutts-Smith, A & Downey, PO 2006, *Impact of weeds on threatened biodiversity in New South Wales,* Technical Series no. 11, CRC for Australian Weed Management, Adelaide.

Csurhes, S & Edwards, R 1998, *Potential environmental weeds in Australia: Candidate species for preventative control,* Biodiversity Group, Environment Australia, Canberra, 208 pp.

Department of Primary Industries 2010, *Invasive Plants and Animals Policy Framework,* State Government of Victoria, Melbourne.

Downey, PO, Scanlon, TJ & Hosking, JR 2010, 'Prioritizing weed species based on their threat and ability to impact on biodiversity: a case study from New South Wales', *Plant Protection Quarterly,* vol. 25(3), pp. 111 – 126.

Dunphy, M 1991, 'Rainforest weeds of the big scrub', *Rainforest Remnants: Proceedings of a workshop held at the North Coast*, pp. 109 -15, New South Wales National Parks and Wildlife, Lismore, NSW.

Esler, AE 1988, 'The naturalisation of plants in urban Auckland, New Zealand 4. The nature of the naturalised species', *New Zealand Journal of Botany,* vol 26, pp. 345-85.

Ernst CM & Cappuccino N 2005, 'The effect of an invasive alien vine, *Vincetoxicum rossicum* (Asclepiadaceae), on arthropod populations in Ontario old fields' *Biological Invasions,* vol 7, pp. 417 - 425.

Floyd, AG 1985, 'Management of small rainforest areas (Part 1)', *National Parks Journal,* vol 29(2), pp. 17 – 19.

Floyd, AG 1989, 'The vine weeds of coastal rainforest: Noxious plant control: responsibility, safety and benefits', *Proceedings of the 5th Biennial Noxious Plants Conference*, vol 1, 109 – 15, New South Wales Agriculture and Fisheries, Sydney NSW.

Harden, GJ & Fox, MD 1988, *Wingham Brush regeneration assessment,* Report 9, Royal Botanic Gardens Sydney.

Harden, GJ, Fox, MD & Fox, BJ 2004, 'Monitoring and assessment of restoration of a rainforest remnant at Wingham Brush, NSW', *Astral Ecology,* vol 29, pp. 489 – 507.

Hobbs, RJ & Humphries, SE 1995, 'An integrated approach to the ecology and management of plant invasions', *Conservation Biology*, vol. 9(4), pp. 761-770.

ISSG Database (Global Invasive Species Database), *Distribution of Anredera cordifolia,* viewed June 2012, <www.issg.org/database/species/distribution.asp?si=776&fr=1&sts=sss&lang=EN>.

Lawson, BE 1999, 'Predicting the potential distribution of two environmental weed species, *Anredera cordifolia* and *Schinus terebinthifolia*, using CLIMEX', BSc (Honours) Thesis, The University of Queensland, St. Lucia, Queensland.

Lloyd, S 2006, *Department of Agriculture Garden note 37: Climbers out of control,* Department of Agriculture, Western Australia.

McFadyen, R 2011, 'Successful control of Madeira vine in natural vegetation in southeast Queensland', *Proceedings of the 11th Queensland Weeds Symposium, Mackay*.

Mulvaney, MJ 1991, 'Far from the garden path: an identikit picture of woody ornamental plants invading south-eastern Australia bushland', Ph.D. Thesis, Australian National University, Canberra, ACT.

Muyt, A 2001, *Bush invaders of south-east Australia: a guide to the identification and control of environmental weed found in south-east Australia,* R.G. and F.J. Richardson, Melbourne.

Myers, JH, Simberloff, D, Kuris, AM, Carey JR 2000, 'Eradication revisited: dealing with exotic species', *Trends in Ecological Evolution,* vol 15, pp. 316-320

NRMMC (Natural Resource Management Ministerial Council) 2006, *Australian Weeds Strategy – A national strategy for weed management in Australia,* Australian Government Department of the Environment and Water Resources, Canberra ACT.

NSW DPI & OEH 2011, *Biodiversity priorities for widespread weeds,* Report prepared for the 13 Catchment Management Authorities (CMAs) by NSW Department of Primary Industries and Office of Environment and Heritage, Orange.

NSW Environment and Heritage 2006, *Exotic vines and scramblers – key threatening process listing,* viewed June 2012, <www.environment.nsw.gov.au/determinations/ExoticVinesKtp.htm>.

Osunkoya, OO, Bayliss, D, Panetta, FD & Vivian-Smith, G 2010, 'Variation in ecophysiology and carbon economy of invasive and native woody vines of riparian zones in south-eastern Queensland', *Austral Ecology*, vol 35, pp. 636 - 649.

Palmer, W A 2009, *Application to release the leaf feeding beetle Plectonycha correntina (Coleoptera: Chrysomelidae) for the biological control of Madeira vine, Anredera cordifolia (Basellaceae),* Biosecurity Queensland, Department of Primary Industries & Fisheries**:** 1-18.

PIER (Pacific Islands Ecosystems at Risk) 2000, *Invasive plant species: Anredera cordifolia,* viewed June 2012, <www.hear.org/pier/species/anredera_cordifolia.htm>.

Richardson DM, Pyusek P, Rejmànek M, Barbour MG, Panetta FD & West CJ 2000, 'Naturalisation and invasion of alien plants: concepts and definitions', *Diversity and Distributions,* vol. 6, pp. 93 -107.

Shu, LK 2003, '*Anredera cordifolia* (Tenore) Steenis', in: *Flora of China,* vol 5, p. 446, viewed October 2012, <www.efloras.org/florataxon.aspx?flora_id=2&taxon_id=242303491>.

Sperling, CR 1995, 'New species and new combinations in *Anredera* Juss. (Basellaceae)', *Phytologia,* vol. 79(1), pp. 1 - 4.

Starr, F, Starr, K & Loope, L 2003 *Anredera cordifolia:* Madeira vine, Bassellaceae, viewed June 2012 <www.hear.org/starr/hiplants/reports/pdf/anredera_cordifolia.pdf>.

Stockard, J 1983, 'Rainforest regeneration', *National Parks Journal,* vol. 27, pp. 18 - 19.

Stockard, J, Nicholson, B & Williams, G 1985, 'An assessment of a rainforest regeneration program at Wingham Brush, New South Wales', *Victorian Naturalist,* vol. 103(3), pp. 84 - 93.

Swarbrick, JT 1991, 'Towards a rating scheme for environmental weeds", *Plant Protection Quarterly,* vol. 6, pp. 185.

Swarbrick, JT 1999, 'Technical Note: Seedling production by Madeira vine (*Anredera cordifolia*)', *Plant Protection Quarterly,* vol. 14(1), pp. 38 - 39.

Vivian-Smith, G & Panetta, D 2002, 'Going with the flow: dispersal of invasive vines in coastal catchments', *Proceedings of the Coast to Coast conference 2002*, pp. 491– 494.

Vivian-Smith, G, Lawson, BE, Turnbull, I & Downey, PO 2007, 'The biology of Australian weeds: 46. *Anredera cordifolia* (Ten.) Steenis', *Plant Protection Quarterly,* vol. 22(1), pp. 2 -10.

Wagner, WL, Herbst, DR & Sohmer, H 1999, *Manual of the flowering plants of Hawaii,* Bishop Museum Special Publication 83, University of Hawaii Press and Bishop Museum Press, Honolulu, HI, USA.

Watts, E & Smith, L 2012, Unpublished data: The Weight of the Vine Research Project, Wollongong University.

West, C J 2002, 'Eradication of alien plants on Raoul Island, Kermadec Islands, New Zealand', *Turing the tide: the eradication of invasive species,* C. R. Veitch and M. N. Clout, IUCN SSC Invasive Species Specialist Group, IUCN**:** 365-373.

Wilson, PD, Downey, PO, Gallagher, RV, O'Donnell, J, Leishman, MR & Hughes, L 2010, *Modelling climate suitability for exotic plants in Australia under future climate: Final report on the potential impact of climate change on the distribution of national priority weeds in Australia.* Report prepared by Macquarie University on behalf of the NSW Office of Environment and Heritage, Sydney Australia.

Xifreda, CC, Argimon, S & Wulff, AF 1999, 'Infraspecific characterization and chromosome numbers in *Anredera cordifolia* (Basellaceae)', *Thaiszia Journal of Botany,* vol. 9(2), pp. 99 – 108.