Australian Government
Department of Agriculture, Fisheries and Forestry

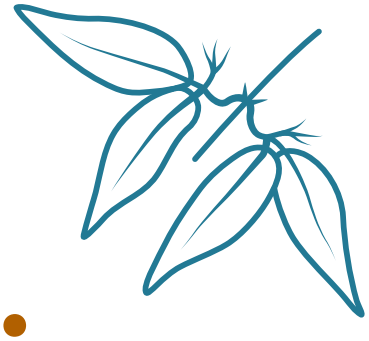


Weeds of National Significance

Invasive vines

National best practice management manual for cat's claw creeper (*Dolichandra unguis-cati*) and Madeira vine (*Anredera cordifolia*)

Australian Government
Department of Agriculture, Fisheries and Forestry



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National best practice management manual for cat's claw creeper (*Dolichandra unguis-cati*) and Madeira vine (*Anredera cordifolia*)

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2024

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We acknowledge the Traditional Custodians of Australia and their continuing connection to land and sea, waters, environment and community. We pay our respects to the Traditional Custodians of the lands we live and work on, their culture, and their Elders past and present.

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Additional information sources

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The authors gratefully acknowledge the Australian National Botanic Gardens and the Australian Plant Image Index as the source of several plant images in this publication. You can view the image collection at anbg.gov.au/photo

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Using this manual

Who should use this manual?

This manual has been written to assist anyone with an interest in managing invasive vines, from site managers, community groups, private landholders and volunteers to government agency staff and managers of waterways and resources. The manual's content is intended to help people make decisions about invasive vine management by providing a guide based on current knowledge and understanding of best practice.

Where does the information come from?

The information in this manual has been sourced from Australian and international published material, research, and reviews by technical experts. It also incorporates the experiences of individuals and organisations currently managing invasive vines in Australia.

While this manual aims to provide a synthesis of the most current information on best practice management of cat's claw creeper and Madeira vine, it is acknowledged that this will continue to evolve. Further information will come from future research, continued development of weed control tools, and ongoing land manager observations on managing these invasive vines throughout Australia.

How to use this manual

This manual has been designed to allow easy access to all available information on managing cat's claw creeper and Madeira vine. Arranged in six stand-alone yet complementary chapters, the manual presents an overview of invasive vines and scramblers (Chapter 1), a guide to the biology and impacts of cat's claw creeper and Madeira vine (Chapter 2), how to develop a weed management plan (Chapter 3), how cat's claw creeper and Madeira vine can be prevented and controlled (Chapter 4) and case study examples of how these weeds are being managed (Chapter 5). Chapter 6 provides more specifics and sources of further information.

The manual also highlights how to increase a site's resilience to future weed invasion and assess the potential need for site restoration based on disturbance levels. The role of natural regeneration and revegetation after invasive vine control is also discussed.

It is important that the information provided in this manual is adapted by individuals according to their own environmental, financial and social circumstances. Always seek local advice in planning weed control on your property or the sites you manage.

Summary of the six chapters

1. Invasive vines and scramblers – an overview
- The difference between vines and scramblers
- Where they come from
- General impacts
- Help with identification

2. Biology, ecology and threat – cat's claw creeper and Madeira vine
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- The importance of planning
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- What are other land managers doing?
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- Identification of other vines and scramblers
- Legal obligations to control
- Useful contacts
- Herbicide use, training and certification
- References

Glossary

Allelopathic	A plant releases chemical compounds that affect the growth, development, and distribution of other plants and microorganisms
Appendages	A subsidiary part of a plant, such as a leaf or branch, that is usually smaller and less functional than the main part it is attached to
Compound leaves	Leaves that are made up of multiple leaflets that are attached to a common stalk
Delimitation	The process of determining the full extent of an invasion. This usually involves intensive surveys of areas in which the species is considered likely to be present (Blood et al., 2019)
Dispersal	Process of transporting propagules via a vector, such as wind, water, birds or other animals
Eradication	The elimination of every individual plant and propagules (both seeds and vegetative plant parts) in a defined area, plus no further reintroduction from outside the area
Exotic	See 'introduced'
Introduced plant	A plant that has been moved from its native environment to a new location by human activity, either intentionally or accidentally
Invasive plants	Non-native plants that are introduced to a new area and spread rapidly, causing harm to the environment, economy, or human health
Propagule	Any part of a plant that can become detached to produce a new plant, e.g. bud, sucker, seed, spore
Scrambler	A plant that creeps along the ground and grows over other plants using hooks, thorns, or tendrils
Skirting	A control method for cat's claw creeper that involves cutting vines at chest height and again just above ground level. It does not kill underground tubers and follow-up control is required
Stomata	Microscopic pores on the surface of plants that allow for gas exchange and water loss control
Surveillance	The process of monitoring and recording the presence, absence, and population levels of pests and diseases to detect and respond to biosecurity threats
Threatened ecological communities	A rare group of native plants, animals, and other organisms that are at risk of extinction
Transformer species	A type of invasive plant that can significantly alter the nature of an ecosystem over a large area
Vegetative reproduction	A type of asexual reproduction where a new plant grows from a fragment of the parent plant
Vine	A plant that uses different features to climb, such as spines, tendrils and aerial roots
Weed incursion	When an invasive species is detected in a region for the first time, or when isolated populations of an invasive species are newly discovered

Abbreviations

ACT	Australian Capital Territory
Cth	Commonwealth
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DPI	Department of Primary Industries
GPS	global positioning system
NRM	Natural Resource Management
NSW	New South Wales
Qld	Queensland
SA	South Australia
SEQ	South East Queensland
NT	Northern Territory
Tas	Tasmania
Vic	Victoria
WoNS	Weeds of National Significance
WA	Western Australia

WoNS
WEEDS OF NATIONAL SIGNIFICANCE

Cat's claw creeper and Madeira vine are Weeds of National Significance

These species were added to the existing list of 20 Weeds of National Significance (WoNS) in 2012. National strategic plans were developed, which aimed to prevent new incursions; encourage best practice management of existing infestations; and increase capacity and willingness to manage these weeds.

For more information visit: weeds.org.au/lists/established/

Chapter 1

Invasive vines and scramblers – an overview

At a glance

- **Vines and scramblers are a diverse group of climbing plants that use other plants or structures as supports.**
- **Plants use different features to climb, such as spines, tendrils and aerial roots.**
- **Invasive vines and scramblers can change the structure and function of natural areas, with impacts for native plant and animal communities.**
- **The performance of agricultural crops and forestry plantations can also be negatively impacted by invasive vines and scramblers.**
- **The presence of invasive vines and scramblers can restrict human access and reduce aesthetic values of natural areas.**
- **Some invasive vines and scramblers are poisonous to humans.**
- **The impacts of invasive vines and scramblers are acknowledged as key threatening processes under Australian and New South Wales (NSW) legislation.**
- **It is important to correctly identify which species of vines and scramblers are present at sites so that you can manage them appropriately.**

What are they?

The term 'invasive vines and scramblers' is used to describe those species that have been introduced to Australia and are known, or have the potential, to establish and cause negative impacts (Bernich et al., 2024).

Invasive vines and scramblers are a diverse group of climbing plants. They:

- are typically fast growing
- produce copious amounts of seed and/or other propagules such as tubers
- use other plants and structures—such as buildings or fences—as supports, allowing them to invest more resources into growth and reproduction than self-supporting species can
- can cause extensive damage to both native plant communities and planted vegetation (including gardens or commercial plantations).

Native vines and scramblers may also exhibit invasive tendencies in some situations. See Chapter 6 for examples of other common vines and scramblers, both introduced and native.

Origin

Most invasive vines and scramblers were introduced to Australia for ornamental purposes and have subsequently escaped from gardens.

A 2007 study found 179 non-native vine and scrambler species present in Australia, from all continents except Antarctica (Harris et al., 2007).

What makes a plant a vine or a scrambler?

Vines and scramblers are species of plants that either grow up, or out across the ground (APS NSW, 2020). They do not form their own supports, and instead use other plants or structures (e.g. fences) to grow. They climb in various ways:

Twiners

Twist their way up, wrapping their whole stem around the support; e.g. common silkpod (*Parsonsia straminea*), shown here.

Adam Bernich

Tendril climbers

Use modified appendages to 'grab' onto small branches and other supports; e.g. kangaroo vine (*Cissus antarctica*), shown here.

Adam Bernich

Aerial roots

Sprout from the stem, or leaves of climbing plants, which can stick onto supports. Also called adventitious roots; e.g. cat's claw creeper (*Dolichandra unguis-cati*), shown here.

Adam Bernich

Scramblers

Grow over the top of lower-lying vegetation; e.g. trad (*Tradescantia fluminensis*), shown here.

Matt Sheehan

Spines

Hook onto supports as they climb; e.g. cockspur thorn (*Maclura cochinchinensis*), shown here.

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Preferred habitats

Invasive vines and scramblers affect a range of ecosystems across Australia, particularly rainforests or wet sclerophyll forests. In South East Queensland (Qld) and NSW alone, vines and scramblers account for approximately 70% of introduced species in subtropical rainforests (Grice and Setter, 2003).

They can also dominate a wide range of habitats such as coastal dune scrub, savannahs, floodplain forests and open woodlands, and can be prolific in riparian areas and disturbed areas such as roadsides and urban parklands.

Impacts

Environmental

The smothering and rambling nature of invasive vines and scramblers can cause functional and structural changes to the vegetation communities that they invade. They do this by:

- smothering vegetation at the ground, shrub layer and canopy, and suppressing growth and recruitment of native species (Harris et al., 2007)
- increasing the risk of tree and shrub damage through extra weight on limbs and branches, increasing susceptibility to damage during storm events (Estrada-Villegas and Schnitzer, 2018; Phillips et al., 2002)
- having extensive root systems, making them strong competitors for underground resources such as water and nutrients (Schnitzer et al., 2005)
- killing trees through the combined effect of the above impacts (Estrada- Villegas and Schnitzer, 2018; Phillips et al., 2002)
- altering soil chemistry and nutrient cycling, which can further suppress the growth and recruitment of native species (French et al., 2017; Schnitzer et al., 2005).

These impacts have flow-on effects for animal communities, reducing the abundance and diversity of plant-dwelling invertebrates (Harden et al., 2004), restricting movement and water access for some native fauna and favouring pest animals by providing protective shelter (NSW Scientific Committee, 2006).

'Structural parasites' transforming entire ecosystems

Matt Sheehan

Pictured here is a highly disturbed wet sclerophyll forest in northern Sydney, NSW, where multiple invasive vines and scramblers—including balloon vine, lantana, Madeira vine and trad—have established.

This is an excellent example of why invasive vines and scramblers are often referred to as 'structural parasites': the species are dominating the canopy and causing physical damage or death to host plants and surrounding vegetation (Harris et al., 2007).

Many invasive vines and scramblers have also been categorised as transformer species because of the severe and often irreversible damage they cause to the invaded ecosystem (Ernst and Cappuccino, 2005; Richardson et al., 2000; Swarbrick, 1991).

Climbing to boost reproduction

Kate Blood

The ability of vines to climb to treetops puts them in a prime position for long-distance seed dispersal. Windblown seeds can be carried many kilometres. In this photo, the ivy (*Hedera* spp.) that covers this tree is putting its fruit in prime bird-dispersal position. Birds and arboreal animals eat fruits and deposit seeds long distances away, and seeds can fall into water courses and be carried away.

Impacts to threatened species

The Richmond birdwing butterfly (*Ornithoptera richmondia*) is a highly threatened species of subtropical rainforest in Qld/NSW, vulnerable to the clearing of rainforest habitat. At low elevations, its larvae depend entirely on the native birdwing butterfly vine (*Pararistolochia praevenosa*) for food.

Unfortunately, this vine species (also near threatened) is often outcompeted by exotic vines and scramblers, reducing the number of host plants available to the butterfly.

To make matters worse, the butterflies are also attracted to the closely related exotic vine, Dutchman's pipe (*Aristolochia elegans*; top right photo) and often lay eggs on it (bottom photo). The leaves of Dutchman's pipe are poisonous and fatal to larvae that try to feed on them (Queensland Government, 2020).

The butterfly's survival is dependent on containment of Dutchman's pipe and prevention of it dominating the few remaining rainforests that provide habitat to the butterflies.

Adam Bernich

Don Sands

Agriculture and production systems

While the impacts of vines and scramblers on intensive agriculture systems is believed to be low, there are some documented cases in specific industries where they can be problematic. Vines and scramblers can reduce the performance and yield of crops. For example, common morning glory (*Ipomoea purpurea*) can reduce soy bean yields by up to 80% when at high densities (Pagnoncelli et al., 2017). Some species of invasive vine, such as moth vine (*Araujia sericifera*), are poisonous to livestock.

Forestry is the most impacted industry, with invasive vines and scramblers reducing tree growth and damaging branches (Estrada-Villegas and Schnitzer, 2018). When a tree with attached vines is felled, neighbouring trees may be damaged or even pulled down (Estrada-Villegas and Schnitzer, 2018). This may have both economic and safety implications.

Social

Invasive vines and scramblers can also have significant social costs, reducing the enjoyment of and ability to utilise, impacted natural areas. They can quickly grow over tracks and form thickets that can restrict movement and access, as well as reduce the aesthetic values and social amenity of parks and reserves. This is particularly problematic for species with spiky stems or thorns, such as climbing asparagus (*Asparagus plumosus*) and Mysore thorn (*Caesalpinia decapetala*).

In urban areas, vines and scramblers can occur as weeds on neglected land, parks, gardens and reserves where garden waste is commonly disposed. They can move from these areas into native bushland.

Some species, such as moth vine, glory lily (*Gloriosa superba*) and English ivy (*Hedera helix*) are poisonous to humans and often grow in residential environments. Leaves of old man's beard (*Clematis vitalba*) are poisonous and can cause skin irritations.

Invasive vines and scramblers – a key threatening process

Invasive vines and scramblers are the subject of key threatening process listings, meaning they threaten or may threaten, the survival, abundance or evolutionary development of a native species or ecological community. The listings include:

- 'Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants'. Listing under the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (Threatened Species Scientific Committee, 2010).
- 'Invasion and establishment of exotic vines and scramblers'. NSW Key Threatening Process listing (NSW Scientific Committee, 2006).

These key threatening process listings identify species and communities at risk and the actions required to reduce impacts. Aligning with or complementing the threat reduction recommendations for these listings should be considered when planning vine and scrambler control activities.

Refer to Chapter 6 for further information on the legal status and management requirements of cat's claw creeper and Madeira vine.

Bluebell creeper (*Billardiera heterophylla*), a native vine that has established outside its natural range, contains toxins that can cause skin irritation and nausea, while the spines of leaf cactus (*Pereskia aculeata*) can injure people and pets.

Invasive vines and scramblers can also affect the welfare of weed managers, conservationists and nature enthusiasts. The noticeable degradation of natural areas following vine and scrambler invasion can be distressing and overwhelming for those who work in and care for these environments. Additionally, the requirement for long-term management of vines and scramblers is often taxing—physically, financially and emotionally—for land managers.

Economic

There is currently limited ability to quantify the economic cost of vines and scramblers across the range of situations and values that they impact – in particular, the environment. Similarly, current control costs vary considerably depending on the species, management approach employed and density and remoteness of the infestation.

Identifying invasive vines and scramblers

Knowing which vine or scrambler species are present at a site is important so that you can choose the most appropriate control method while protecting native species from off-target damage.

Identifying invasive vines and scramblers can be difficult because distinguishing features, such as leaves, are often in the tree canopy and there may be more than one species present, including native species.

Many vine and scrambler species have features that can make identification possible if leaves, flowers or fruit cannot be accessed. For example, cat's claw creeper is characterised by its 'claws' on young stems and dense and prominent aerial roots on larger stems, while Madeira vine may be identified by its aerial tubers on larger stems.

However, to confidently identify vine and scrambler species, samples of leaves, flowers and fruit must be taken. The following resources may assist in identifying common species (native and exotic):

- weeds.org.au/categories/vine/
- sydneyweeds.org.au/vines-and-scramblers/
- moretonbay.qld.gov.au/files/assets/public/services/environment/vines.pdf
- resources.austplants.com.au/plant-database/climbers/

You can also seek assistance by lodging a plant specimen with your state/territory herbarium. See Chapter 6 for more information, including contact details for herbaria.

While cat's claw creeper and Madeira vine are two of the most harmful invasive vines and scramblers, many other species also pose a threat to biodiversity in Australia. Refer to Chapter 6 for more information on the identification of other invasive vines and scramblers, some of which may co-occur with cat's claw creeper and Madeira vine.

Adam Bernich

Stems can assist with identification. Left to right: stems of moth vine, cat's claw creeper, coastal morning glory and balloon vine.

Chapter 2

Biology, ecology and threat

This chapter provides detailed information on the characteristics and impacts of cat's claw creeper (*Dolichandra unguis-cati*) and Madeira vine (*Anredera cordifolia*), both listed as WoNS in recognition of their damaging and widespread nature.

Cat's claw creeper profile

At a glance

- **Cat's claw creeper is native to Central and South America and the West Indies and was introduced to Australia as an ornamental plant.**
- **Plants have compound leaves, large yellow flowers and long, leathery seed pods.**
- **It is an invader of natural areas, including riparian zones, forests and woodlands. Cat's claw creeper also grows in gardens and roadsides.**
- **The weight of cat's claw creeper can break branches and kill trees. It also forms thick mats that prevent native plant germination and growth.**
- **Plants reproduce via seeds and underground tubers.**
- **Large numbers of light, papery seeds disperse long distances via wind and water.**

Cat's claw creeper is a yellow-flowering vine native to Central and South America and the West Indies, introduced to Australia as a garden plant. It has a range of features that make it a successful invader:

- vigorous, smothering growth
- large numbers of winged seeds easily dispersed by wind and water
- aerial roots that enable it to climb host trees of any size to reach light
- extensive root and long-lived tuber systems, which enable it to reproduce vegetatively and survive periods of unfavourable conditions such as drought (Downey and Turnbull, 2007).

Today, cat's claw creeper is prevalent throughout tropical, subtropical and some temperate regions of Qld and NSW, where it has escaped from backyards into a range of natural ecosystems.

Short or long pod?

This profile focuses on the short-pod form of cat's claw creeper prevalent in Australia.

A second, long-pod form occurs in isolated sites in South East Qld and, although genetically and morphologically distinct, is classified as the same species.

Studies suggest the long-pod form possesses traits more suited to opportunistic establishment (i.e. fast growth under conditions of high nutrient availability), though the short-pod form has traits that allow it to adapt to environments with different resources (Buru et al., 2014). This may explain why the short-pod form is widespread, and the long-pod form is not.

If you find a population of long-pod cat's claw creeper report it to the local weed authority (see Chapter 6 for contact details), so any distribution changes can be recorded.

See Box 2.1 for key distinguishing features of both forms of cat's claw creeper.

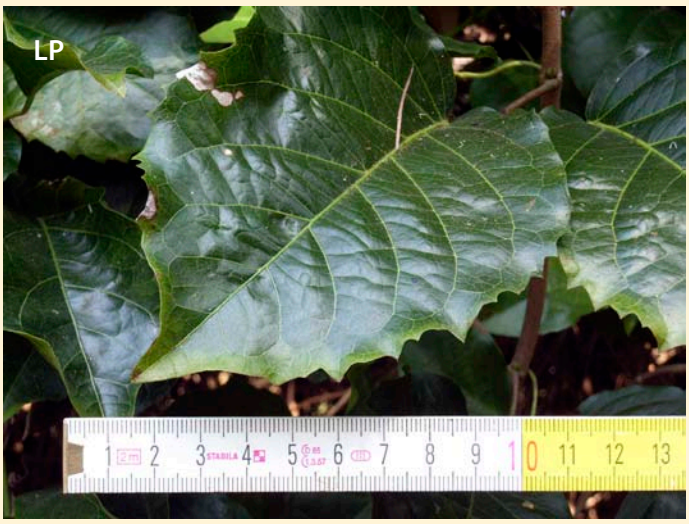
Box 2.1 Distinguishing between short- and long-pod forms

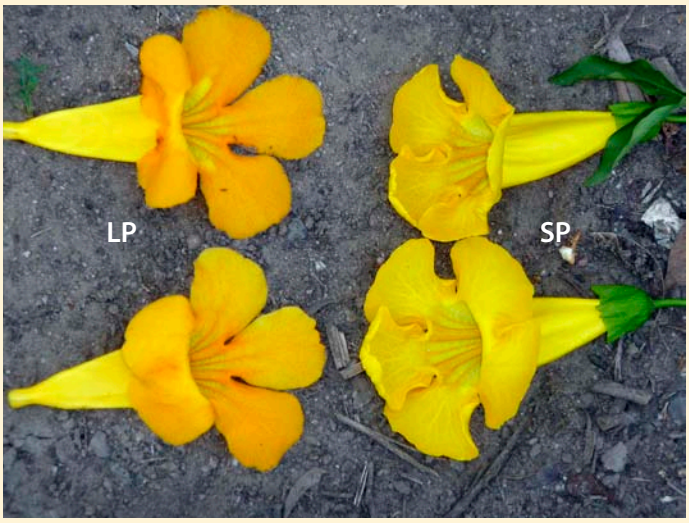
Short-pod form:

- main form found in Australia
- seed pods 15–45 cm long
- leaves 2–7 cm long, 1–3 cm wide
- flowers 2–8 cm long, yellow with darker yellow or orange streaks in the tube

Long-pod form:

- also known as hairy or bat's claw creeper
- only known to be present in a few isolated sites in South East Qld
- seed pods 60–100 cm long
- leaves longer, broader and occasionally toothed
- flowers pale orange to pale yellow





Leaves, pods and flowers of the common 'short-pod' (SP) form and less common 'long-pod' (LP) form of cat's claw creeper. Photos from Shortus and Dhileepan (2010).

Origin

Cat's claw creeper is native to Central and South America and the West Indies region (Downey and Turnbull, 2007). Because of its ornamental value, it has become widely naturalised around the world; for example, it occurs in South Africa, India, China, south-eastern United States of America (USA), Hawaii, the Pacific Islands and Europe (Downey and Turnbull, 2007; Holm et al., 1991; Langeland and Burks, 1998; Rafter et al., 2008; Sherley, 2000).

Cat's claw creeper was introduced to Australia as a garden plant, primarily to screen trellises and walls (Batianoff and Butler, 2003). The first record of sale is dated 1865, when the species was advertised in a Melbourne, Victoria (Vic) nursery catalogue (Downey and Turnbull, 2007). It was recorded as naturalised in South East Qld in the 1950s (Batianoff and Butler, 2002) and in north-eastern NSW in 1966 (Downey and Turnbull, 2007). Genetic studies suggest that most cat's claw creeper infestations in Australia are closely related to each other and likely to have been introduced from a single population in the native range (Prentis et al., 2009).

Impacts

Environmental

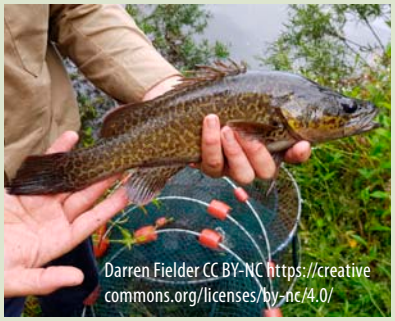
Cat's claw creeper is one of the worst environmental weeds in Qld and NSW. Of South East Qld's 1,060 naturalised species, it was ranked fourth for invasiveness and impact (Batianoff and Butler, 2003); and among NSW's 340 worst environmental weeds, it was ranked eleventh for biodiversity impacts (Downey et al., 2010).

In heavily infested areas, the weight and shading of cat's claw creeper in the canopy can break branches and kill trees (Sparks, 1999). In the understorey, it forms thick mats that can prevent native plant germination and growth (Dhileepan et al., 2010; Downey and Turnbull, 2007). It can germinate in low light conditions (Vivian-Smith and Panetta, 2004) and, with its aerial roots immediately enabling it to climb large trees, it is not reliant on disturbance to invade a site. Cat's claw creeper is able to invade a forest, degrade the structure and open the canopy to allow more light to enter, which provides opportunities for other weeds to invade. In this way it can alter ecosystem functions and is referred to as a 'transformer species' (sensu Richardson et al., 2000).

A threat to endangered and vulnerable fauna

Coxen's fig parrot
(*Cyclopsitta diophthalma coxeni*)
- Critically Endangered (NSW)
- Endangered (Qld)

Grey-headed flying fox
(*Pteropus poliocephalus*)
- Vulnerable (NSW and nationally)



Eastern freshwater cod
(*Maccullochella ikei*)
- Endangered (NSW and nationally)

Reason for population decline:

Degradation of habitat due to cat's claw creeper invasion (Coutts-Smith and Downey, 2006)	Combined effect of canopy loss and tree mortality caused by vines, including cat's claw creeper, and the subsequent reduction in the availability of habitat and food	Loss and modification of riparian vegetation, stream banks and the effects of cat's claw creeper on water quality, food and shelter (Downey and Turnbull, 2007)

Chapter 2

Cat's claw creeper poses a significant risk to threatened ecological communities. Its ecosystem-altering tendencies can create a positive feedback loop in which it establishes and degrades communities. Often fragmented and already vulnerable to other threatening processes such as fire, storms and cyclones, this can cause these communities to be even more susceptible to further degradation and invasion by other weeds.

Economic

Cat's claw creeper has major and varied impacts on forestry. Its claw-like tendrils and aerial roots allow it to cling tightly to host trees. This creates issues in hoop pine (*Araucaria cunninghamii*) plantations as extra time and effort is needed to remove cat's claw creeper stems. If this is not done, automatic harvesting sensors can over-estimate the diameter of hoop pine trunks, leading to processing issues after harvest (I. Last, pers. comm.). Its many windblown seeds allow it to easily infest fallow areas, and substantial time and money must be spent on its control (I. Last, pers. comm.).

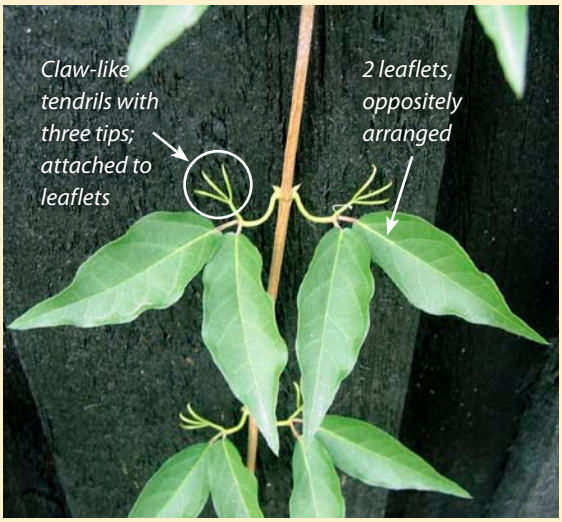
Cat's claw creeper can also impact linear reserves such as power easements and railways. It has the potential to cause localised power interruptions by growing up power poles and lines, where its weight can damage the poles or even cause them to fall (Downey and Turnbull, 2007). Linear reserves also provide a pathway for the introduction and spread of vines and scramblers into intersecting bushland.

Social

Like other vines and scramblers, cat's claw creeper can create access issues along walking tracks and trails. It can also reduce the aesthetic value of parks and bushland by smothering other plants. The climbing style of cat's claw creeper allows it to grow over most surfaces, which can create issues in urban settings, where damage has been reported to fences, walls and even roof tiling (Downey and Turnbull, 2007). Removal of the vine from these surfaces is difficult because of how tightly the tendrils and aerial roots adhere to them, which creates further damage.

Identification of short-pod form

Leaves and tendrils	Leaves are compound, usually consisting of 2 leaflets with a tendril between them; there may be up to 5 leaflets per group in young plants The leaflets are dark green above and lighter green below, 2–7 cm long, 1–3 cm wide, oval to oblong in shape and with a pointed tip The compound leaves, and their leaflets are oppositely arranged The tendrils are 3-pronged and have stiff tips that form hooks, resembling claws



Sheldon Navie

Flowers	The large (2–8 cm long), showy flowers are yellow in colour and often have darker yellow or orange streaks in the tube Grow from the leaf axis, sometimes solitary or in small clusters Present in spring	 Sonia Jordan
Fruit and seeds	Seeds are contained in seed pods 15–45 cm long and 0.8–1.3 cm wide Seed pods are leathery and can contain up to 80 seeds The seeds themselves are 2–4 cm long, 0.5–1 cm wide and paper thin; they have 2 papery wings, which allows for wind and water dispersal The pods mature in late summer to autumn, splitting open along lateral seams to release large numbers of seeds	  Sheldon Navie
Stems	Woody, up to 30 m long and 15 cm thick Younger stems are reddish in colour, with golden tips Older stems are light brown and often densely covered by aerial roots	 Adam Bernich
Roots and tubers	The root system is extensive and deep, with tubers being produced every 50 cm along lateral roots Each tuber can be up to 40 cm long (although the majority are 0.5–10 cm) Entwined roots and tubers form a dense underground mat in mature infestations	  Matt Sheehan

Similar species

The characteristic 'cat's claws' and yellow flowers make cat's claw creeper stand out; however, when no fruits or flowers are present, large stems on some other species with aerial roots can look similar, as shown in the following examples.

Cat's claw creeper *Dolichandra unguis-cati*	**Common silkpod** *Parsonisa straminea*	**Giant pepper vine** *Piper hederaceum*
Exotic species widespread in coastal and subcoastal areas of Qld and NSW.	A native, occurring in rainforest and floodplains along the entire east coast of Australia.	A native that is widespread in warmer coastal rainforest along the entire NSW and Qld coasts.
Stems are numerous; long aerial roots grow from any part of the stem.	Stems have rough bark with lenticels (holes used for gas exchange), and small aerial roots. Stem diameter is smaller than cat's claw creeper (up to 9 cm).	Stems grow to 15 cm thick. Larger stems have horizontal scarring from where leaf nodes used to be. Unlike cat's claw creeper, roots are confined to and protrude from leaf nodes.
 Adam Bernich	 Adam Bernich	 Adam Bernich

Current distribution

Cat's claw creeper is widespread in coastal and subcoastal areas of Qld and NSW, extending from the Atherton Tableland to south of Sydney (Figure 2.1). It is often found in Lowland Subtropical Rainforest, Littoral Rainforest and other threatened communities.

There are also records from north of Cooktown but there is no evidence of this population naturalising. It has been reported that the worst infestations occur along the Clarence River in northern NSW, spanning approximately 150 km (T. Moody, pers. comm. *in* Downey and Turnbull, 2007); however, major infestations also occur around Gympie and in the Boyne Valley near Gladstone in Central Qld.

Cat's claw creeper is typically considered a tropical and subtropical species. However, in Australia it has also established in temperate regions such as the New England Tablelands and the Sydney region (Downey and Turnbull, 2007), and has spread into nearby dry sclerophyll forests (e.g. forest dominated by spotted gum, *Corymbia maculata*; T. Moody, pers. comm. *in* Downey and Turnbull, 2007).

Cat's claw creeper is not well established elsewhere in the country, but naturalised plants have been collected from Darwin in the Northern Territory (NT) and Melbourne (Downey and Turnbull, 2007); and overseas it has invaded savannas, secondary forests and remnant high forests (Downey and Turnbull, 2007), suggesting it has the potential to spread and establish in drier environments.

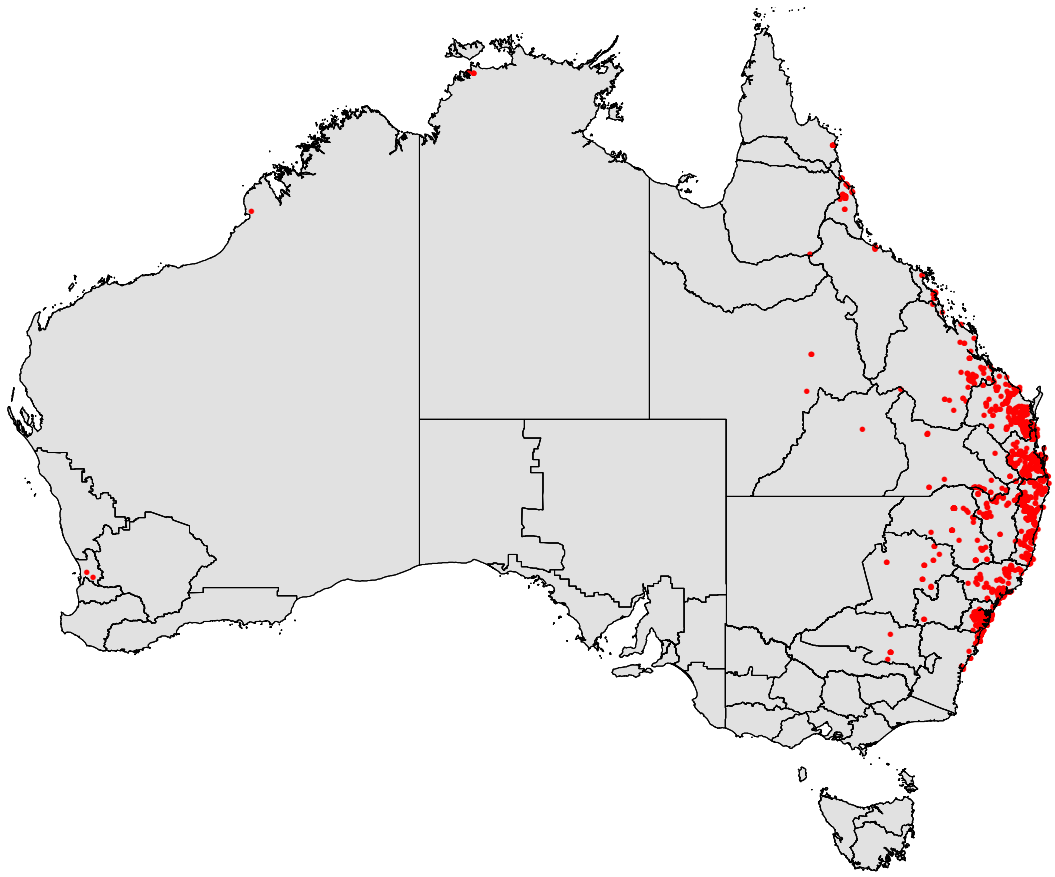


Figure 2.1 Current distribution of cat's claw creeper in Australia. Records from Atlas of Living Australia (2022).

Potential distribution

Climatic modelling as shown in Figure 2.2 indicates that the most suitable habitat for cat's claw creeper occurs in coastal regions from southern NSW to Far North Qld. Coastal areas of south-western and northern Western Australia (WA) and northern NT, south-western Vic and southern South Australia (SA) may be suitable. It is widely cultivated (in gardens) in southern Australia, which provide a source for further spread.

Other areas of Australia likely do not provide suitable habitat for cat's claw creeper. However, under future climates, the predicted suitable habitat for cat's claw creeper moves southward, with there being some habitat of low suitability predicted in the northern areas of Tasmania (Tas; Figure 2.2b).

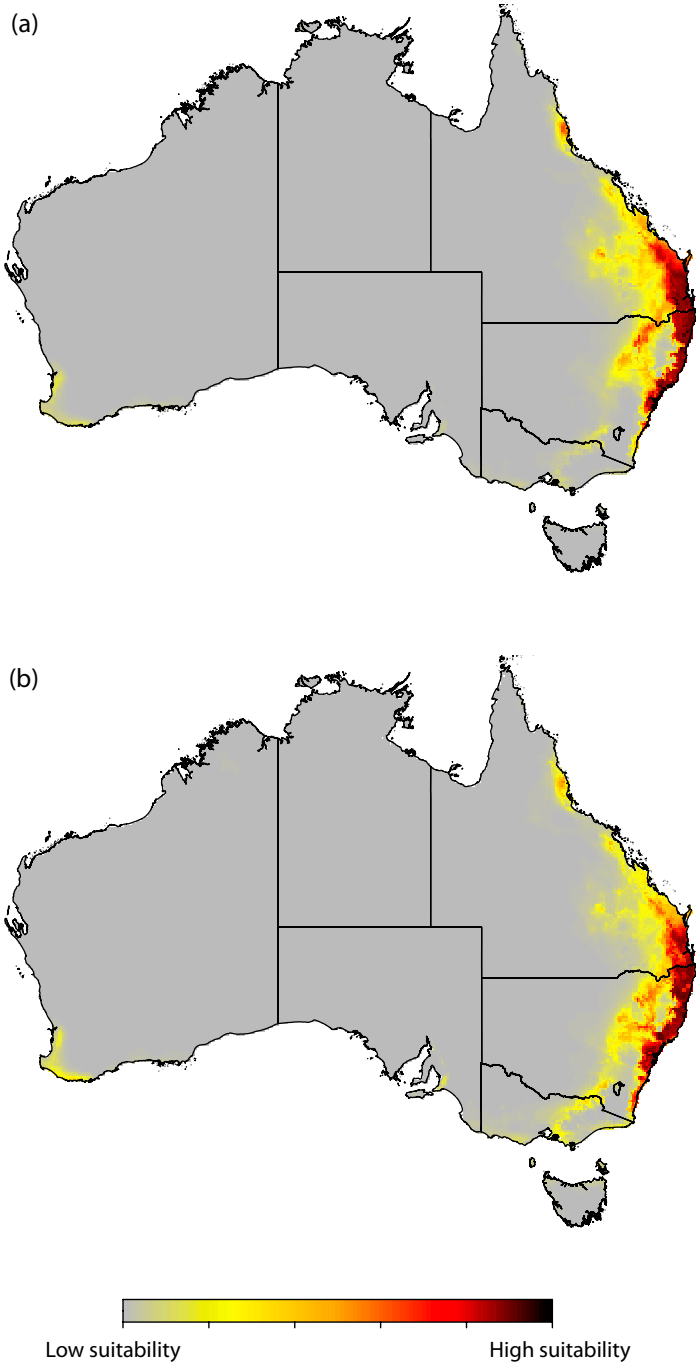


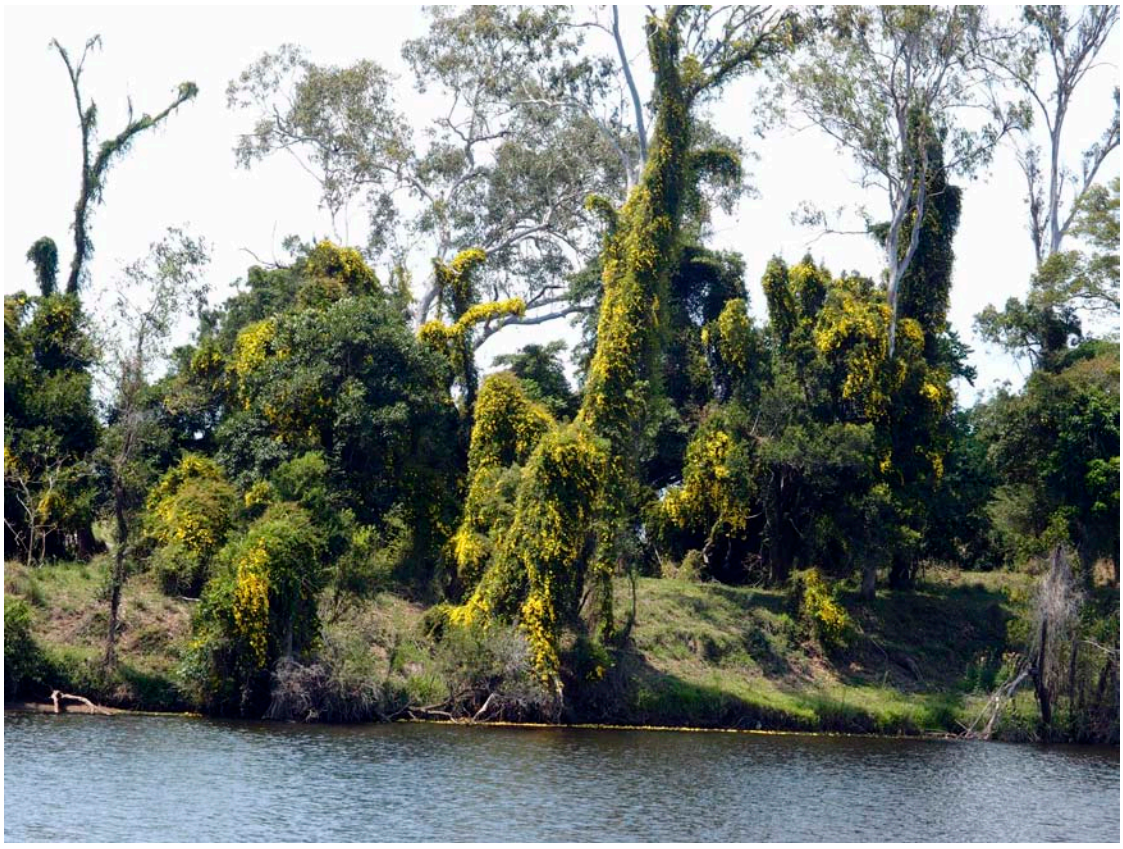
Figure 2.2 Areas of habitat suitability for cat's claw creeper modelled under (a) current climatic conditions and (b) predicted climatic conditions in 2050 under the SSP2-4.5 climate scenario. SSP2-4.5 is an intermediate greenhouse gas emissions scenario where global carbon dioxide emissions continue around current levels until 2050 and then decrease but do not reach net zero by 2100 (Riahi et al., 2017). Black and dark red pixels represent the most suitable habitat.

Preferred habitat and limiting factors

In its native range, cat's claw creeper grows in areas with mean annual rainfall of 750–2,400 mm and at elevations from near sea level to over 600 m (Francis n.d. *in* Downey and Turnbull, 2007). In Australia, cat's claw creeper has been found growing in the Blue Mountains at altitudes of 1,100 m, although it is uncertain whether these plants produce seed.

It thrives in full sun or partial shade and has relatively shade-tolerant seedlings. Mature plants are tolerant of both drought and frost, and can die back and reshoot from the underground tubers (Downey and Turnbull, 2007). However, particularly severe conditions may reduce cat's claw creeper's capacity to spread, possibly affecting seed production and germination. For example, anecdotal evidence from Tambo in Central Qld suggests that cat's claw creeper may not seed in areas that experience hot dry summers and severe winter frosts. It appears that cat's claw creeper does not flower when environmental conditions are unfavourable, such as during droughts, or when growing at high altitudes (Shortus and Dhileepan, 2010).

Cat's claw creeper grows in a range of soil types but prefers uniform soils of sandy or clay origin (Downey and Turnbull, 2007). It does not tolerate poorly drained soils (Csurhes and Edwards, 1998) but can withstand saline soils (Downey and Turnbull, 2007). There are no records of cat's claw creeper growing in dune systems.



Sonia Jordan

Cat's claw creeper in riparian zone, South East Qld.

Reproduction and spread

Flowers and seeds

Flowers are usually present on mature plants that have reached the canopy of their host trees. Flowering takes place during spring, with the pod-like fruit maturing in late summer to autumn (January–May), approximately 6–10 months after flowering (Downey and Turnbull, 2007). As the pods age, they brown and split open, each releasing 90–200 seeds (Downey and Turnbull, 2007; King et al., 2011). Seed drop begins in late May and peaks in July–August.

Vegetative reproduction

The main vegetative reproductive strategy employed by cat's claw creeper is underground tubers. Tubers begin to be produced early in the life cycle, when seedlings produce their first true leaves (Downey and Turnbull, 2007), and are continuously produced. Therefore, all mature plants have well-established tuber systems that readily reshoot after disturbance such as fire or mechanical removal (King et al., 2011). Trailing stems are also able to produce roots at the nodes, and stem fragments severed from the parent plant can survive and give rise to new plants (Downey and Turnbull, 2007).

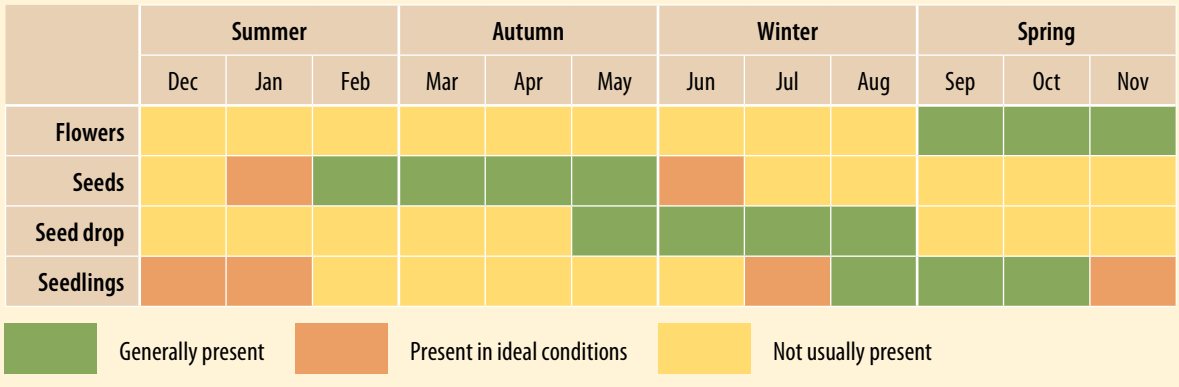
Germination, seed banks and tuber longevity

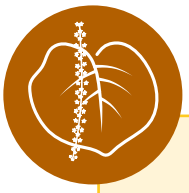
The seeds of cat's claw creeper germinate rapidly at various temperatures with germination success of up to 70% (Buru et al., 2014). However, as seeds are only viable for 12 months (Buru et al., 2014; Vivian-Smith and Panetta, 2004) there is no persistent seedbank. It is not clear how long tubers remain viable in the soil, but reports suggest that tubers allow for cat's claw creeper to regenerate for many years following damage to aboveground parts of the plant (Osunkoya et al., 2009).

Dispersal

The thin, papery seeds of cat's claw creeper are adapted for wind and water dispersal. Wind appears to be the primary dispersal method, but the prevalence of cat's claw creeper in riparian areas suggests that water dispersal is also important. The seeds can float for up to 54 days (Downey and Turnbull, 2007), and therefore can be dispersed long distances by water. These effective dispersal methods allow for cat's claw creeper to spread over long distances via seeds, while tubers allow it to persist at sites and increase in density.

Seasonal patterns of cat's claw creeper





Madeira vine profile

At a glance

- **Madeira vine is native to South America and was introduced to Australia as an ornamental plant.**
- **Plants have large heart-shaped leaves and long creamy-white flower spikes.**
- **It is a fast and aggressive invader of natural areas, including riparian zones and forests. Madeira vine also commonly grows in gardens and roadsides.**
- **The weight of Madeira vine can break branches and cause host trees to collapse.**
- **Plants mainly reproduce via masses of aerial and underground tubers.**
- **Long-distance dispersal occurs via dumping of garden waste, streams and flood waters.**

Madeira vine, also known as lamb's tails, is a South American vine introduced to Australia as an ornamental plant. It is easily distinguished by its large and numerous aerial tubers, fleshy leaves and white flowers clustered on long spikes that often resemble a lamb's tail. It has a range of features that make it a successful invader with a competitive advantage over other vine species:

- vigorous and fast growing
- extensive tuber production, both aerial and underground, allowing the species to quickly spread and persist for many years
- tubers contribute to the weight of Madeira vine, which can cause host trees to collapse or loose limbs.

Currently, Madeira vine is most common in NSW and Qld; however, there are small populations present in Vic, SA, WA and Tas.

Origin

Madeira vine is native to tropical and subtropical South America, in countries such as Bolivia, Brazil, Paraguay and Argentina. In Australia it was introduced as an ornamental plant with its first record of sale in 1906. It was first reported as naturalised in the 1960s in both Qld and NSW (Vivian-Smith et al., 2007). It has also been introduced to China, Japan, India, the USA, New Zealand and parts of Africa, likely as an ornamental plant; however, it has also been used as a medicinal plant in some countries (Bari et al., 2019).

Impacts

Environmental

The fast growth rate and tuber system of Madeira vine make it an aggressive invader and a serious threat to many ecological communities. Plants can grow at a rate of 1 m/week under favourable conditions (Starr et al., 2003; Vivian-Smith et al., 2007). The vine's biomass is particularly high because of the prolific growth of semi-succulent leaves and masses of aerial tubers, causing the collapse of host trees. Its fast growth rate and ability to quickly reach high densities mean that it can rapidly invade and degrade forests. This has led to it being ranked as NSW's worst environmental weed for biodiversity impacts (Downey et al., 2010) and the fifth worst in Qld (Batianoff and Butler, 2002).

Madeira vine generally invades areas with high water availability, such as riparian vegetation, rainforests and wet sclerophyll forests (Vivian-Smith et al., 2007), though it is also often seen in disturbed areas such as road edges and backyards. It typically invades forests with closed canopies where low light levels enter the understorey; however, Madeira vine's ability to break branches and even collapse canopy trees allows for more light to reach the understorey, providing opportunities for other sun-loving weeds to establish. Madeira vine is therefore considered a transformer species.

There is a lack of knowledge of the allelopathic potential of Madeira vine. However, recent research has revealed allelopathic chemicals present in the leaves can hamper the growth of common food crops (Bari et al., 2019). Further research is needed to determine how Madeira vine leaves can affect the growth of nearby native plants.

RG & FJ Richardson

Madeira vine is an aggressive invader and a serious threat to many ecological communities.

Economic

Madeira vine's impact on the economy is a key knowledge gap. Its fast growth rates and heavy stems likely affect timber plantations but detailed information is lacking. There have been reports of poisoning occurring to livestock after Madeira vine consumption, though information is contradictory. It appears that it is rarely consumed and may cause diarrhoea in sheep and pigs (Vivian-Smith et al., 2007).

Social

Madeira vine is often seen in urban areas where it can grow as a weed in gardens and parklands, causing damage to structures and reducing aesthetic values. In nature reserves, it can grow over walking trails and its canopy weight can increase the chance of tree fall over trails and roads, potentially reducing access to areas. It can degrade natural areas, reducing enjoyment of them and increasing risk of injury from falling limbs.

Kym Johnson

Madeira vine can quickly grow over infrastructure, with potential impacts for maintenance costs and safety.

A threat to endangered native plants and ecosystems

Purple-leaf muttonwood (*Myrsine richmondensis*) and Illawarra socketwood (*Daphnandra johnsonii*)—shown here—are just two endangered plant species threatened by Madeira vine. Nielsen Park sheoak (*Allocasuarina portuensis*) is another. The closed-canopy threatened ecological communities in which these species occur—among them Littoral Rainforest, Lowland Subtropical Rainforest and Riverflat Eucalyptus Forest on coastal floodplains—are particularly vulnerable to Madeira vine invasion.

Madeira vine has not yet reached its potential distribution and may threaten many more ecological communities, plants and animals.

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Purple-leaf muttonwood (endangered).

Gavin Phillips NSW DCCEEW

Illawarra socketwood (endangered).

Identification

Leaves

Heart shaped (cordate), fleshy 3–15 cm long and 2–10 cm wide; mature leaves are on the larger end of this scale, and are much darker in colour than juvenile leaves

Hairless, occasionally glossy; leaf margins may be wavy

Alternately arranged

Matt Sheehan

Flowers

Small (6 mm in diameter) white to cream, sweet scented and occur as clusters along flower spikes (racemes)

Flower spikes 6–30 cm long

Flowers late summer to autumn

Matt Sheehan

Matt Sheehan

Fruit and seeds

Fruit and seeds very rarely produced in Australia

When present, fruits are tiny, 0.9–1.1 mm long, globe shaped and single seeded

Stems

Initially green or red–green, hairless and cord like, becoming green to grey; semi-woody and rope like with age

Flexible and climbs by twining; stem width can exceed 5 cm

Does not produce sap or milky latex

Small lenticels (raised pores for gas exchange) present along larger stems

Matt Sheehan

Tubers

Aerial: Light brown or green

Variable shapes, ranging from round to irregular with a 'warty' appearance

Up to 25 cm in diameter, though usually much smaller

Thousands produced at nodes along the stems

Underground: Found to a depth of 1 m

Potato like, commonly 20 cm in diameter

Aerial and underground tubers can be similar in size and appearance

Sonia Jordan

Matt Sheehan

Similar species

Madeira vine is easily identified by its fleshy leaves, distinctive flowers and mass of aerial tubers. Tubers are usually present year round; however, flowers are usually absent June–November, during which time it may look superficially like other vines. Examples of some vines that may be mistaken for Madera vine and share a similar distribution are shown below.

Malabar spinach *Basella alba*	**Climbing lignum** *Muehlenbeckia adpressa*	**Climbing grounsel/Cape ivy** *Senecio angulatus*
An introduced tropical climber commonly grown as a garden vegetable. Recorded in NSW, Vic, Tas, Qld and WA.	A native climber found predominantly in coastal regions of southern NSW, Vic, Tas, SA and WA.	A weed mostly found in southern Qld, NSW, Vic, Tas, SA and WA.
 Creative Commons Pubic Domain	 © Melvin Xu Creative Commons CC BY-SA 4.0	 RG & FJ Richardson
Similar fleshy leaves but lacks the aerial tubers.	Similar leaf shape but they have finely crinkled margins. Lacks aerial tubers.	Similar glossy and fleshy leaves but they are more narrow and less rounded. It also has yellow daisy-like flowers.

The introduced weeds Cape ivy (*Delairea odorata*) and Japanese honeysuckle (*Lonicera japonica*) may also be confused with Madeira vine; see profiles in Chapter 6.

Current distribution

In Australia, Madeira vine mainly occurs in subtropical and warm temperate coastal areas of NSW and Qld, from Rockhampton to Narooma, though it is recorded growing as far north as Cairns, and south to Eden (Figure 2.3). There are also naturalised populations around Perth in WA; East Gippsland and Melbourne in Vic; and near Adelaide and Mount Gambier in SA. It has also been recorded as growing in Tas, Lord Howe Island and Norfolk Island.

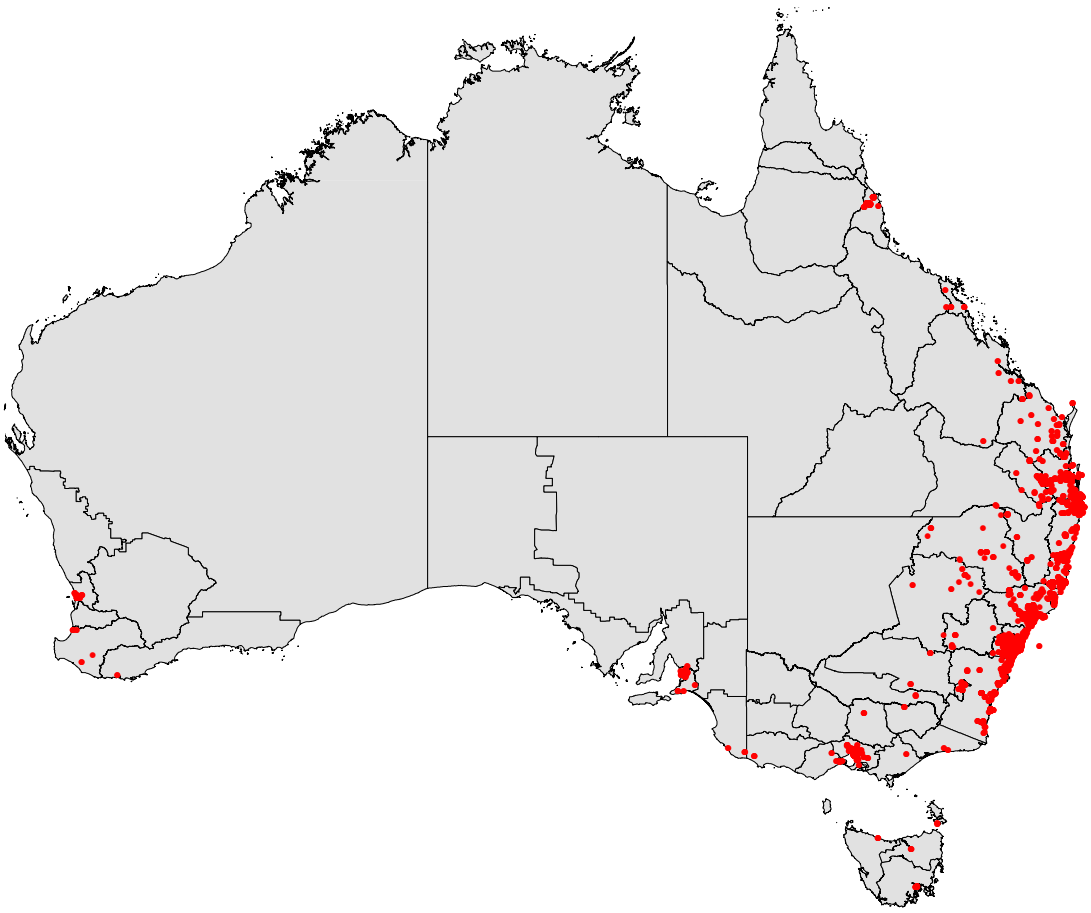


Figure 2.3 Current distribution of Madeira vine in Australia. Records from Atlas of Living Australia (2022).

Potential distribution

Future climate modelling suggests that although forests in tropical Australia will likely become less suitable for Madeira vine (Gallagher et al., 2010; Zhang et al., 2020), the climate will be more suitable in southern coastal areas (Figure 2.4). Therefore, naturalised populations in the southern states could become more of a threat under future climatic conditions.

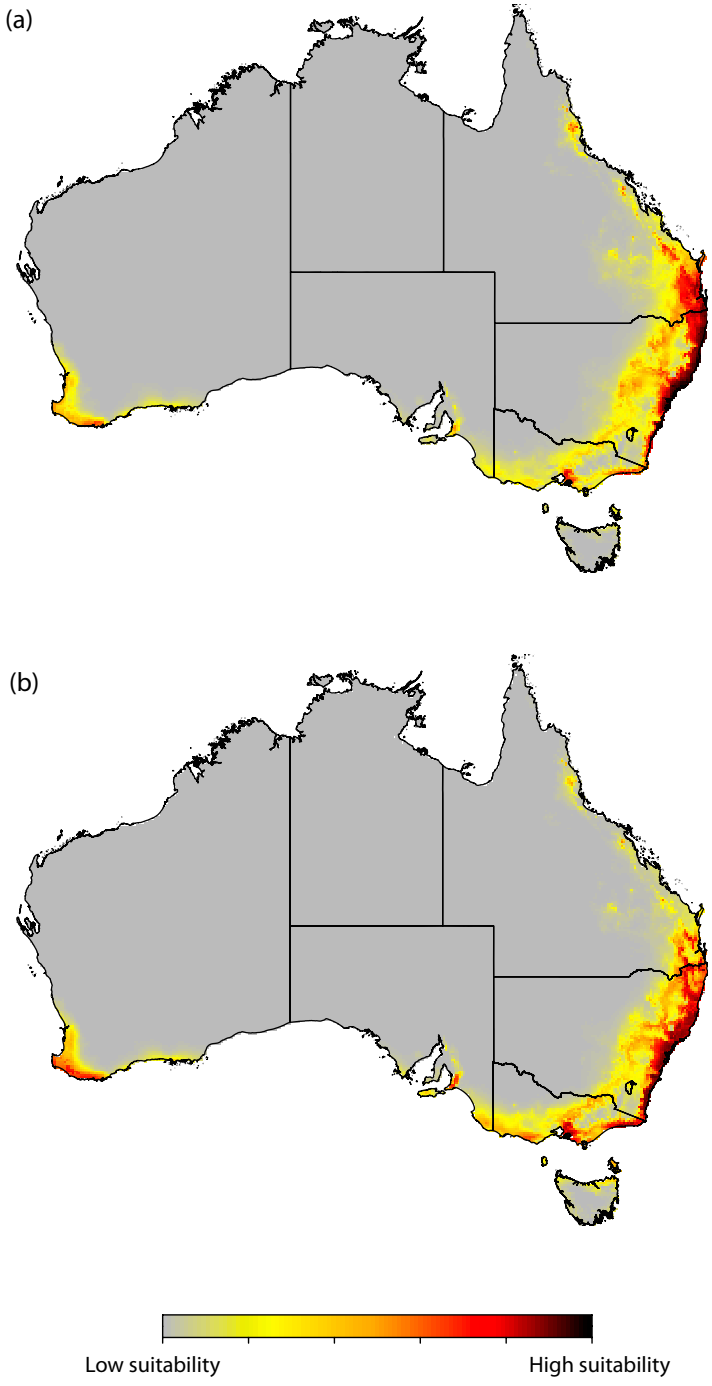


Figure 2.4 Areas of climatic suitability for Madeira vine modelled under (a) current climatic conditions and (b) predicted climatic conditions in 2050 under the SSP2-4.5 climate scenario. SSP2-4.5 is an intermediate greenhouse gas emissions scenario where global carbon dioxide emissions continue around current levels until 2050, then decrease but do not reach net zero by 2100 (Riahi et al. 2017). Black and dark red pixels represent the most suitable habitat.

Preferred habitats and limiting factors

Madeira vine is most impactful in riparian areas, rainforests and wet sclerophyll woodlands where there is high and consistent water availability. In Australia, it is often observed in disturbed areas such as railway corridors and roadsides, as well as on rocky outcrops and cliff faces (Vivian-Smith et al., 2007). In its native range, the average rainfall is 500–2000 mm/year and average temperatures are 20–35°C in summer and 10–30°C in winter (Vivian-Smith et al., 2007). However, Madeira vine has adapted to a range of climates, including Mediterranean, subtropical and tropical. Species distribution modelling suggests that the ideal mean annual temperature and annual precipitation range for Madeira vine is 20–30°C and 800–2,000 mm, respectively.

Leaves are short lived and easily die off in situations where water or other resources are depleted (Boyne et al., 2013), or under drought or heavy frost conditions. However, plants usually survive, reshoot from tubers and quickly re-establish when conditions are favourable.

Madeira vine can persist in heavy shade, but grows more vigorously in full sunlight (Boyne et al., 2013). It can creep across the forest floor and co-exist with other scramblers, but tends to produce more leaves and tubers in climbing stems (French et al., 2017).

Reproduction and spread

In Australia, Madeira vine mainly reproduces vegetatively through aerial and underground tubers but has been recorded to occasionally produce viable seeds (Vivian-Smith et al., 2007). Additionally, it can reproduce via stem cuttings and rhizomes.

A competitive edge

Research indicates that Madeira vine:

- has a very simple leaf structure and can produce leaves quickly and in large numbers with little cost to the plant, making photosynthesis more efficient (Boyne et al., 2013)
- is 'amphistomatous', meaning it produces stomata on both sides of its leaves and produces more stomata in full-light situations (Boyne et al., 2013)
- produces more biomass (leaves, stems and tubers) in climbing stems (French et al., 2017).

It is hypothesised that the leaves and their greater photosynthetic potential in full-light situations allow Madeira vine to grow quickly and exploit gaps in the canopy. This gives Madeira vine a competitive advantage over many other species and may be one reason why it is such a successful invader, particularly following disturbance events such as storms and fire.

Matt Sheehan

Madeira vine 'tuberlings' growing from a fallen tuber.

Matt Sheehan

*Arrows indicate where Madeira vine, spreading across the forest floor, is emerging above another highly invasive creeper – trad (*Tradescantia fluminensis*).*

Tubers

One of Madeira vine's most characteristic features is its extensive tuber production, both aerial and underground. Aerial tubers are produced in the nodes along the stem and have a warty appearance. These tubers easily break off and drop to the ground following disturbance (including treatment). Each tuber can produce a 'tuberling' (similar to a seedling but originating from a tuber, rather than a seed) that can produce more aerial tubers within six months in ideal conditions (French et al., 2017).

Each stem produces a mass of aerial tubers, with densities as high as 1,500 tubers per square metre recorded under the canopy of dense infestations (Vivian-Smith et al., 2007). Aerial tubers grow all year (Vivian-Smith et al., 2007), meaning Madeira vine can spread at any time. Aerial tubers that are attached to living stems will gradually enlarge until they drop off because of weight or disturbance. While they are attached to stems aerial tubers are believed to remain viable for several years, and possibly indefinitely (G. Vivian-Smith pers comm., October 2023).

Tubers that are detached from stems are viable for shorter periods. Trials in South East Qld showed that tubers either buried, placed on the soil surface or suspended from trellises in mesh bags (to replicate those held in the vine canopy) experienced a steep decline in viability over a two-year period, with no viable tubers at 24 months (G. Vivian-Smith pers comm., October 2023).

Underground tubers are similar in shape and appearance to aerial tubers and can grow at depths of 1 m and reach 20 cm in diameter (Vivian- Smith et al., 2007). Being underground, these tubers allow for stems to regrow following mechanical control or other disturbances and may also support regrowth following herbicide treatment. This adds to the difficulty of removing Madeira vine from a site.

S. Burchill

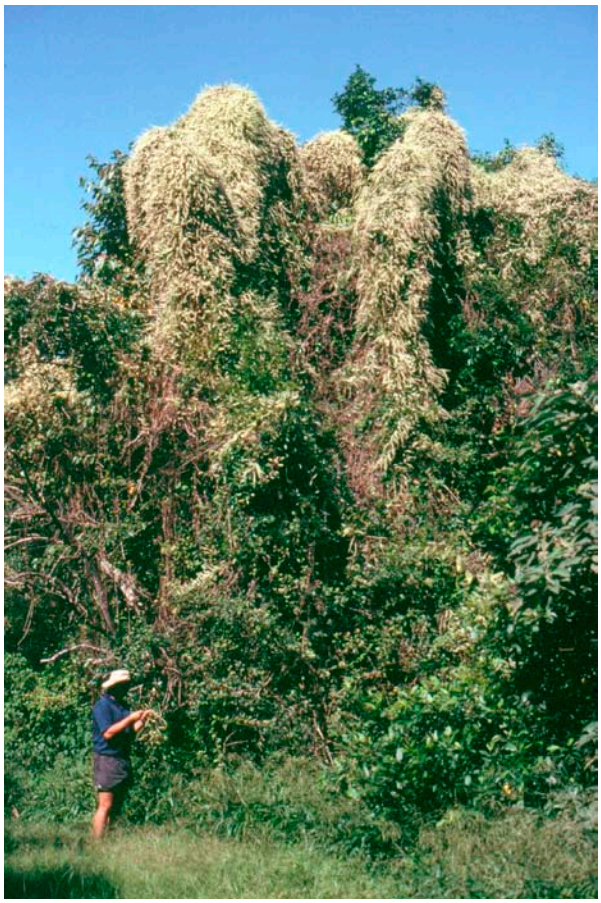
Underground tubers of Madeira vine.

Flowers and seeds

In Australia, Madeira vine's long spikes of white flowers are present from December to May, with large numbers produced by each plant. Pollination information is limited, even in its native range. The flowers are similar to those pollinated by insects, being scented and containing nectar (Vivian-Smith et al., 2007); in Hawaii, flowers have been observed to be visited by bees, wasps and ants but not followed by fruit set. Further study into the pollination requirements of Madeira vine is needed.

Although Madeira vine flowers can be abundant, they are believed to rarely produce seeds in the introduced range. Madeira vine seeds are very small (1 mm long), produced in very low numbers and difficult to differentiate from dry flowers, so it is possible that seeds are produced but go unrecorded. Some seeds were collected and successfully germinated in a laboratory setting from a small number of Qld populations in Brisbane and Samford Valley. However, it was considered unlikely that these seedlings would survive in field situations (G. Vivian-Smith pers comm., October 2023).

The absence of genetic studies to determine the relationships among Australian populations, and the lack of knowledge regarding germination requirements and seed viability, makes it difficult to quantify the role seeds play in Madeira vine reproduction and spread. However, given Madeira vine is primarily spread vegetatively through the production of masses of tubers, spread via seed is considered insignificant.



Andrew Storrie

Madeira vine flowers abundantly, but very rarely produces seeds in Australia.

Dispersal

Madeira vine's reliance on vegetative reproduction in Australia means that it is often spread by humans, likely from activities such as dumping of garden waste that contains viable plant fragments (tubers, stems and rhizomes). Natural dispersal over short distances (i.e. within forests or sites) would be possible through gravity when tubers fall off canopy stems, and potentially via animals such as brush turkeys (*Alectura lathami*) spreading tubers when building nests. Streams and floodwaters are a major mechanism for long-distance spread of tubers and stem fragments (Vivian-Smith et al., 2007). Tubers generally do not float, but experiments have shown that 33% of tubers can survive up to 30 days underwater (Vivian-Smith et al., 2007).

Matt Sheehan

Madeira vine is commonly spread via water.

Seasonal patterns of Madeira vine

	Summer			Autumn			Winter			Spring		
	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Tuber production	■	■	■	■	■	■	■	■	■	■	■	■
Tuberlings	■	■	■	■	■	■	■	■	■	■	■	■
Flowers	■	■	■	■	■	■						
Leaves	■	■	■	■	■	■	■	■	■	■	■	■

■ Generally present ■ Not usually present

Chapter 3

Planning

At a glance

- **Planning helps you prioritise what actions are needed to manage and restore areas affected by invasive vines and scramblers.**
- **A weed management plan determines priority actions to prevent new weeds and manage the spread and impacts of existing weeds.**
- **This chapter describes a simple way to develop a weed management plan.**
- **The chapter also provides guidance on planning community-led and large (landscape-scale) weed management programs.**

This chapter refers to planning for cat's claw creeper and Madeira vine management; however, the planning principles and weed management cycle are broadly applicable to preparing weed management plans for all invasive vines and scramblers.

Some content in this chapter was adapted from the national asparagus weeds management manual (OEH, 2013), available at: environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Pests-and-weeds/asparagus-weeds-management-manual-130486.pdf

Why plan?

Planning is one of the most important steps in weed management. While it is tempting to jump straight in, planning before undertaking management ensures the best possible outcome.

A well-thought-out plan can:

- make weed management tasks more achievable
- reduce off-target impacts of your control
- prevent reinvasion or the establishment of new weeds in the long term
- save time, effort and money now and into the future.

Managing cat's claw creeper and Madeira vine is a long-term endeavour, so it is critical to implement a strategic approach that sets achievable weed management goals. This will allow you to:

- prioritise the use of limited resources
- identify the best methods for and timing of control, increasing your chances of success
- coordinate activities with your neighbours
- meet your legal obligations (in states where applicable; see Chapter 6)
- incorporate critical tasks into general property planning
- undertake monitoring activities to gauge and increase the likelihood of long-term success.

Chapter 3

Planning principles

A good plan is one that provides a clear path to your management goals, allowing for flexibility and refinement along the way. It need not be lengthy or elaborate, but it must consider the long-term commitment needed to manage cat's claw creeper and Madeira vine. Being clear on the following questions will inform your overall goal:

- Why do you want to manage cat's claw creeper and/ or Madeira vine? For example, is it to protect threatened species, increase native biodiversity, prevent further spread into new areas, or another reason? Your plan will differ depending on your values.
- What are your management goals and how can you achieve them?
- What does success look like?
- How will your management activities integrate with day-to-day activities and other management objectives?
- Who needs to be involved?

Set up your plan for success

The best management approach and techniques will depend on your site and situation.

To set up your plan for success, ensure it considers important concepts such as:

- multiple treatments and adaptive management (see Chapter 4)
- integrated weed management (see Chapter 4)
- monitoring for regrowth and reinvasion (see Step 5 of this chapter).

The weed management planning cycle

Figure 3.1 summarises the main steps involved in general weed management planning. Initial assessment of the situation (**Step 1**) leads to the development of goals and priorities (**Step 2**). These form the basis of a plan (**Step 3**) that identifies and guides on-ground management (**Step 4**). Review of outcomes allows reassessment and refinement of the plan and the management approach (**Step 5**) to identify and undertake follow-up actions (**Step 6**) to ensure goals continue to be achieved in the long term. In some instances, you may also want to carry out restoration activities (**Step 7**).

The next section provides further detail for each step with a focus on developing a weed management plan for cat's claw creeper and/or Madeira vine.

Developing a management plan

Step 1. Assess the situation

The first step in creating an effective weed management plan is to understand the scale of the problem and what can realistically be done about it. To do this, a site assessment must be carried out to collect information about the infestation, the site and even the surrounding area.

The following actions will form the basis of your site assessment.

Identify and liaise with relevant land managers

Permission is required to undertake activities on other people's land and weed management across multiple tenures may be required. Partnerships and cooperation across areas to be managed are a foundational component of strategic weed management efforts. Refer to Box 3.1 to help you navigate this step.

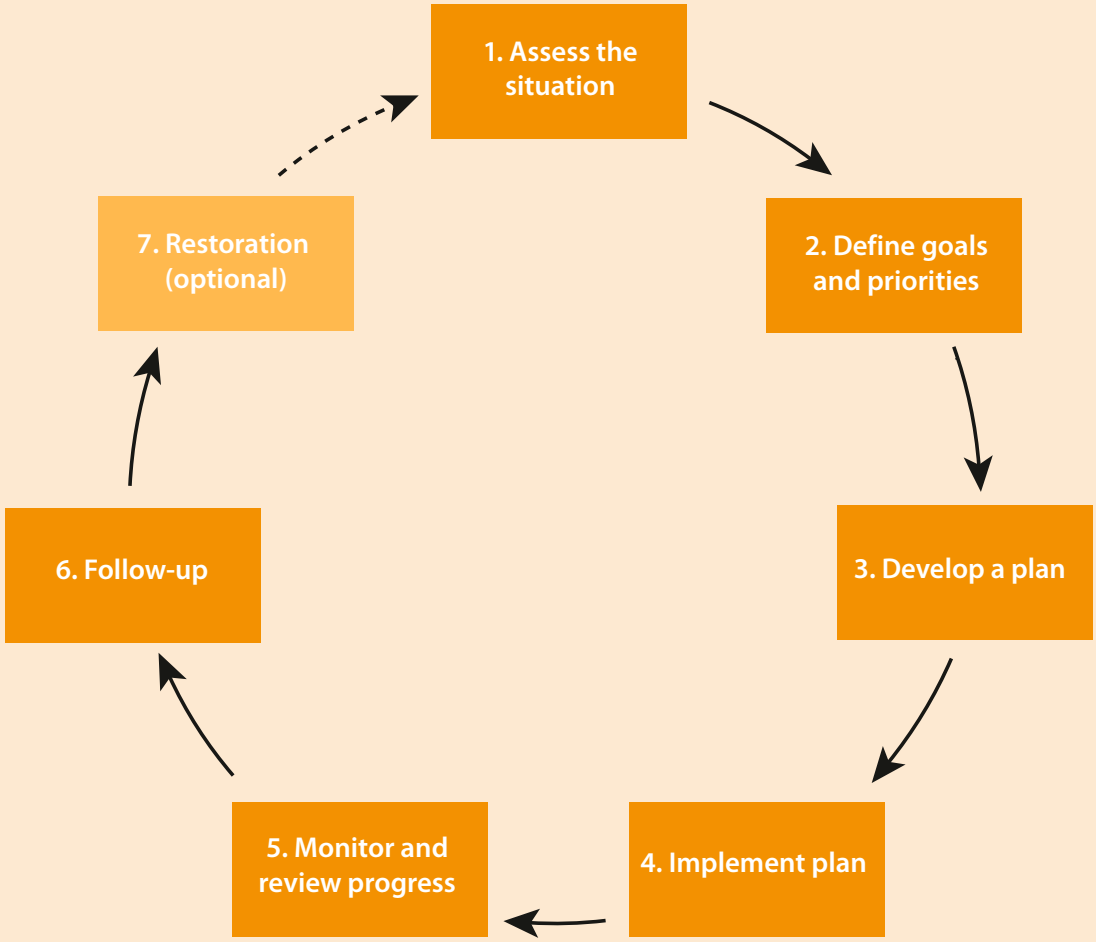


Figure 3.1 A flow chart showing the weed management planning cycle.

Box 3.1 Tips for engaging with the right people.

Situation	Considerations
Public land infestations	Contact the council or local parks office to discuss how to get involved. They may link you in with an existing group or advise on efforts already in place.
Private land infestations	Talk with other land managers or groups working on invasive vines and scramblers for advice and to complement existing programs.
Sites with existing weed control programs	Access any existing plans or, if there are none, discuss the need for a plan with the weed program leader.
Sites with threatened species	Contact the relevant threatened species officer in your state or territory. Please refer to Chapter 6 – Further information for contact details.

Identify and research the target species

First, compile a list of which major weeds are present. Research the impacts each species may have and prioritise which weeds you should include in your management plan. Where there are multiple invasive vine and scrambler species present, the complexity and cost of your management program may increase as a combination of controls may be required over several years. Depending on the growth cycle of each species, control may be carried out concurrently; conversely, you may have to wait until another time of year.

Cat's claw creeper and Madeira vine are only two of many invasive vines and scramblers that may be present on your site. If you actively control these species, there may be others present ready to take over – which may end up having equivalent impacts. You should therefore think holistically during site

Managing other weeds: a holistic approach

One of the main factors influencing the restoration of sites affected by cat's claw creeper and/or Madeira vine is the threat from co-existing or secondary weeds.

Co-existing weeds, such as other vines and scramblers – or even trees, shrubs, herbs and grasses – may also cause harm to your site.

Similarly, other weed species can invade or dominate a site once primary control of invasive vines and scramblers has occurred.

Decisions must be made whether to control all weed species at once or to prioritise species based on their threat.

Sometimes, disturbance from weed invasion can impair ecosystem function and result in a dominance of native vine and scrambler species.

Considering these factors during planning will help set realistic management objectives, contribute to management success and avoid burnout.

Adam Bernich

A dense exotic vine infestation along a rainforest edge where moth vine, cape ivy, lantana and Madeira vine can be seen.

assessment to identify and understand all weed species—and their density—on your site.

It might be helpful to also list other major weeds present in the local area but not yet at your site. Talking to your local biosecurity officer, neighbours, NRM or Landcare officer or finding other sources of advice will help build your understanding of local and regional weed threats. Also consider weeds that may be brought to your site from a long distance, through pathways such as water, people or vehicles/machinery.

Various online resources list and identify major weeds, including:

- NSW WeedWise – weeds.dpi.nsw.gov.au/
- Local Land Services – www.lls.nsw.gov.au/help-and-advice/pests,-weeds-and-diseases/weed-control/weed-identification-and-management
- Qld Department of Agriculture and Fisheries – https://www.daf.qld.gov.au/business-priorities/biosecurity/invasive-plants-animals/plants-weeds
- Weeds Australia – https://weeds.org.au

Map infestations and key assets

Mapping the location of infestations and other important attributes forms the basis of your site assessment and planning of your control activities. Your map should show:

- location, extent and density of weed infestations
- site/property boundaries
- spread pathways such as water courses, roads and stock routes
- any safety hazards.

Delimitation

Delimitation surveys help you to understand the full extent of a weed infestation and whether the weed is at, or beyond, the early stage of invasion (Blood et al., 2019). This informs the most appropriate and realistic management objective for your site.

Mapping your site assets—for example, rare and threatened plants, animals or ecological communities, and cultural and heritage sites—will also help define your management goals. Their presence may mean affording higher priority to those sites but also that extra care must be taken when working around them to limit off-target damage.

A map need not be complex; the goal is to have a visual representation of the management area and infestation so everyone working on the site, now or in the future, can follow a logical and strategic management approach. A hand sketch or mud map can work for smaller sites, while a simple, computer-generated map may be better for larger sites. Waypoints and tracks can be taken in the field using a GPS device or smartphone app (e.g. GPS Essentials App).

Free online mapping tools

There are many freely available online mapping tools, including for use on a smartphone. For example:

- the Atlas of Living Australia (www.ala.org.au) provides a free platform for interactive map making
- software such as Avenza Maps or Fulcrum enables you to create and save maps to a smartphone or tablet for use in the field.

Talk to your local weed officer or project leader for other recommendations.

National guidelines for weed mapping are provided in *A Field Manual for Surveying and Mapping Nationally Significant Weeds* (weeds.org.au/wp-content/uploads/2020/04/Weeds_Manual.pdf)

Consider weed density

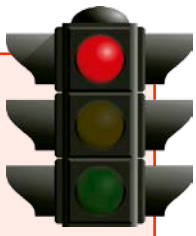
Determining the density of weed species on your site will help in setting realistic objectives and priorities (Step 2) and allow you to judge in future years whether your control efforts have been successful (Step 5). Plant density can be classified in many ways, including as a specific percentage density class (e.g. 0–5%) or a simple description (such as 'light', 'medium' or 'scattered individual plants'). Different assessment methods may be used to measure density, depending on the plant form:

- for plants growing in the canopy (vines): density can be measured using crown projective cover and foliage projective cover methods
- for plants growing along the ground (scramblers): density can be measured using ground percentage cover methods.

Further information on assessment methods can be found at:

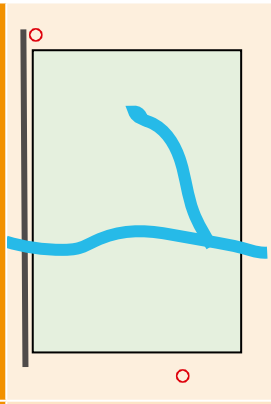
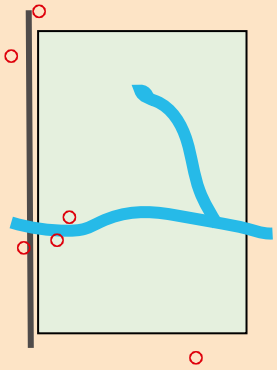
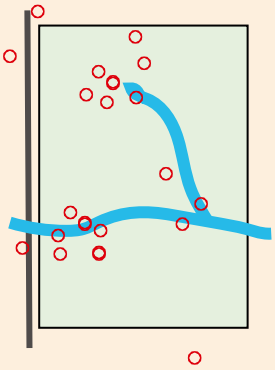
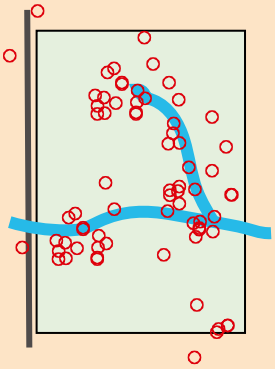
- dcceew.gov.au/sites/default/files/documents/vegetation-assessment-guide.pdf
- weeds.org.au/wp-content/uploads/2020/04/Weeds_Manual.pdf

Simple categories for recording weed density are described in Table 3.1.



Much of the biomass of vines and scramblers is hidden underground in the form of tubers. In older infestations, the tuber bank may be significant and should be considered when setting a realistic management objective (Step 2).

Table 3.1 Management objectives and associated activities for each stage of weed invasion.

				
Stage of invasion	**Absent** ▪ Not known to be present on the site (but may be present in the local area)	**Early stages of invasion** ▪ Rare (<1%) ▪ Isolated individuals, limited distribution ▪ Low risk of reinfestation from neighbouring areas	**Scattered to frequent** ▪ Light (1–10%) scattered patches and isolated plants OR ▪ Medium (11–50%): frequent patches with isolated plants commonly interspersed	**Widespread and dense** ▪ Large, dense (>50%) infestations ▪ Large areas affected across the site
Management objectives	**PREVENT** ▪ Prevent new weeds arriving	**ERADICATE** ▪ Eliminate all plants, propagules and seeds (including seed banks and tubers)	**CONTAIN** ▪ Prevent further spread ▪ Eliminate outlying infestations and work back towards core infestation/s	**PROTECT ASSETS** ▪ Reduce adverse effects on highly valued assets ▪ Reduce weed density ▪ Reduce seed production and propagule spread
Management activities	**Surveillance:** ▪ Monitor for vine introduction along high-risk pathways **Spread prevention:** ▪ Implement hygiene protocols and other measures **Control:** ▪ Conduct a coordinated control program across infested site, where weed is new to the area	**Delimitation:** ▪ Conduct regular surveillance to map all known infestations **Spread prevention:** ▪ Implement hygiene protocols and other measures **Control:** ▪ Search for and remove all plants prior to reproduction	**Spread prevention:** ▪ Implement hygiene protocols and other measures **Control:** ▪ Conduct an ongoing integrated control program to reduce weed density in areas where firmly established ▪ Search for and remove all plants prior to reproduction for outlying infestations ▪ Allow for regeneration of native vegetation surrounding core infestation to reinforce containment lines	**Spread prevention:** ▪ Implement hygiene and spread prevention activities **Control:** ▪ Conduct an ongoing integrated control program to reduce density to keep impacts at an acceptable level ▪ Protect high-value assets at risk from weed impact
		Follow-up ▪ Resprouting from tubers will continue for many years, even in small infestations ▪ Continue surveillance activities downstream and in dominant wind directions (for cat's claw creeper only)		

Establish a baseline

The weed distribution and density information you collect at the planning stage establishes an important reference point – or 'baseline' – for your site *before* you commence your management program. As you move into the monitoring stages of your program, this baseline will enable you to compare and assess the effectiveness of your management outcomes over time.

For example, in five years' time, you could re-calculate and map the density using the same technique and compare the results to your `baseline' map. This will help you visually determine if the control program has resulted in a change to both weed distribution and density over time.

Step 5 details other information you can start collecting before implementing your plan that will help measure your management success over time.

Prepare a site risk assessment

During planning, conduct a risk assessment identifying any health and safety risks to prevent potential injuries on site, and include ways to mitigate or minimise these. Consider how you will manage:

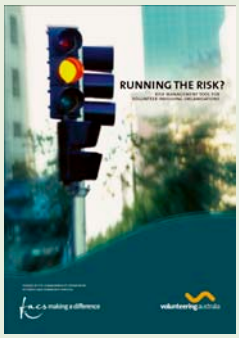
- site access and movement across sites (e.g. remote sites, long drives, steep or uneven terrain, water courses)
- hazards such as dumped material, barbed wire and snakes
- weather conditions and the need to carry water, food and protective equipment (e.g. sunscreen, hat, insect repellent)
- working in flood zones and near water
- toxicity and/or allergenic properties of weeds
- first aid (e.g. snake bite kits)
- morale and mental health of the stakeholders involved – long-term weed control can come at the expense of other work or leisure activities and can lead to worry, stress and burnout
- handling herbicides and operating machinery
- working with volunteers.

Safety regulations, training and resources

All weed control activities involve risk, so personal safety must be prioritised. Regulations regarding the safe use of herbicides and machinery must be followed and personal protective equipment such as gloves, respiratory equipment and eye and ear protection worn as appropriate.

Training may also be required for handling herbicides and operating machinery (see Chapter 6). Work health and safety laws (including acts of parliament, regulations and codes of practice) vary – check with your state or territory for the latest information. Guidance, information and fact sheets for working with volunteers are available from Safe Work Australia, Volunteering Australia and relevant authority websites in each state.

A risk management tool called *Running the Risk?* is available from Volunteering Australia at volunteeringaustralia.org/wp-content/files_mf/1377053059VAManagersrunningtherisk.pdf



Other details to note

Other details to note during your site assessment may include:

- areas of disturbance, such as clearing, recent fires or floods
- your site's management history.

Step 2. Define management objectives and priorities

Using your site assessment, and your map showing the infestation extent and density (Step 1), you can now start to set some clear, realistic goals.

Set your objectives

There are four overarching objectives for weed management, which relate to the weed's invasion stage: prevention, eradication, containment and asset-based protection. Table 3.1 uses descriptions of infestation size and density to:

- determine the most appropriate management objective
- identify the recommended management activities you would undertake to achieve those objectives.

Eradication – is it feasible?

Note that eradication is a term often used for weeds but rarely achieved in practice. Successful eradication requires the elimination of every individual plant and propagules (both seeds and vegetative plant parts) in a defined area, plus no further reintroduction from outside the area. This is extremely difficult to achieve. Generally, eradication is only possible where the weed is new to an area or property.

Factors required for successful weed eradication on a site include:

- weed distribution is limited and density is low across the site
- all infested areas are known
- the chance of reinvasion from surrounding areas is low
- newly emerged plants are easily detected before they set seed (or vegetative propagules, for some types of weeds)
- individual plants are easy to kill, including those that regenerate vegetatively.

Prioritise areas for control

The number and extent of weeds on a site often means it is too much to tackle all at once. In general, it is best to prioritise new, small or outlying infestations, then areas with high risk of spread, then protection of high-value assets (Table 3.2).

Table 3.2 General order of priority for where to control weeds.

PRIORITY 1	**New, small or outlying infestations** These should be eradicated where feasible to stop seed and tuber banks from developing and reduce the likelihood of a large infestation forming. Undertake strategic surveillance of potential vine sources or pathways.
PRIORITY 2	**Areas with high risk of spread** Areas such as roadsides, riverbanks, waterways and floodplains should be targeted as a priority to limit further spread and reduce the chance of new infestations developing. Target point sources of infestations, such as old homesteads and dumping sites.
PRIORITY 3	**High-value assets** For established infestations, the priority is to reduce their impact on important assets. This may include areas where there are threatened species or communities, or areas of community or cultural importance.

Priorities can be further assessed by examining the following:

- infestation age (and approximate extent of the seed/tuber bank)
- proximity to other infestations
- site access
- resources available.

Seek advice and input from weed management experts and neighbours to ensure that your priority setting is sound and will be supported by those around you.

Working smarter

Align your weed management actions with your other site management plans and objectives. There may be opportunities to combine activities or plan around busy periods, ensuring important weed work is not forgotten.

What are others doing to manage cat's claw creeper and Madeira vine in your area? Try to integrate or complement work occurring at the local, catchment and regional levels and seek guidance and feedback from neighbours, nearby landholders and local groups when necessary.

See 'Better together' (page 42) for more ideas on how to leverage communities to work together on coordinated landscape weed management programs.

Step 3. Develop a plan

With your objectives clearly defined, you can now create your plan. A weed management plan can be broken down into who, what, when, where and why, plus details on costs and resources.

Who should be involved?

If your plan includes multiple stakeholders, it is important you agree on the objectives. Allocating responsibility for each action will reduce confusion and help you to monitor progress.

Consider whether you have the skills needed for all actions. You may need to seek help from a weed professional, your neighbour or your local weed management authority.

You may also be able to bring together various stakeholders in a coordinated, landscape-scale weed management program (see 'Better together' page 42).

What are you doing?

State the weed management objectives, and realistic timeframes for achieving them. What are you trying to protect? How does this complement existing plans or past works?

How are you doing it?

Identify the control techniques that best suit the species present and their density (refer to Chapter 4). Determine actions to address factors that might be causing or exacerbating the problem, such as inappropriate dumping of vegetation at your site that could introduce more cat's claw creeper or Madeira vine propagules. Also consider how your control techniques might cause disturbance or erosion, and identify ways to minimise this.

When are you doing it and for how long?

Consider the best times to carry out control treatments based on control efficacy and safety of personnel (e.g. cat's claw creeper control is most effective if carried out before seed set to minimise spread). See Chapter 4 and the 'Better together' section of this chapter (page 42) for further information on the best time to control cat's claw creeper and Madeira vine.

Ideally, the plan will cover at least three years and be reviewed annually to examine progress and make changes if necessary. Remember to include follow-up activities and monitoring: cat's claw creeper and Madeira vine infestations may require many years to control.

Be flexible with your timing to adapt to unforeseen circumstances such as drought, floods, fires or other extreme weather events. You may also have to alter timing of activities based on other factors, such as the regeneration of native vegetation following removal of weeds. If resources allow, incorporate the assessment and/or control of other invasive weeds at the same time.

Keep track of planned management activities using a calendar that combines your weed management tasks with other jobs on the site. This will help identify conflicts and efficiencies in your overall site management.

Plan for any absences: ensure your plan is available to others and built into ongoing programs so that it is followed even if you are not around.

Where will you do it?

Based on your objectives and priorities (Step 2), clearly identify where the works will be carried out. If it is a multi-year plan, you might identify priorities that will be tackled at different times throughout the program. If you are taking an integrated approach, you may have several sites you are targeting at the same time but using different control techniques. If your site is a catchment area, undertake staged management, working from the top to the bottom of the catchment to reduce reinfestation of previously controlled areas. To communicate where you will be working:

- identify sites on your map
- clearly state your management objective for each site (e.g. prevention, eradication, containment, asset-based protection)
- link to the calendar for when management will occur at those sites.

What are your resources?

It is critical to assess whether you have access to the skilled personnel, funds and equipment needed to complete the work. Human resource considerations include:

- available skills sets
- workplace health and safety obligations
- insurance
- availability
- how to avoid burn out.

How much will it cost?

This is a frequently asked question with no clear answer. The cost of weed management can vary greatly depending on the size, density and location of the infestation, site accessibility, preferred control technique – the list goes on!

To help estimate weed management costs:

- consider total management expenses including running costs, labour, equipment purchases or hire and, in remote areas, any travel, accommodation and meal allowances
- determine short-term and long-term budgets based on each management phase
- factor in the (often underestimated) costs of follow-up and monitoring.

To reduce costs:

- borrow equipment from neighbours, local councils, Landcare groups or natural resources management organisations
- consider the cost implications of whether work is carried out in-house or by a contractor (the latter may still be more cost-effective)
- access any available financial incentives, grants, low-interest loans or labour programs
- carry through with your entire weed management plan to mitigate the cost implications of partial action or inaction.

Step 4. Implement the plan

Commence your management program. Use your plan to keep on track and stay motivated. Share your successes, setbacks and learnings along the way to encourage support from others.

Remember to prevent the spread of weed propagules and pathogens by disposing of weed refuse appropriately and creating hygiene protocols (see Chapter 4).

Step 5. Monitor and review progress

Monitoring is an essential component of your weed management program. Your approach should be set up during planning, commence at the start of your control efforts and continue during and after control efforts (Figure 3.2).

Why monitor?

Monitoring allows you to:

- measure the success of your management program's objectives and goals
- decide if you need to adjust your management program, particularly in the initial stages
- assess the rate of native regeneration
- identify new weed infestations or other issues that may affect your program success
- communicate progress to stakeholders
- identify which actions worked—and which didn't—for translation to future management plans.

Finally, if you document what you did and how, others can learn from your success and follow your example.

When to monitor?

To make more efficient use of time, monitoring can be incorporated into follow-up activities (see Step 6 and Chapter 4 for a discussion on follow-up).

Monitoring approaches

Monitoring approaches range from simple to complex and at a minimum should include:

- maps that document expansion/reduction of infestations relative to the maps prepared at the start of the program (baseline maps)
- photo monitoring (see Box 3.2 'Establishing photo monitoring points') to provide an easy 'visual' method of assessing change over time
- a log or diary of activities, dates and climatic and environmental factors to help determine why some methods may have worked one year but

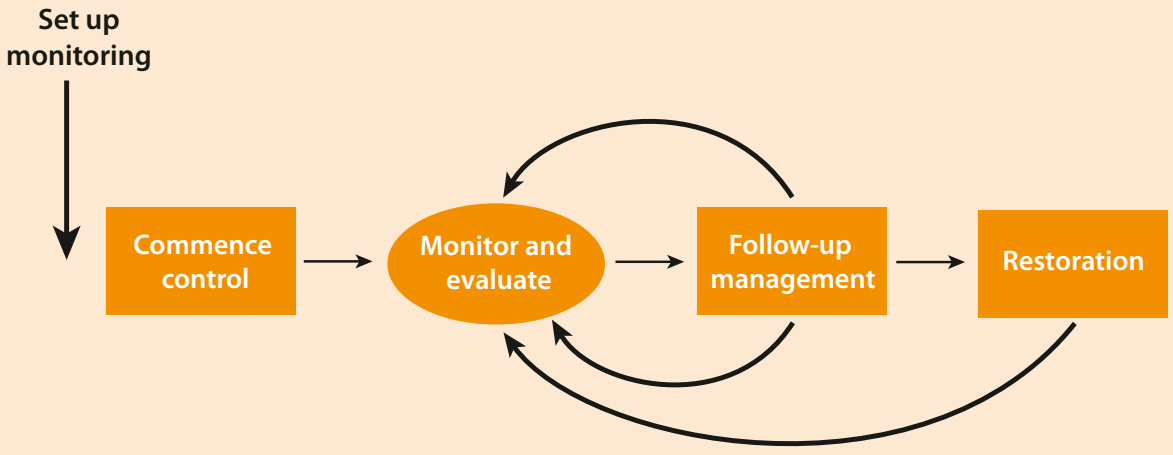


Figure 3.2 Monitoring programs established at the start of a management program inform future follow-up treatments and activities, improving outcomes through adaptive management.

not in another (see Chapter 6, 'treatment record sheet')
- records and assessment of your program's expenditure
- records of herbicides used and their efficacy
- recording failures as well as successes to ensure ongoing improvement and development of management practices
- biocontrol agent release sites, population changes and impacts (see Chapter 4)
- quadrats or transects to quantify changes in weed densities or the response of native plants.

Reviewing progress

An annual review of your plan is recommended to inform what changes are needed for the following year. Examples of some review questions and monitoring techniques to address them are provided in Table 3.3. Draw on the information gathered in Step 1 to measure these questions against a baseline.

Given most weeds require multiple years of follow-up control, you may not be making major changes to your plan initially (unless a control method is clearly not working). When substantial gains have been made against target weeds, usually after at least several years, you can shift your focus to other weeds of lower priority.

Table 3.3 Examples of review questions.

Review questions	Related monitoring techniques
Has the extent (area) of the weed infestation increased or decreased?	Update the site map to record any changes in weed distribution or any new weeds.
Has the density of the weed increased or decreased?	Check against categories in Table 3.1.
Are native plants recovering?	Native species can also be assessed using the categories in Table 3.1. You can also use photo points or quadrats and transects.
Which control methods have been most successful?	Establish trials of different methods, compare results and record efficacy.
How much is control costing?	Calculate costs from your record keeping. This should include logistics, equipment, labour and chemicals.

Box 3.2 Establishing photo monitoring points

Set up correctly, photo monitoring can be one of the cheapest and most reliable records of change over time. It is quick, inexpensive, requires little technical skill and causes little to no site disturbance. To establish photo monitoring points:

- mark out the location at which the photo will be taken (e.g. with a star picket)
- record the location with GPS or using a camera that attaches geospatial data to the image
- align photos in a north–south direction to avoid excessive sun or shadow – if this is not possible, record a compass bearing of the direction the camera is pointing and try to have the sun behind you when taking photos
- avoid excess glare or downward shadows when taking photos. Try to do so on a slightly overcast day
- include distinct objects in the photo to provide a basis for comparison (e.g. a significant tree or piece of infrastructure)
- take photos as frequently as needed to show changes
- ensure geospatial data is turned on with the camera or recording device when taking photos and video so that the spatial data is attached to the image
- take photos at the same time of year using the same camera and settings for annual comparisons.

(a)

Rachel Hughes

(b)

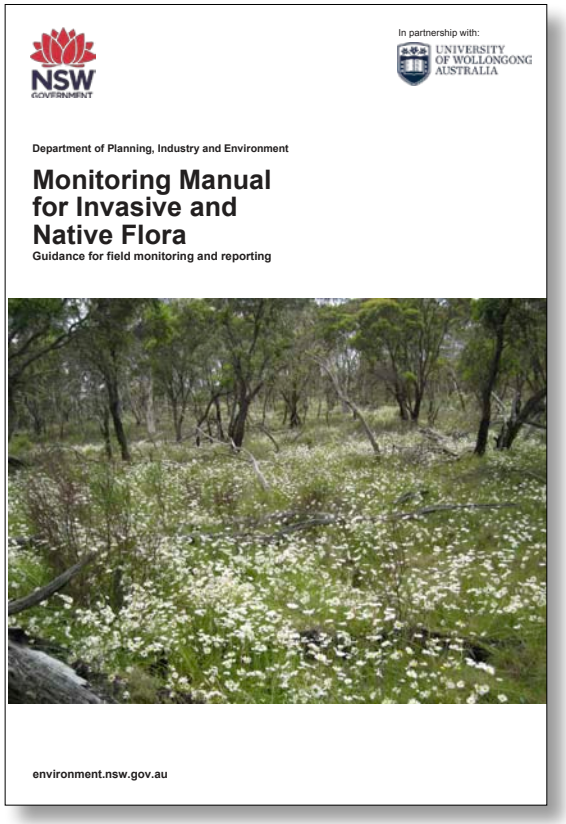
Rachel Hughes

Photo point images showing an infestation of cat's claw creeper (a) before and (b) after control.

Further information

The following publication provides in-depth information on the different methods of monitoring and reporting before, during and after weed control programs:

Monitoring Manual for Invasive and Native Flora (Watson et al., 2021). Available at: environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Pests-and-weeds/monitoring-manual-for-invasive-and-native-flora-210638.pdf



Step 6. Follow-up

Successful management of cat's claw creeper and Madeira vine requires a commitment to a long-term program. It will take many years of follow-up to exhaust the tuber bank, or at least reduce it to levels at which impacts are low or negligible. Set out the timing of your follow-up activities during the planning stage so that this important activity is factored into budgets and work plans.

The main consideration in planning follow-up is to determine timing and frequency. The aim is to:

- prevent or minimise further seed set in cat's claw creeper
- prevent or minimise dispersal of aerial tubers in Madeira vine
- commence follow-up control of vines that resprout from tubers while small and before they re-establish in the canopy.

See Chapter 4 for more information.

Step 7. Restoration (optional)

Ecosystems vary in how they respond to intervention to improve ecosystem health and function. For many ecosystems, we do not know enough about them to understand how to restore them. For this reason, restoration is included here as an optional step. It is valuable at the planning stage to consider whether restoration will be part of your long-term plan. Researching answers to the following questions can help you assess this:

- Is there any evidence of the ecological community under management benefiting from restoration?
- What interventions could be considered (e.g. planting, soil stabilisation)?
- What is the likely cost of restoration and how long will it take?

- How will restoration change, compromise or complement ongoing weed management?
- Who would need to be involved?

If you decide to include restoration, you may want to develop a separate restoration plan. More guidance is provided in Chapter 4.

Working together on weeds

Weeds do not respect property boundaries, and a coordinated approach with neighbours will result in effective control programs. Approaches can be implemented at different scales (local, landscape) and either informally or formally.

Local – informal

This is a grassroots approach in which a rural neighbourhood chooses to work together on a common weed problem. Such cooperation can be quite informal; for example:

- welcoming new landholder arrivals and providing them with information on local weed problems
- organising site walks to discuss control methods
- sharing weed control equipment
- agreeing to let each other know if you observe a weed outbreak on your neighbour's property
- having an in-principle agreement that neighbours may hand pull the occasional weed appearing just over the fence.

Local – formal

A more formal approach is to form a weed-focused community group. Recommendations on how to achieve this from the Australian Centre for Culture, Environment, Society and Space (ACCESS), University of Wollongong are detailed below. Key points are:

- establishing an agreed, common goal for the weed in the local area
- defining the boundaries within which the weed will be tackled
- creating an achievable workplan
- sharing the organisational and weed management load
- documenting and promoting what has been achieved.

Regional

The next level of collaboration is a district coordinated control program run by a biosecurity officer to tackle a regional priority weed. Understanding and developing social relationships is vital for planning and implementing such a program. Guidance to help establish the social context is provided by ACCESS and is presented below.

Key points are to:

- tap into existing networks to reach land managers
- understand community diversity, capacity and views concerning weed management
- build community support for viewing the control of the weed as a priority
- document where the weed is and where it could spread to – who is affected now and who is at risk?
- establish what has been successful regarding timing and methods of control
- draft a regional weed management plan that includes both social and technical considerations
- establish a steering committee to oversee the plan's implementation.

Better together: building networks and shared objectives to achieve landscape scale control

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Coordinated control of invasive vines and scramblers provides many benefits to land managers, from building neighbourly relationships and support networks, though to reducing the spread and impact of the weeds themselves. Making connections with others may provide motivation, knowledge and friendships and help ease the burden of weed control. Working together can be especially beneficial in breaking the back of established weed infestations.

This section provides tips for property managers, community groups and weed management professionals to leverage and coordinate communities to achieve landscape control.

Tips for property managers and community groups

There are many examples across Australia of property managers, including community groups, successfully working together across properties to reduce their shared weed burden. These tips come from observing community groups working with a diverse range of weeds.

1. **Identify a group of people** concerned about the target weed and passionate about working together. Locate them through a community meeting, social barbeque, Facebook group or other opportunity.
2. **Develop a common goal**; for example, prevent the weed from going to seed, reduce local spread or local eradication.
3. **Define a clearly bounded area** to work together on weed control; for example, a river corridor, small valley, several adjoining properties or a rural residential estate. Define an area consistent with the amount of time and resources you have to invest in weed management; too large an area can mean results take too long to see and motivation wanes.
4. **Develop a plan to prioritise your efforts** within the clearly bounded area. This may involve focusing on the lightest infestations and the outliers, and then working in towards the densest infestation. Include:
   - the activities the group will use to address the weed; for example, working bees, individuals looking after specific sections, employing a contractor to reach difficult-to-access areas or to manage particularly dense infestations
   - the frequency (e.g. weekly, monthly) and timing (e.g. Tuesdays) of any group work
   - whether there are any native animals or plants currently benefiting from the weed – this ensures your management activities are undertaken sensitively.

Ensure you have landowner(s) permission (and ideally involvement) before commencing planning and work.

5. **Ensure a social component to activities** – keep motivation going through social activities (e.g. sharing afternoon tea at the end of a working bee). This enables groups to reflect on what they have achieved together, beyond what they could have achieved alone, determine their plan's effectiveness and whether the clearly bounded area is too big or small.

6. **Share the load** – organising working bees, contractors and other weed control activities can become an administrative burden that undermines the group's longevity. Assign group roles based on experience, expertise and interest in key areas such as:
   - communications – for sharing information about group activities on social media or via email
   - recruitment – for inviting and welcoming new people to the group
   - grant writing – to apply for funding to support group activities
   - plant identification – to teach members to identify the target weed(s) and other plants.

   Also share the weed control load. Groups of neighbours might rotate work on each other's properties, finishing each rotation with a barbecue or other social activity.

7. **Document your journey** – for example, photos or brief written accounts of weed management impacts – to showcase your successes, develop a collective sense of achievement and attract new recruits. Recording lessons learned may also be useful for other groups.

8. **Connect with others** – make connections with groups addressing the same, or similar, weeds in neighbouring areas or further afield. Share your knowledge and resources and the activities and decisions that have (and haven't) worked. Link with local, state government and non-government organisations for potential funding and grants, resources and support.

Tips for weed professionals

The following points guide professional weed control officers in understanding and working with their local communities to develop coordinated weed management programs for priority regional weeds.

1. **Know who – identify, understand and encourage social relationships**

   Identify existing land manager networks
   Networks, including those that are not weed specific, may be leveraged for communicating weed-related messages and events; for example:
   - farming networks – producer groups, sustainable farming, restorative agriculture
   - volunteer networks – Landcare groups, community associations, Rural Fire Services
   - agronomist and other advisor networks
   - local government
   - regional NRM bodies (e.g. Local Land Services), regional managers of reserves (e.g. conservation, water) and existing cross-agency bodies (e.g. roadside environment committees).

   Understand the local community
   Understanding the composition, capacities and perspectives of the community will help to determine weed control priorities, preferred control methods, underlying issues related to

weeds and weed control, and where tensions are likely to emerge. Consider:

- the proportion of land managers that are Indigenous land managers, production farmers, hobby farmers/life-stylers, government or corporate (e.g. forestry)
- how these proportions have changed over time
- which land managers and weed management experts people currently turn to for advice
- who may be most interested in building their capacity to manage weeds.

Build trust
Encourage formation of positive relationships among land managers and other stakeholders. Consider:

- bringing together land managers who may not know one another early on
- prioritising weed management along private and public boundaries to demonstrate commitment to being a good neighbour
- developing relationships with other relevant stakeholders with land management aspirations – for example, Indigenous organisations and community groups – to broaden the weed management knowledge base and practice.

2. **Know what and know why – prioritise your target weed relative to other weeds and land management issues**

Establish the community's priority weeds
Where does your target weed fit in relation to the list of weeds that are declared for control? What are the other key weeds of community concern? These may be different from locally declared weeds or other formal priorities. Are some segments of the community more concerned about your target weed than others?

Establish your target weed's community impacts
What are the motivating factors that drive people in the community to control the weed? Are they to do with protecting livestock? Being a good neighbour? Caring for nature? Having a tidy-looking property?

Identify the benefits of controlling your target weed
This includes not only reduced weed density and spread but also environmental, economic and social benefits resulting from working together on weeds.

3. **Know where – where is your target weed located and most likely to spread?**

Map the weed extent
Establish where the core and outlying infestations are. The weed may be widespread in some areas, but emerging in others. Knowing its extent and density will be important in developing a plan for where to prioritise on-ground works, how to allocate resources and to identify stakeholders in adjoining areas who could benefit from joining the initiative.

Consider any boundaries the weed crosses
Any land tenure boundaries the target weed crosses will have management implications that need to be considered.

- Does the target weed spread across private land or public land?
- Does it spread along corridors, such as rivers, roadsides, travelling stock routes or irrigation channels?

- Do opportunities exist to coordinate the timing of management along corridors or across boundaries for more effective control?
- Are there stakeholders whose jurisdiction spans similar boundaries to the weed who could facilitate coordinated responses?

4. **Know how – what approaches have been used to control your target weed locally?** Identifying and examining stories of previous target weed control success, failure and experimentation provides for collective learning and insights into the time and approaches needed to achieve success. Were there any weaknesses inherent in unsuccessful past efforts where land managers had given up? How long did any successful effort take to achieve?

5. **Know when – identify the most effective time to control your target weed.** Timing is critical to successful weed control. Consider how the optimum weed control time fits with other community commitments such as sowing, harvesting and summer holidays. Will land managers have the capacity to control the target weed at certain times of year or during periods of seasonal difficulty such as floods and drought?

6. **Bringing it all together – develop a weed management plan.** Develop a landscape-scale weed management plan that brings together your understanding of both the weed and the local community. This is fundamental to leading an effective weed management program. Consider establishing a steering committee to help develop the plan, engage with diverse stakeholders and oversee its implementation. Follow the seven steps at the beginning of this chapter.

Acknowledgements: This section was prepared by the Australian Centre for Culture, Environment, Society & Space (University of Wollongong) with contributions by A/Prof Nicholas Gill, A/Prof Jenny Atchison, A/Prof Sonia Graham, Dr Gina Hawkes, Dr Kaitlyn Height, Dr Rebecca Campbell, Crystal Arnold, Diana Dawson, Jennifer Smart, Janine Bailey, Laura Butler.

Management Plan Checklist

Step	Further information
1. Assess the situation	
☑ Identify and liaise with relevant land managers	
☑ Identify and research the target species (both weeds and native)	Chapters 1, 2, 4 and 6 of this manual Local field guides Council and government websites
☑ Map infestation and key assets	A Field Manual for Surveying and Mapping Nationally Significant Weeds
☑ Consider weed density	Chapter 3 – Planning Vegetation assessment guides
☑ Establish a baseline for future reference	
☑ Identify site risks to safety and welfare	
2. Define objectives and priorities	
☑ Set your objectives (prevention, eradication, containment or asset protection)	Early Invader Manual: Managing Early Invader Environmental Weeds in Victoria (environment.vic.gov.au/invasive-plants-and-animals/early-invaders)
☑ Prioritise areas for control	
☑ Consider other requirements	
3. Develop a plan	
☑ Who will be involved?	Introductory Weed Management Manual
☑ Describe what you are aiming for and why	
☑ Describe management methods	Chapter 4 – Management
☑ Establish a calendar of actions	
☑ Link what you are doing to your site map	
☑ Identify resources and management costs	
☑ Find out what else is being done – can you coordinate for wider-scale control?	Contact your local weed authority Chapter 6 – Further information
4. Implement your plan	
☑ Get started	
5. Monitor and review progress	
☑ Establish a monitoring program that outlines what and how you will monitor	Chapter 3 – Planning Monitoring Manual for Invasive and Native Flora Weeds and Pests on Public Land – Weed Monitoring Protocol
☑ Is management adhering to your priorities and goals?	
6. Follow-up	
☑ Have you allowed for adequate follow-up?	Chapter 4 – Management
Restoration (optional)	
☑ Will restoration form part of your long-term management plan?	Chapter 4 – Management

Chapter 4

Controlling cat's claw creeper and Madeira vine

Rachel Hughes

At a glance

- **Limiting the spread, establishment and reproduction of cat's claw creeper and Madeira vine is critical.**
- **Various control methods are available. Combine these for more effective results.**
- **Managing invasive vines is challenging. Controlling infestations early, when plants are small, is the best approach.**
- **A range of herbicides and application methods are available to suit different situations.**
- **Several biological control agents have been released. However, their impact is generally low or very localised.**
- **Sites may require follow-up control for several years.**
- **Consider other factors, such as site disturbance, secondary weed invasions and site restoration, during a control program.**

Share your experience

Best practice management is the use of control methods that have been found, through experience and research, to be the most effective and practical way to control your target weed.

The methods described here capture our current knowledge, and not all methods will have the same level of success in all situations. Refer to Chapter 3 for more information on monitoring the effectiveness of your control efforts.

This chapter focuses on the management of cat's claw creeper and Madeira vine, and includes information on:

- choosing a control method for the species and situation
- applying control methods
- integrating different control methods
- considering other management factors for your site
- restoring your site.

Chapter 4

Cat's claw creeper and Madeira vine are similar in growth form, the habitats they invade, and their impacts (refer to Chapter 2). Both also regrow vigorously from extensive underground tubers. However, there are two distinct differences in the way they reproduce:

Cat's claw creeper produces seed

Madeira vine produces aerial tubers

Because of this difference, control methods vary depending on the species. To identify appropriate options for your target weed, look for the corresponding symbol throughout this chapter.

Rachel Hughes

Principles for successful management

Managing cat's claw creeper and Madeira vine is a challenging task, but you can achieve good control by following these management principles.

Develop a weed management plan and implement it

- Identify suitable weed control options and ways to integrate them.
- Regularly monitor, follow up and review treatments for several years.

Protect tree canopies from vines

- Prevent infestations from establishing through surveillance and hygiene.
- Control plants when they're young to prevent them climbing into tree canopies.

Prevent reproduction and spread

- Regularly monitor areas at high risk of invasion, such as riparian zones and areas surrounding previous infestations.
- Stop cat's claw creeper from flowering and seeding.
- Consider the best way to manage Madeira vine aerial tubers. This can include limiting disturbance or ensuring appropriate disposal.

Manage any regrowth

- Deplete or destroy tubers – underground for both species and aerial for Madeira vine.
- Know that depleting mature tubers can take a long time.

Critical factors for success

- Detect new infestations early.
- Identify the most appropriate control method for your site. Consider site sensitivity, access, weed density and location, experience and resources.
- Begin control when plants or infestations are small and manageable. Letting them 'get away' will increase the time and expense of managing these weeds.
- Make a long-term commitment. Follow-up control is essential.

The above information is adapted from Osmond and Verbeek (2008).

The management challenges of cat's claw creeper and Madeira vine

These weeds can be challenging to manage, due to the traits listed below.

Adapted to grow in a range of environments

Cat's claw creeper grows in a range of soil types, and Madeira vine has adapted to a range of climates, including Mediterranean, subtropical and tropical. Both species:

- grow in full sun or shade, and can persist in heavy shade
- tolerate drought and frost, and cat's claw creeper can also tolerate saltwater.

Competitive and fast growing

Both weeds grow vigorously, with reports of Madeira vine growth rates of up to 1 m per week under suitable conditions (Vivian-Smith et al., 2007). Dense growth of plants along the ground prevents growth and germination of desirable vegetation. Extensive tuber systems allow both weeds to thrive, even under adverse conditions.

Easily spread

Both weeds reproduce vegetatively via plant parts such as tubers, stems and rhizomes. This material can be transported long distances. For example, Madeira vine tubers are spread through creeks and rivers and in floodwaters. Cat's claw creeper also produces large amounts of seed that's dispersed via wind and water.

Difficult to control

Due to their aerial climbing nature and tuberous root systems, both species are:

- hard to control and readily regrow, requiring follow-up over several years
- costly to control, especially when established or occurring in sensitive sites.

Sheldon Navie

Sheldon Navie

The fast-climbing nature of cat's claw creeper (left) and Madeira vine (right) contributes to the challenges of managing them.

Chapter 4

Choosing a control method

Effective control of cat's claw creeper and Madeira vine requires an approach that's tailored to your situation. Factors identified in your weed management plan, such as goals, management constraints and opportunities, will also influence the options available to you.

To achieve long-term success, choose an appropriate method (or methods) for your situation. The control options available for cat's claw creeper and Madeira vine are:

- physical control
- herbicide control
- biological control.

Cat's claw creeper and Madeira vine typically grow on and around other vegetation, so it's crucial to choose a control technique that will have minimal impact on desirable vegetation. Use the decision support tool (Figure 4.1) to select a control method(s) based on the **size of your infestation** and **whether the plants have reached the canopy of supporting vegetation**.

In addition to the factors outlined in Figure 4.1, the vine's species and whether the site is sensitive will inform the best options for your site. Read on to better understand appropriate control options.

Box 4.1 The trouble with tubers

Control of the underground (and, in the case of Madeira vine, aerial) tubers is crucial for effective long-term management of these weeds. These structures act as both reproductive bodies and carbohydrate sources, and they can persist for many years, presenting challenging conditions for control. For example:

- Herbicide translocation into both aerial and underground tubers can be poor, resulting in the need for extensive and ongoing follow-up over several years.
- Manual removal of the tubers, a more lasting control method, is impractical in heavily infested areas.
- Damage to cat's claw creeper tubers and roots, such as through mechanical disturbance, can lead to the production of more tubers (Raghu et al., 2006).

Sheldon Navie

Clusters of Madeira vine aerial tubers.

Leasie Felderhof

Cat's claw creeper tubers are produced along lateral roots.

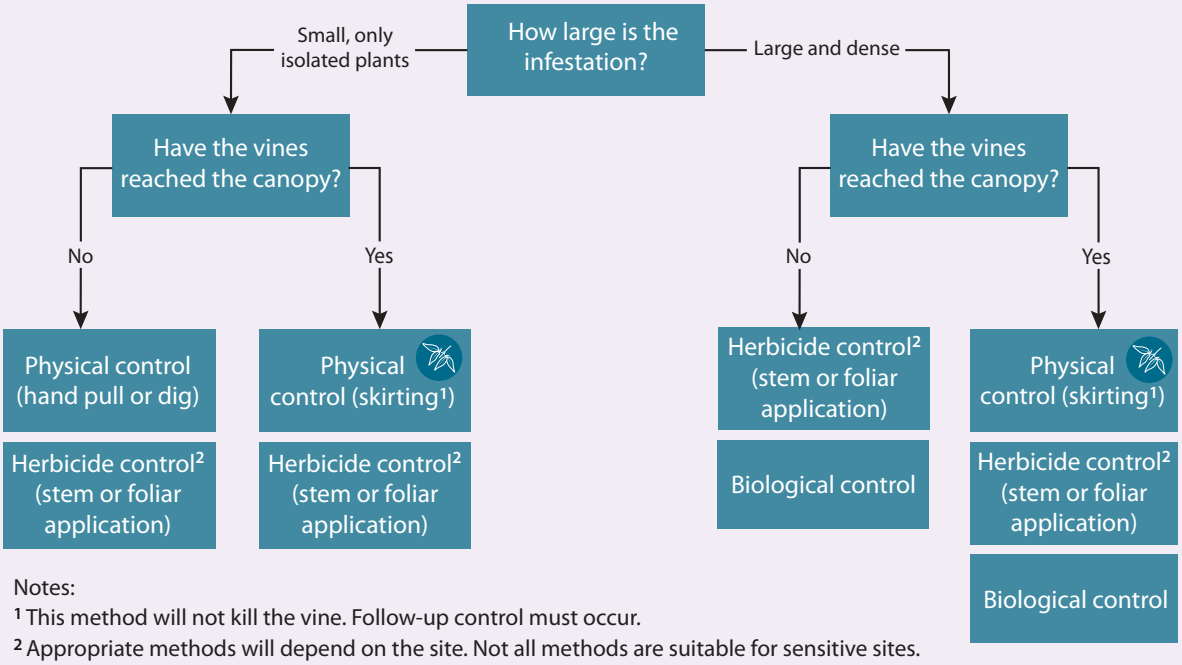


Figure 4.1 Consider infestation size and vine height when choosing appropriate control options for cat's claw creeper and Madeira vine.

Taking an integrated approach

Often the most successful and cost-effective approach to manage any weed is to combine or integrate several control methods over time (termed 'integrated weed management'). Integrated control can:

- target vulnerable aspects of a weed or its life cycle
- reduce the impact of control on the surrounding desirable vegetation
- maximise both control effectiveness and cost efficiencies
- reduce the chance that weeds will adapt to a given control method (e.g. build up resistance to a herbicide)
- limit secondary weed invasion.

For example, an infestation of cat's claw creeper can include vines growing up trees and a ground-based infestation. You may choose to treat vines growing up trees using cut and swab and spot-spray or hand-remove ground-based plants, depending on their size and number.

Table 4.1 collates the control methods available for cat's claw creeper and Madeira vine, summarising their advantages and disadvantages and including any cautionary notes on their use, when to apply them, and which methods can be integrated with others.

Table 4.1 Cat's claw creeper and Madeira vine: a summary of control methods and key considerations

	Advantages	Disadvantages / limitations	Caution!	Timing	Integrate with
PREVENTION AND EARLY INTERVENTION					
Biosecurity	▪ prevents weed entry and spread ▪ avoids future costs and impacts ▪ low ongoing cost	▪ ongoing time commitment to manage spread pathways ▪ ongoing effort needed to obtain everyone's compliance	▪ difficult to limit natural pathways of spread	▪ year round	▪ all on-site activities ▪ all other control measures
Surveillance	▪ reduces impacts and costs	▪ time consuming and ongoing	▪ can be hard to detect new infestations in inaccessible areas, such as riparian zones and in tree canopies	▪ spring to late autumn for cat's claw creeper to avoid seeding ▪ late summer to autumn for Madeira vine (when it's flowering and most conspicuous) ▪ opportunistically for both species, when undertaking other management activities	▪ all other control measures
PHYSICAL REMOVAL					
Hand removal	▪ highly targeted control for seedlings, tuberlings and small plants ▪ no chemicals and minimal equipment required ▪ suitable control method in most soil types and terrain ▪ causes minimal impact to desirable vegetation	▪ not suitable for controlling established plants or large infestations ▪ can cause significant soil disturbance if attempted on established plants ▪ time consuming and labour intensive ▪ all removed plants and plant parts must be disposed of properly	▪ can result in vines reshooting if tuber fragments remain ▪ can result in new populations establishing off-site due to inappropriate disposal ▪ needs follow-up for any seedlings and regrowth of tuber fragments that remain	▪ year round (subject to accessibility) but best when soil is moist ▪ when plants are small ▪ for cat's claw creeper, best done prior to flowering or seed set	▪ all other control measures
Skirting	▪ can prevent vines from setting seed ▪ kills aerial vines and stems ▪ no chemicals and minimal equipment required ▪ causes negligible impact to desirable vegetation	▪ doesn't kill plants ▪ secondary treatment required ▪ time consuming and labour intensive	▪ must be followed up with herbicide control to kill plants ▪ considered less suitable for Madeira vine due to aerial tubers; therefore not recommended for most situations	▪ year round ▪ often applied prior to flowering/seeding	▪ herbicide control

	Advantages	Disadvantages / limitations	Caution!	Timing	Integrate with
HERBICIDE CONTROL					
Stem application – all methods	▪ can effectively kill many stems ▪ can kill underground tubers ▪ some techniques (e.g. scrape and paint) can kill aerial tubers ▪ low chance of off-target damage	▪ time consuming and labour intensive ▪ different methods required for different species (e.g. cut and swab won't control aerial tubers of Madeira vine) ▪ follow-up required	▪ read herbicide label ▪ avoid herbicide application to desirable vegetation ▪ 'tuber rain' from cut and swab in Madeira vine infestations requires significant follow-up	▪ best done when plants are actively growing (spring) and not under stress	▪ physical control – can manually remove small tubers and new plants ▪ foliar spraying of ground-running stems and regrowth from tubers ▪ biological control agents in dense infestations
Foliar application	▪ relatively time and labour efficient ▪ can cover large areas ▪ some methods suitable for use in hard to access locations (splatter gun) ▪ minimal soil disturbance	▪ high chance of off-target damage if applied without care ▪ both species can regrow from underground tubers ▪ can result in poor control of aerial tubers	▪ read herbicide label ▪ minimise spray drift ▪ minimise residual chemicals remaining in the soil	▪ warmer months when plants are actively growing and not under stress ▪ at least twice per year in early spring and summer/early autumn	▪ physical control and/or stem applications for outlying individuals or smaller populations ▪ stem application – apply before or after initial stem treatment
BIOLOGICAL CONTROL					
Biological control	▪ most labour-efficient and cost-efficient method ▪ can reduce density and impact of cat's claw creeper and Madeira vine in the long term	▪ highly situationally dependent ▪ variable success seen in current agents for cat's claw creeper and Madeira vine ▪ won't eradicate infestations ▪ establishment and results can take several years	▪ contact local weed officer or authority before attempting biological control ▪ biocontrol agents need cat's claw creeper or Madeira vine plants to survive and persist	▪ generally between September and March	▪ use in dense infestations and combine with stem applications and physical control to treat outlying individuals and populations

Biosecurity

Biosecurity helps prevent the entry, spread and establishment of new weeds, pests and diseases. It also includes not 'exporting' weeds, pests and diseases from your site to other sites (e.g. through contaminated soil or equipment). Developing and routinely implementing a site biosecurity plan is a valuable, low-cost investment to prevent and lessen incursions of a wide range of weeds and other pests and diseases.

Weeds are easily spread during control activities. This can occur when:

- hygiene protocols aren't followed
- removed weeds aren't disposed of appropriately.

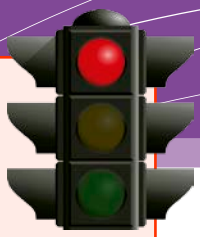
Many weeds have sticky or spiky seeds that stick to clothing or boots and travel as unwanted stowaways to new sites. Others can regrow from stem or root fragments, and incorrect disposal of this plant material can lead to new infestations. Pathogens (e.g. the root-rot fungus *Phytophthora*) may also be present at some sites and can be spread via soil, shoes, clothing and dirty tools and equipment.

Practicing good hygiene

Regardless of whether you're monitoring a site, looking for new weeds, or actively controlling weeds, the best weed hygiene practices follow the concept of 'arrive clean, leave clean' and occur at all sites.

To reduce the spread of hitchhiking weed species:

- Check clothing and boots and remove any seeds, vegetation or soil attached. A dry brush can help to remove seeds and soil from boots and clothing.
- Start work in lightly infested areas and move towards more heavily infested areas to reduce spread within and between sites.
- Check and remove any seeds and vegetation on vehicles and machinery before leaving the site.
- Avoid driving off-road in areas with priority weeds.
- Wash vehicles/machinery regularly to remove soil.



Legal requirements to control cat's claw creeper and Madeira vine

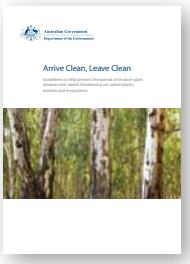
Cat's claw creeper and Madeira vine are declared weeds in all Australian states and territories (except for Madeira vine in WA). Restrictions on their sale, trade and movement, as well as any control requirements, vary throughout Australia.

Refer to Chapter 6 for the current declaration status of cat's claw creeper and Madeira vine (as of July 2024). Contact your local weed officer for further information.

Spread by water and wild animals is more difficult to manage but should still be considered when seeking to prevent new weeds arriving and spreading on your site. Monitor areas that feral and native animals frequent. Bear in mind that watercourses can be a spread pathway for cat's claw creeper and Madeira vine.

To reduce the spread of pathogens:

- Put together a simple hygiene kit to use before and after a site visit. Include a stiff brush and a spray bottle with a disinfecting product. Options include 70% methylated spirits and 30% water, one part bleach to four parts water, or a commercial product such as PhytoClean®.
- Remove mud, soil and organic matter from clothing, footwear, tools, vehicles, machinery equipment, etc.
- Spray clothing and boots with the disinfecting solution before entering clean areas.
- Spray tools (especially cutting tools) and machinery with 70% methylated spirits.
- Shower to remove myrtle rust spores from skin and hair.
- Take extra care to clean inside and outside vehicles and machinery immediately after leaving a site.



Further information including tips, detailed guidelines and resources can be found here: dcceew.gov.au/sites/default/files/documents/arrive-clean-leave-clean.pdf

Surveillance: finding new infestations

Undertaking surveillance will help detect new incursions of weeds. Aim to:

- Conduct regular searches to detect new outbreaks of cat's claw creeper and Madeira vine, and monitor high-risk sites.
- Control cat's claw creeper and Madeira vine before they climb into the canopy of trees.
- Control cat's claw creeper plants before they set seed.
- Focus on areas that are at high risk for invasive vine incursions.
- Record locations where invasive vines are found to check again in future searches.

Areas to check during regular site visits include:

- riparian areas
- disturbed areas, e.g. roadsides
- forest and woodland margins
- areas where garden waste is disposed.

Record and map locations of treated or removed plants so that it's easy to return to the same location to search for new plants. The use of aerial imagery can be helpful in detecting canopy infestations of cat's claw creeper during its flowering season from September to November.

Physical control

In specific circumstances, physical control by hand or the use of tools can be a feasible and cost-effective control method for cat's claw creeper and Madeira vine. Consider physical removal:

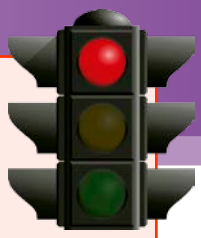
- when your infestation is small and in an early stage of invasion
- for control of Madeira vine aerial tubers that have fallen to the ground
- for seedlings and young plants emerging outside of a core infestation
- for smaller plants that have ground-running stems that haven't yet reached the canopy of supporting trees
- for follow-up control, when targeting seedlings and tuberlings.

Established plants may not be suitable for physical removal. Consider other options before proceeding.

Combine physical control with chemical or biological control methods if your site has a combination of seedlings, small plants and mature plants that have reached the canopy of supporting trees or other structures.

Sheldon Navie

Cat's claw creeper's bright yellow flowers allow for easy spotting during spring.



Physical removal of large, established infestations isn't considered a best practice control option because:

- **Plants with established stems are likely to also have established root systems and tubers.**
- **Digging out tubers and large root systems is labour intensive and greatly disturbs the soil.**
- **Research indicates that disturbance of cat's claw creeper root systems can result in the production of more tubers (see Box 4.1).**
- **Removing vine stems from a native plant can also damage the canopy of the desired plant.**
- **Pulling down vine stems can dislodge aerial tubers (on Madeira vine), which can spread over a large area and grow into new plants.**
- **For large, established plants or infestations, it may be difficult to find and remove all roots and underground tubers, resulting in plant regrowth.**

Hand removal

Application method

- Gather equipment, including gloves and a bucket or bag for collecting plant material. For seedlings, use small tools, such as a hand trowel. A mattock may be required for larger plants.
- Use your tool to carefully lift the plant and any tubers and roots out of the ground, being mindful that there could be more than one tuber.
- Be careful not to leave roots, tubers or tuber fragments in the ground.
- Place the plant in a bucket or bag for correct disposal.
- Monitor the area for any missed plants.

Madeira vine tuberlings often occur as a dense carpet under the parent plant. These can be easily removed with a small trowel. Underground tubers of both Madeira vine and cat's claw creeper can be deep in the soil and can snap easily, so take care when using this method.

Matt Sheehan

Madeira vine tuberlings can be easily removed by hand.

Timing

Physical removal can be done year round, but it's best done when soil is moist and friable. Aim to control cat's claw creeper plants before they set seed (late summer to autumn).

A short video by Pittwater Ecowarriors on the hand removal of Madeira vine tuberlings can be viewed at youtube.com/watch?v=4L7GBMF2NU4&t=90s

Skirting

In some instances, you may want to limit the spread of cat's claw creeper by preventing the plant from flowering or producing seed. This can be helpful when you have:

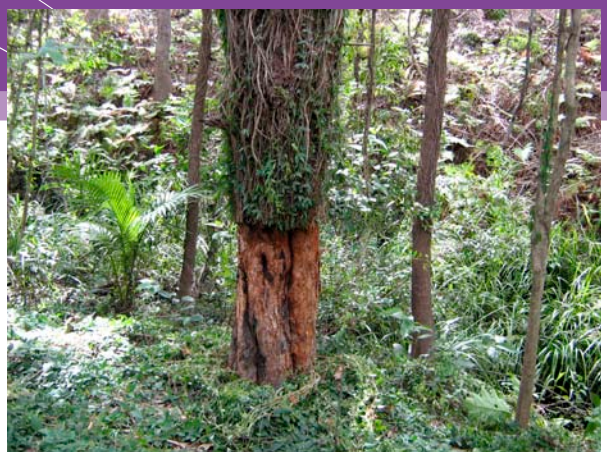
- a large infestation of cat's claw creeper but not enough time to control the plants before they flower and set seed
- insufficient resources to apply other methods, such as scrape and paint or cut and swab.

'Skirting' the vines involves cutting them off above ground level and leaving the aerial vines to die in the canopy. This aims to stop flowering and seeding, buying you time to return and treat the remaining vine at another time.

Application method

- For thin-stemmed vines, use a pair of secateurs to cut stems approximately 1.2 m (or at chest height) above the ground so there's no contact with the ground.
- Recut the stem again close to the ground but not at the roots.
- For larger vines use a chainsaw or reciprocating saw to cut stems.
- Leave stems attached to host trees or structures. Don't attempt to pull the vines down – this can damage host trees or structures or result in injury to personnel.
- Aerial stems will die in the tree canopy.
- Regrowth from the roots will be visible for future treatment.

This method isn't recommended for Madeira vine, as aerial tubers can drop from cut stems and grow into new plants (see Box 4.3).



Maggie Scattini

Cat's claw creeper has been cut approximately 1 m from the ground, leaving a clear 'window' of tree trunk to allow easy inspection of regrowth from below.

Rachel Hughes

Before (left) and after (right) skirting cat's claw creeper growing up a mature tree.

Timing

Skirting can be done year round, but it's often conducted when plants are flowering to prevent seed set.

Follow up

This method won't kill the plant, as the root system and a portion of the stem is still alive. These stems will reshoot quickly (sometimes in less than one season). **You must return to control the plants.**

This method is often combined with herbicide control, such as spot spraying. Refer to the 'Herbicide control' section for information on how to treat the remainder of the plant for effective control.

Box 4.2 Weed disposal

Many weed species – including cat's claw creeper and Madeira vine – can spread by vegetative reproduction. Vegetative parts (e.g. tubers, stem and root fragments, stolons) must be disposed of correctly to avoid secondary weed invasion or new introductions. To correctly dispose of weeds, it's important to know:

- which species you're controlling
- how the weed spreads
- whether you have the option to dispose of weeds on site or off site.

On site disposal:

- Compost material by covering with black plastic and turning routinely to speed up decomposition. Spot-spray resprouting weeds. Select an area that can be easily checked for regrowth and is away from other vegetation where it can be easily and frequently managed. Don't use this method for Madeira vine – the risk of spread by aerial tubers is high.
- Solarise by placing weed material in a black plastic bag and leave in the sun to 'cook' for several months to kill the tubers and rhizomes of some species.
- Suspend material from trees or other structures so it's not in contact with the ground. The material will dry out and decompose over time. Don't use this method for Madeira vine – aerial tubers can drop to the ground and shoot.

Be careful not to store weed material within a flood zone. Flood waters can wash it away, contributing to weed spread downstream.

Off site disposal:

- Remove as much soil as possible from roots, and place plant material in a strong plastic bag:
  - Take to an approved deep burial/green-waste facility – check with your local council about any specific requirements. Cover trailers and trays when transporting weed refuse to avoid propagules falling out.
  - Seek advice from your local weed officer or waste facility manager for other safe disposal options.

Other options, such as microwaving or freezing tubers, have been trialled, but their effectiveness is unproven and likely to be impractical.

Matt Sheehan

Sheldon Navie

Madeira vine aerial tubers readily shoot, both on and off the stem.

Herbicide control

Herbicides are a fundamental tool in the control of cat's claw creeper and Madeira vine, and a range of herbicides are available for use. This section provides information so you can tailor a herbicide control program for your situation, based on available application methods. Controlling these weeds can require multiple treatments per year, over several years. This can have implications for both time and cost. It can also inform the control method you choose.

This section outlines critical information on:

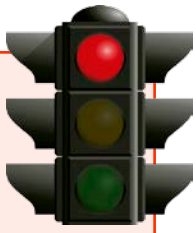
- herbicides available for use on cat's claw creeper and Madeira vine, with additional detail in Chapter 6
- how and when to apply herbicides.

Herbicides for cat's claw creeper and Madeira vine

Herbicides for controlling cat's claw creeper and Madeira vine can be highly effective and are used for infestations of all sizes. Only two herbicides are registered for use on cat's claw creeper and Madeira vine – aminopyralid + picloram gel, and fluroxypyr – but several herbicide options are contained within minor-use permits that you can also use on these species.

You must check the label and permit carefully to ensure your intended use meets requirements.

Two types of herbicides are used to control these invasive vines – non-selective herbicides (e.g. glyphosate), which kill any plant they come into contact with, and selective herbicides (e.g. fluroxypyr), which target broadleaf weeds only. Some selective herbicides are also residual (e.g. triclopyr, picloram, metsulfuron-methyl) and remain active in the soil for an extended period, preventing seed germination.



Before commencing any herbicide control:

- **read the the Safe use of herbicides factsheet (Chapter 6)**
- **familiarise yourself with the legislation regarding herbicide use.**

Refer to weed control contacts (Chapter 6) for advice and assistance.

Glyphosate is commonly used to control cat's claw creeper and, to a lesser extent, Madeira vine. Take care to prevent off-target damage when using glyphosate. Indiscriminate spraying will open up bare ground for opportunistic weed invasion and kill any native vegetation (Johnson, 2011a).

Selective and residual herbicides may more effectively control tubers long term, including by increased translocation of herbicides into the aerial tubers of Madeira vine (Johnson, 2011a). However, these herbicides will also impact other woody plants and vines, particularly those in the immature stages. Therefore, avoid the use of residual herbicides in more sensitive sites until further trials can assess the long-term impacts on the germination of native species. In degraded and heavily infested sites, where recolonisation of native species from adjacent areas or active revegetation will be required, these selective and residual herbicides may provide a better control option (Johnson, 2011a).

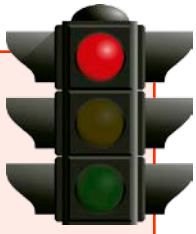
Further research is needed into the comparative effectiveness and off-target impacts of herbicides for the management of cat's claw creeper and Madeira vine under different conditions.

Chapter 6, Table 6.1 and Table 6.2 summarise the range of herbicides and herbicide mixes available to control these species.

Combining herbicides

Sometimes herbicides are combined in the same tank mix. For example, a common tank mix for controlling large and dense cat's claw creeper infestations in the Port Macquarie Hastings Council area is 300 mL/100 L Starane advanced + 10 g/100 L Brush-Off + Pulse Penetrant. This tank mix is applied via high-volume foliar spray with great success.

Tank mix partners must be physically compatible and registered for your situation, and some tank mixes can reduce control efficacy. Read the label and seek advice from a reputable herbicide retailer or weed professional.



Cat's claw creeper and Madeira vine are weeds of riparian areas. Take care when selecting and using herbicides to minimise off-target damage to waterways. Refer to the Safe use of herbicides factsheet in Chapter 6 for more information.

Application methods

Two main methods are used for applying herbicides for the control of cat's claw creeper and Madeira vine:

- stem application, such as scrape and paint, cut-stump and stem-injection
- foliar spraying using a knapsack or vehicle-mounted spray unit.

Select an appropriate herbicide application method for cat's claw creeper and Madeira vine based on the size and density of your infestation, the resources available to you, the environment you'll be working in, and your management objective. Choose a method that will limit the chance of off-target damage, especially if working in native bushland.

Table 4.2 provides guidance on choosing an application method, with more detail provided in the following sections.

James Martin

Weed control in the Mary River catchment has reclaimed this Moreton Bay fig tree.

Table 4.2 Choosing the best herbicide application method depends on the situation.

Situation	Method	Species	Considerations
Sites where: ▪ stems can be pulled off host tree (e.g. young plants, regrowth) ▪ masses of seedlings occur ▪ off-target damage isn't a concern ▪ vines have prostrate growth	Foliar spray		▪ may not be suitable for high-value conservation areas with native species understorey – apply with caution ▪ choose the equipment that will provide the best coverage for your situation – refer to page 72 for more information
Many stems growing up trees	Cut and swab		▪ large vines – use large tools for cutting (e.g. axe, machete, handsaw, chainsaw) ▪ small vines – use hand tools (e.g. secateurs)
	Scrape and paint		▪ best for vines with thinner stems ▪ more commonly used for Madeira vine
	Stem injection		▪ less commonly used method – can be time consuming and regrowth may occur post control ▪ best for thicker stems that are more than 50 cm in circumference ▪ for effective application can only be used if you can access the whole stem circumference ▪ Madeira vine may be too soft for this method, depending on stem size
	Foliar spray		▪ particularly useful for established, dense infestations growing up trees, with aerial tubers present ▪ use a skilled spray operator to reduce spray drift and off-target damage. May not be suitable for high-value conservation areas with native species – apply with caution ▪ choose equipment that will provide the best coverage for your situation – refer to page 72 for more information
Follow-up control of 'skirted' vines	Foliar spray		▪ use to spray regrowth of vines previously cut to reduce flowering and seeding ▪ choose equipment that will provide the best coverage for your situation – refer to page 72 for more information
Small, isolated plants	Basal bark		▪ take care to avoid off-target damage ▪ not suitable for controlling seedlings or large infestations
Hard-to-reach, dense infestations	Splatter gun		▪ for example, vines growing on steep slopes, or across small gullies ▪ can be used to reach plants up to 10 m away. Take care to avoid off-target damage

Box 4.3 Choosing the best approach for your site

Careful consideration of your site and its unique features will help you identify the best control method. Factors that influence the best approach include weed infestation:

- size and density – certain methods may be too laborious for large dense infestations
- location – vines growing along watercourses or on steep slopes can restrict your control options
- growth pattern – aerial infestations require a different approach to ground-based infestations.

Resources, experience and access to equipment will also influence your choices.

Some weed managers prefer to use methods and herbicides that minimise disturbance to Madeira vine and maximise death of aerial tubers where they occur (i.e. without cutting the plant or allowing 'live' tubers to drop to the ground and resprout). In large, dense infestations, this may involve high-volume aerial spraying with low-concentration herbicide (see Box 4.5).

Others choose to cut plants and allow a 'tuber rain' to occur, because it's easier to control plants and tuberlings on the ground, rather than in the canopy. This option may be appropriate if your site:

- has an old infestation where many tubers have fallen to the ground, already requiring long-term follow-up
- is small and easy to access on foot for repeat visits
- is flat and not conducive to tubers rolling into watercourses and spreading downstream – this may also allow for tarpaulins to be laid out to catch any falling tubers.

You may need to visit repeatedly over several years to manage tuberlings if this approach it taken.

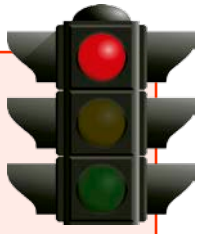
Stem application

Stem application methods:

- are targeted control methods that minimise damage to desirable vegetation such as native plants
- involve cutting, scraping or drilling stems and applying herbicide to the incision
- transport the herbicide from the application site to the rest of the plant, including aerial tubers in the case of Madeira vine.

Although stem-application methods are labour intensive and time consuming, they can be efficient in the long term. This is particularly so when you integrate them with other methods, such as spot spraying, to control regrowth of ground trailing stems. If you're using biological control to suppress a dense weed infestation, you can also use stem application to treat outlying populations.

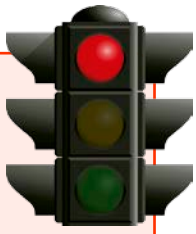
The main stem application methods are cut and swab (for cat's claw creeper) and scrape and paint (for Madeira vine). Basal-bark and stem injection (drill and fill, axe cut) are less commonly used.



Specific chemicals (and associated rates) are used for each of the various stem application methods (summarised in Tables 6.1 and 6.2). Select and apply the correct chemical and rate depending on your situation and the species present.

Cut and swab

The cut and swab method targets the underground tuber and root systems and is primarily suited to cat's claw creeper. Use this method when stems are actively growing and not stressed (e.g. by drought, waterlogging, cold conditions). In dense infestations with many large stems, work in pairs, with one person cutting the stem and the other applying the herbicide.



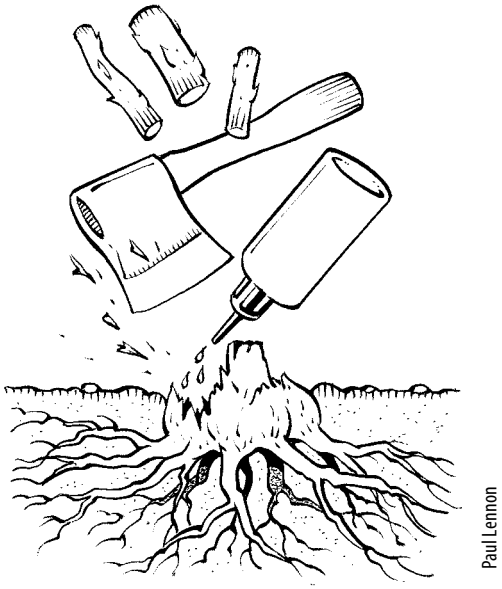
This method isn't recommended for use on Madeira vine:

- when aerial tubers are present, as it won't kill aerial tubers and they can drop to the ground and take root, forming new plants. Refer to Box 4.3 for more information.
- that has mature, thick stems, as there may not be enough herbicide uptake to kill underground tubers.

Consider an alternative chemical-control technique, such as scrape and paint or foliar spraying, that may help to control aerial tubers.

Application

- Using secateurs, a small hand saw, axe or chainsaw, cut all climbing stems 1–2 m above the ground, and peel cut stems back from the host tree to provide a clear area in which regrowth can be monitored.
- Recut the stems again less than 10 cm from the ground.
- Within 15 seconds, apply concentrated herbicide to the cut surface of the lower stems using an applicator (e.g. small squeeze bottle, brush, spray bottle).
- The stems above the cuts will die, and the herbicide should kill some of the underground tubers.
- Resprouting is common, so follow-up treatment will be required for many years.
- For large stems, a chainsaw can be used in place of secateurs or a hand saw (see Box 4.4).
- For large stems, extra cuts can be made into the top of the cut stem to increase the exposure to herbicide.



Paul Lennon

Cut and swab application.

Timing

Cut and swab can be done year round, but it's most successful when plants are actively growing.

Follow-up control

Cat's claw creeper has many underground tubers and, while this method can kill some tubers, surviving tubers can regrow. You may need to do follow-up control for approximately five years (DAF, 2023).

Box 4.4 Cat's claw creeper control in state forests and national parks, Queensland

James Martin, Queensland Parks and Wildlife Service

Inland from the Sunshine Coast in South East Queensland, cat's claw creeper impacts the health of the Mary River Catchment and several endangered species that call this environment home. Changes to the structure of vine scrub thickets threatens the Nangur spiny skink (*Nangura spinosa*), listed as Critically Endangered under the *Australian Environment Protection and Biodiversity Conservation Act 1999*. The vine smothers the skink's burrows and reduces light reaching the forest floor (DESI, 2013). The Nangur spiny skink has a restricted distribution, with only two known populations in Australia.

Rangers managing cat's claw creeper in the Gympie region integrated several control methods, including cut and swab, spot spraying and biological control. Efforts focused on Oakview National Park and areas of significant vegetation along the Mary River Catchment, notably Amamoor State Forest.

QPWS

Controlling cat's claw creeper.

Initial control

Vines were cut at chest height, pulled off the tree, and cut again at ground level (as per the skirting method). Cut stems were sprayed with glyphosate at a rate of 83 mL/L (as per the cut and swab method). Larger vines were cut using a battery-powered chainsaw, and vines were pulled off host trees using a large screwdriver or prybar.

Using a tool to remove vines from host trees greatly reduced staff's physical labour and resulted in a much cleaner outcome, with a bare tree trunk. Having over a metre of bare tree trunk made follow-up treatments much easier and ensured no herbicide came into contact with the trees through broken bark.

Priority vines for treatment were those closest to waterways, growing on mature trees, or older vines. This reduced the likelihood of seed production and spread and decreased the chances of losing important canopy trees. After these vines were controlled, focus moved on to other areas and smaller trees.

Maintaining site accessibility

Creating access paths by spraying the weedy understory made follow up easier. Care was taken to avoid broad-scale spraying the understorey, as this would've created too much disturbance and allowed further weed invasion. Breaking up the management areas with the access tracks allowed for staged management of smaller areas with a clean 'edge' to work from. Spot spraying access paths also allowed for in-fill planting of desired vegetation, with reduced competition from cat's claw creeper.

Follow-up control

Rings approximately 1.5 m in diameter were spot sprayed around treated trees where infestations of cat's claw creeper were covering the ground. This prevented cat's claw creeper from climbing treated trees for months. Creating a vine-free ring around trees also provided an edge to work from into other more heavily infested areas. Rather than spraying large areas where cat's claw creeper was thickly covering the ground, individual rings between trees were joined to create treated corridors. This avoided creating large open areas which would've just been invaded by other weeds.

Where possible, follow up treatments were conducted within 6–12 months, before vine stems were greater than 5mm in diameter. These young, thin vines were pulled off trees and spot sprayed with glyphosate at 10 mL/L. This allowed for reduced chemical use compared to the cut and swab method.

The next step was spraying weeds underneath trees with established canopies to help with regeneration. Tree species that were known food sources for birds were the first choices, as a large seed bank already existed in the soil from seeds deposited in droppings. These rings have kept prostrate cat's claw creeper at bay for almost two years.

Integrating control methods

Activity from biological control agents – the leaf-feeding tingid (*Carvalhotingis visenda*) and the jewel beetle (*Hedwigiella jureceki*) – was observed. Approximately 800 jewel beetles were released to assist other control methods. The agents were most effective at slowing the regrowth of treated vines. However, herbicide control of large vines is still required. Refer to the biological control section later in this chapter for more information.

Restoration

Ideally, natural regeneration will occur after control of invasive vines, but revegetation may be required. Any planting should consider the native species present at the site and the openness of the canopy. Planting canopy species can reduce the proliferation of pioneering weeds. Planting some native pioneer species, as well as larger, climax species, helps create a closed canopy more quickly, reducing the chance of further weed invasion. See the 'Site restoration' section at the end of this chapter for more information.

SWQP

Preparing vines for herbicide application using the skirting method.

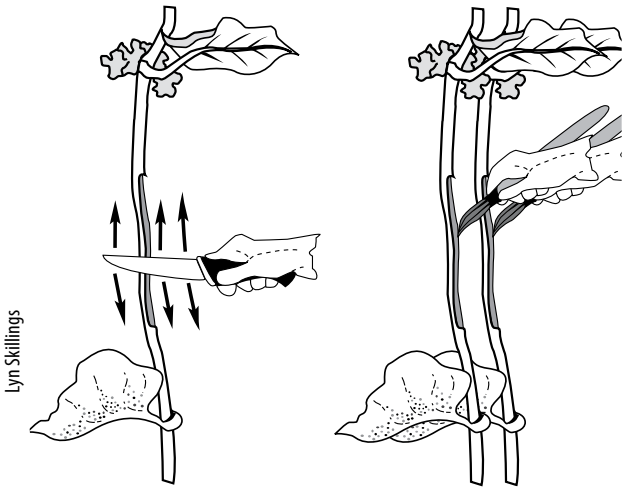
SWQP

Applying herbicides to cut vines on mature trees.

Scrape and paint

The scrape and paint method is commonly used for Madeira vine and can also be used for cat's claw creeper. Scraping the surface of the stem allows translocation of herbicide throughout the entire plant, including stems and aerial and underground tubers. This method provides effective control and is suitable to use in sensitive bushland environments. Although time consuming, this method is easy to apply and only requires basic equipment.

For cat's claw creeper, this method works best on thin stems. Consider other methods for thicker stems (e.g. cut and swab, stem injection).



Lyn Skillings

Scrape and paint method.

Application

- Find where the stem emerges from the ground.
- Start at the base and, working 20–30 cm along the stem, use a vegetable peeler, knife or secateurs to scrape the stem to reveal the green cambium layer.
- Within 15 seconds, apply herbicide to the exposed area using a paint brush or drip applicator.
- Work up the vine, scraping and painting all stems as high as you can reach. Make several scrapes and, if possible, on both sides of each stem.
- Take care not to ringbark stems – completely severing them will stop the spread of herbicide through the plant.
- Remove and collect small tubers along the stem near where it'll be scraped, as they can easily fall off when the vines are being treated. Larger tubers can also be scraped and painted.

Timing

Scrape and paint can be done year round, but it's most successful when plants are actively growing. For Madeira vine, use this method in spring before new tubers are produced.

Follow-up control

As Madeira vine plants die, they can drop aerial tubers, which can sprout and form new plants. For best results, integrate this method with hand removal of any tubers or tuberlings that may have dropped from the parent vine and sprouted. Alternatively, in disturbed sites, place tarpaulins under treated vines to catch aerial tubers for subsequent collection to prevent their sprouting (see Box 4.3). Dispose of aerial tubers carefully – refer to Box 4.1 for more information.

This method may not translocate enough herbicide into mature cat's claw creeper plants with large tubers and regrowth may occur. If this occurs, wait for sufficient regrowth before retreating, or consider an alternative method e.g. cut and swab or foliar spray.

A short video by Coffs Harbour Regional Landcare on the use of the scrape and paint technique can be viewed at youtube.com/watch?v=6iKYFUvvbHQ

A longer video of the Pittwater Ecowarriors controlling Madeira vine can be viewed at youtube.com/watch?v=hSX1jTzwya0

QPWS

Madeira vine infestation at Bunya Mountains National Park, Queensland.

Stem injection

Stem injection methods can be used for cat's claw creeper plants with larger stems that can't be easily cut or scraped. Herbicide injected into the sapwood layer just under the bark (the cambium) will be transported throughout the plant.

These methods may be used for vines with stems greater than 50 cm in circumference. They can also be used for vines with a large underground tuber. There are two options: the drill and fill and axe cut methods.

Drill and fill

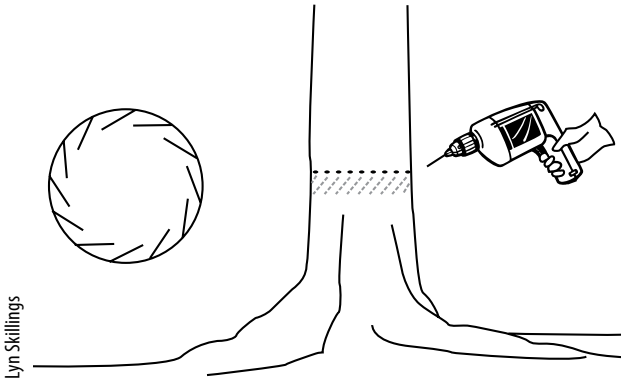
The drill and fill method uses a battery-powered drill to create holes around the circumference of the stem.

Application

- Find where the stem base emerges from the ground.
- Using a 10 mm drill bit, drill downward-sloping holes (e.g. on a 45° angle) into the stem base.
- Drill holes no deeper than the sapwood (approximately 5 mm, depending on the stem size). You want the herbicide to stay within the sapwood layer just under the surface of the bark.
- Be careful not to drill through to the other side of the stem.
- Within 15 seconds, fill the holes with herbicide using a dripper bottle.
- For best results, drill multiple holes 2–5 cm apart around the base of the stem, depending on the size of the stem.
- Treat all stems. You can also drill and inject any large tubers that may be found underground.

Timing

Drill and fill is best done in spring to autumn, when plants are actively growing.



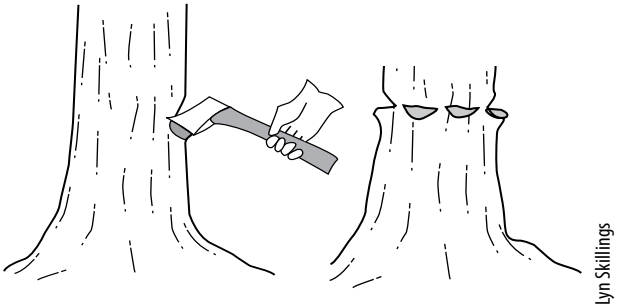
Stem injection (drill and fill) method.

Axe cut

The axe cut method creates horizontal cuts into the sapwood, into which herbicide is immediately applied. Herbicide applied to the tissue layer just under the bark will be transported throughout the plant.

Application

- Using an axe or tomahawk, cut downwards into the stem at a 45° angle.
- Lean the tool out to make a downward angled pocket which will allow herbicide to pool.
- Within 15 seconds, fill the pocket with herbicide using a dripper bottle.
- Repeat the process around the circumference of the stem.
- Make cuts no farther than 3 cm apart.
- Be careful not to ringbark the tree on which the vine is growing.

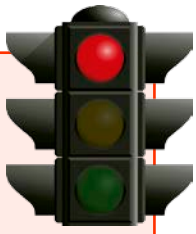


Stem injection (axe cut) method.

Timing

Axe cut can be done year round, but it's most successful when plants are actively growing.

A short video by Coffs Harbour Regional Landcare on the use of the stem injection technique can be viewed at youtube.com/watch?v=zDBNj72Mqos



This method should only be used when the entire circumference of the vine can be accessed for stem injection purposes.

Trials to improve the management of cat's claw creeper

Rachel Hughes, Environmental Scientist and Director of Cedar Grove Landcare in South East Qld, has worked on cat's claw creeper control for 10 years. To reduce its regrowth and the associated costs, Rachel is leading research into new methods aimed at increasing herbicide uptake into the vine's tuberous root system.

Objectives

Trials, initiated in 2021, are being conducted at various locations in the Scenic Rim, Logan and Gold Coast catchments to determine the effects of the combined use of herbicides and plant stimulants via two application methods. These trials measure:

- whether plant stimulants improve the effectiveness of foliar herbicide control
- the effectiveness of herbicide capsules on large mature vines
- cost savings associated with the products used.

Rachel Hughes

Control of large vines using existing methods is labour intensive and costly.

Approach

Plant stimulants are commonly used to improve plant growth, agricultural productivity and herbicide uptake. This trial incorporates the use of ammonium sulphate fertiliser (AMS) and *Ascophyllum nodosum*, a seaweed-based biostimulant. The aim was to identify whether these products enhance herbicide uptake into underground tubers and result in greater control outcomes.

Three herbicides – glyphosate, diacamba and fluroxypyr – were applied (with stimulants) via foliar application.

In addition, DiBak AM (aminopyralid and metsulfuron methyl) capsules (with and without stimulant) were applied using a proprietary tool known as the Injecta 400 or a drill with an 8 mm bit and a hammer.

Rachel Hughes

The Injecta 400 application tool.

Results

The foliar trial using stimulants is showing promising outcomes, with the application of AMS and glyphosate and AMS and dicamba combinations resulting in the death of more than 80% of treated vines. After 15 months, minimal regrowth was evident despite the occurrence of secondary weed invasion and natural regeneration. However, the biostimulant and herbicide treatments were less effective than those with AMS and herbicide. The efficacy of the biostimulant and the herbicide was the greatest 21 weeks post treatment, and new growth was evident 35 weeks post treatment.

The use of DiBak AM capsules with AMS resulted in the death of 85% of the vines treated, whereas the use of only DiBak AM resulted in the death of just 38%. Large vines injected with DiBak AM and AMS showed significant decomposition of the stem, with no evidence of regrowth.

Rachel Hughes

Capsules inserted into cut stems.

Next steps

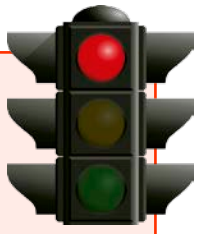
The trial, initially focussed on the short-pod form of cat's claw creeper, now also includes the long-pod form. All trial sites (for both forms) will continue to be monitored for tuber regrowth, which will help identify the need for further treatment.

To date, research on the use of selective herbicides with the addition of AMS or a biostimulant is limited. Therefore, it is hoped this trial will provide new control options that limit the need for ongoing follow-up treatment, whilst reducing the volume of herbicides used in ecologically sensitive habitats.

The DiBak AM capsule is not currently registered for use on cat's claw creeper, and a research permit will be sought for its future application. Keep an eye out for research results at the Cedar Grove Landcare website cedargrovelandcare.org.au

Basal bark

The basal bark technique is similar to scrape and paint, but adds a penetrant (e.g. diesel, kerosene) to the herbicide to remove the need to scrape away the outer layer of the stem. It's suitable for cat's claw creeper and Madeira vine plants with heights of 30–100 cm and stem diameters up to 10 cm. Check herbicide labels carefully for specific instructions.

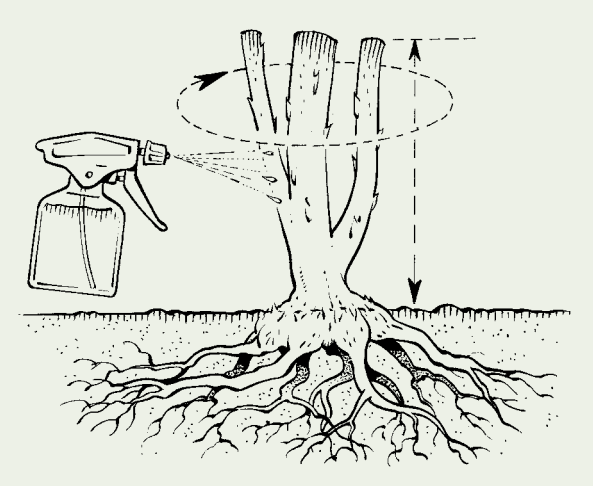


This is a less commonly used control method – use with care when vines are growing up or amongst desirable plants. For this reason, it's unsuitable for sensitive sites with high biodiversity value or other areas where off-target damage is undesirable.

Application

- Find where the stem emerges from the ground.
- Ensure stems are dry so they don't repel the herbicide and carrier.
- Paint or spray the entire stem – from the ground to 30 cm high – with herbicide diluted with diesel or kerosene using a paint brush and small pot, spray bottle or backpack spray unit.
- Treat stems away from host trees so there's no off-target damage.

Thick stems and old, rough or thick bark can inhibit the penetration of herbicide. For this reason, other methods, such as cut and swab and scrape and paint, are used more frequently to treat both cat's claw creeper and Madeira vine.



Paul Lennon

Basal bark method.

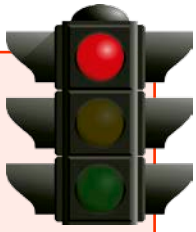
Timing

The basal bark method can be done year round, but it's most successful when plants are actively growing.

A short video from the Northland Regional Council on the use of the basal bark technique can be viewed at youtube.com/watch?v=NELVCFBDnfM

Foliar application

Take care when applying herbicide to the foliage of cat's claw creeper and Madeira vine. There's a high risk of unintended damage to desirable vegetation with foliar application, due to the vines' climbing growth habits, proximity to other plants, and the sensitive environments in which these weeds often occur.



STOP AND THINK

- **Foliar application can cause significant damage to desirable vegetation.**
- **Some herbicides are formulated to be a lower risk when used near water, e.g. Roundup® Biactive. Never spray herbicides over bodies of water or plants standing in water.**
- **Never add unregistered adjuvants to herbicides to be used near water.**
- **Think about your situation, the chance of off-target damage, and whether foliar spraying is necessary.**

However, foliar application may be appropriate:

- for mass areas of seedlings
- when used in conjunction with physical control (i.e. skirting – see page 57) and stem-application methods to treat regrowth or ground-running stems
- in highly modified environments (e.g. industrial areas, wastelands, some roadsides), where there's little chance of off-target damage
- when the supporting plant and understorey are dead or weedy
- when plants are difficult to reach
- when infestations are large and dense, with a high level of weed invasion
- when young vines can be detached from their host, coiled on the ground, and sprayed.

Use foliar application only when vines are healthy and actively growing, and when the risk of off-target damage is low.

Foliar applications include spot spraying and splatter gun. They're detailed below.

Spot spraying

Various equipment types are available to spot-spray herbicide. Which type you select depends on the plant size and growth form, density of infestation, vine height, habitat, site specifications, and the availability of resources, including trained contractors. Consider:

- hand-held spray bottles for small areas or around native vegetation
- backpack/knapsack for spraying small infestations
- vehicle-based powered spray unit, fitted with a pump and hose with handgun, for large infestations.

Choose the equipment that will provide the best coverage for your situation.

Application

The spot spraying method is best used for treating ground-running stems or regrowth. However, it can also be used in dense infestations that are growing over other weedy species (e.g. lantana), where there's minimal risk of damage to desirable plants.

For Madeira vine

Traditionally, foliar spray has been used as a secondary treatment to manage prostrate growth (growth along the ground) and seedlings once the primary stems have been treated using the scrape and paint method. However, some practitioners recommend the use of foliar spray as a primary treatment (with another method, such as scrape and paint, when following up), or as a stand-alone method of treating the plant (see Box 4.5).

This approach increases the cost-effectiveness of management but carries the risk of off-target damage. Make decisions on whether this management approach is suitable for your situation on a site-by-site basis, considering the vegetation composition, sensitivity of the site, and height of infestation, as well as the skills of those applying the herbicide (Johnson, 2011a).

Vehicle-based sprayers can be used along roadsides in areas with no native vegetation. These vines have extensive tuberous root systems, so there'll need to be sufficient leaf material to take up the herbicide for this method to be successful.

Timing

Spray in warmer months when plants are actively growing. Some practitioners report success from winter spraying.

Growth forms	Method	Considerations
▪ seedlings/tuberlings ▪ regrowth (small) ▪ ground runners ▪ vines climbing structures or non-desirable vegetation ▪ sites with a high level of weed invasion	▪ spray foliage to the point of visible wetness (not to the point of run-off) ▪ sprouting Madeira vine tubers can be sprayed when they have 2–8 leaves	▪ best suited to disturbed areas. Use cautiously in sensitive sites ▪ can be used to control regrowth following 'skirting' method (see page 57)
▪ small to medium vines that have begun to attach to or climb host ▪ regrowth	▪ gently pull vines off desired plants ▪ curl them at the base of the tree and spray with herbicide	▪ consider alternative control methods when: • cat's claw creeper vines can't be detached from host trees • aerial tubers are present on Madeira vines ▪ appropriate collection and disposal of dislodged Madeira vine aerial tubers

Box 4.5 Madeira vine control by Port Macquarie Hastings Council

Matt Bell and Ben White

Dense and steep terrain provided a challenging backdrop to a multi-year program to control Madeira vine along the Ellenborough River using high-volume foliar spraying.

Originally using a tank mix of 600 mL/100 L Starane Advanced + 15 g/100 L metsulfuron-methyl + Pulse Penetrant (under APVMA permit 9907), control occurred twice yearly to help clear up privet and lantana that were limiting access to Madeira vine infestations. These herbicide rates, while effective on privet and lantana, led to the rapid defoliation of Madeira vine and dropping of viable aerial tubers. Over time, herbicides were reduced to 300 mL/100 L and 10 g/100 L, respectively. As a result, Madeira vine defoliated more slowly and there was much greater translocation throughout the vine up toward the canopy. Many aerial tubers appeared to desiccate on the vine rather than drop in a viable condition.

Over time, herbicide volume was reduced by 80%, along with a significant reduction in the size and density of the infestation. Care was taken to minimise spray drift and off-target damage.

Ben White

Madeira vine dominating parts of the riparian vegetation canopy on the Ellenborough River.

Box continued on next page/…

Critical success factors were the:

- skill, experience and tenacity of weed-control operators, often working in challenging conditions
- use of lower rates of herbicides, which prevented fast burn-off and provided better translocation to underground and aerial tubers
- use of a powered, quick-spray unit – although difficult to manage in dense vegetation, operators were able to reach high up into the canopy to cover sufficient foliage for successful vine control.

As always, ongoing maintenance was required due to the high potential for reinvasion from tubers brought in via flood waters.

Ben White

Madeira vine growing high into the canopy of native vegetation in the Port Macquarie Hastings Council area.

Ben White

Mature Madeira vine infestations support large tuberous root systems, requiring adequate herbicide translocation for vines to die.

Splatter gun

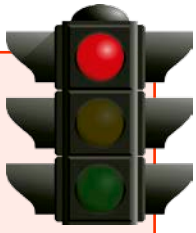
The splatter-gun method uses a pressurised gun to deliver low volumes of highly concentrated herbicide to plant foliage. The splatter gun administers large droplets of herbicide solution in one direct stream and so uses more concentrated herbicide solutions than other foliar applications, such as spot spraying. This application technique uses a much lower volume of spray mixture than standard foliar spraying, and the larger droplets are less likely to drift. Due to the high concentration, you don't need to completely cover all foliage with herbicide (OEH, 2013). This allows for more accurate herbicide application from 6–10 m away, with low chance of spray drift. This application technique can be an option for dense infestations that are hard to access.

Application

- Spray small amounts of concentrated herbicide on the leaves.
- It's not necessary to cover all the foliage.
- Don't spray the leaves of native or other desirable plants.
- Use a marker dye to help identify treated plants (NSW DPI, 2023).

Timing

Spraying in warmer months when plants are actively growing will give the best results.



In some jurisdictions, splatter guns can be used for Madeira vine control under permit. However, its use is uncommon, and its effectiveness hasn't been well documented. If you use this technique, monitor outcomes and report them to your local weed officer.

Hillary Cherry

Splatter gun equipment.

What experience tells us – tips for using herbicides

Managing invasive vines is hard work. Follow these practitioner tips to maximise the success of your herbicide programs.

Madeira vine

- Avoid disturbance as much as possible when undertaking control for the first time. This includes not using any technique that causes aerial tubers to drop to the ground and disperse, e.g. cut and swab.
- If treating with herbicide, choose a product and application rate with the best chance of translocation througout the plant. The herbicide must reach the underground and aerial tubers for successful control.
- High herbicide rates can result in fast 'burn off' and plant stress, causing:
  - aerial tubers to drop before they're killed by the herbicide
  - underground tubers to 'shut down', resulting in vine regrowth at a later stage (see Box 4.1).
- When foliar spraying, there must be enough foliage for the herbicide to be taken up and translocated to the underground root system. This can be particularly problematic when the cut and swab technique is used as a primary control method, resulting in regrowth that's spindly or sparse.
- One option is to leave follow-up control until there's enough foliage to allow for translocation to the roots.
- Consider what will happen to the site as a result of primary control, and set realistic expectations. What level of disturbance might this create? And will this benefit Madeira vine growth, or will it benefit restoration? Do you have the resources to follow up?

K. Lewry

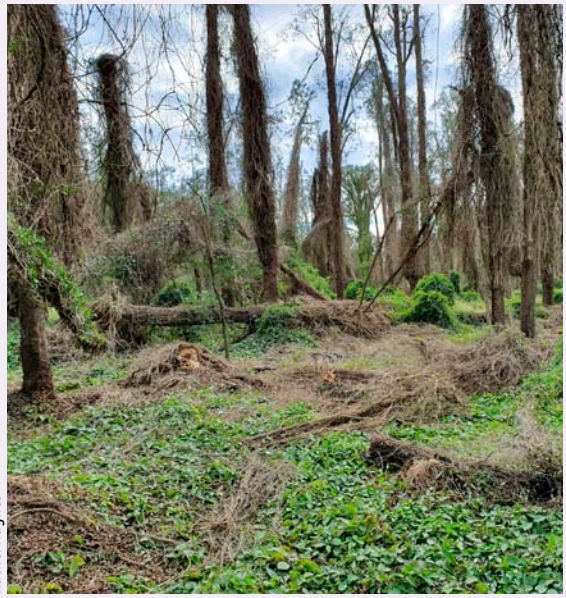
Masses of aerial tubers can drop and resprout if herbicide rates are incorrect.

K. Lewry

Allow enough foliage to regrow before re-spraying.

Cat's claw creeper

- For older vines, prioritise those:
  - closest to waterways to reduce seed spread via water
  - growing on mature canopy trees, moving on to smaller trees to maintain native plant age diversity at the site
- When infestations are ground based, spraying 1 m wide rings around the base of trees can delay vines climbing into the canopy for several months.
- Remove vines from the canopy where possible, e.g. using the skirting method (page 57) or cut and swab (page 63). Ground infestations are more manageable than those in the canopy.
- Field results from cat's claw creeper control in northern NSW indicate the use of aminopyralid and picloram gel wasn't effective when controlling both large and small vines with the cut and swab method.



Rachel Hughes

Skirting and herbicide application will effectively stop cat's claw creeper plants from flowering.

General tips

- Make a plan and follow up regularly for several years.
- Creating access tracks can make maintenance easier during return visits.
- Seek advice or engage experienced weed control operaters to apply the most appropriate control method for your site.
- You can't spray vines directly overhead, so carefully consider the best location and angle to spray from. This limites personnel exposure to herbicide.
- Consider using adjuvants as a useful component of your herbicide mix.
- Using selective herbicides when spot spraying can control tubers more effectively and help retain vegetation that will compete with cat's claw creeper.
- Monitor your site for missed plants or regrowth. If possible, time a follow-up visit 4–6 weeks after intial control to control any vines that were missed.
- Spot-spraying small vines can be more efficient than other methods. Cut and swab or scrape and paint can be physically taxing by comparison. Also, you can cover more area and use less herbicide each year, as vine density reduces over time.

Biological control

Biological control (or biocontrol) is using a weed's natural enemies – usually an insect, herbivore, parasite or pathogen – to reduce the weed's population density to levels that reduce its impacts in its invasive range (Figure 4.2).

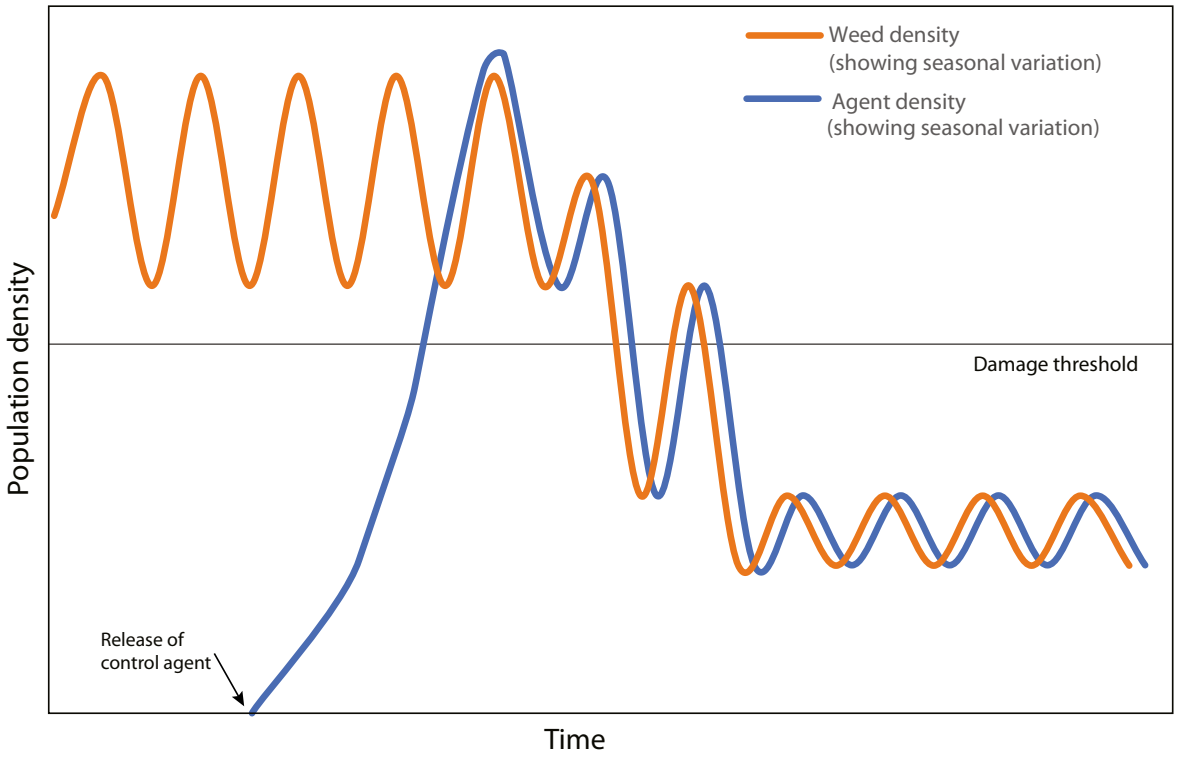


Figure 4.2 The relationship between a weed and its biocontrol agent, illustrating when the agent starts to reduce weed density (source Sheehan and Potter, 2017).

Australia's biocontrol regulations and economic impacts

Releasing biocontrol agents in Australia is regulated under the *Biosecurity Act 2015*. Pre-release, rigorous, risk analysis and testing are required to ensure an agent is host-specific (i.e. it will damage only the target weed).

An agent can be released if it's been shown to be effective and host-specific. A successful release reduces weed populations while causing no off-target damage or physical disturbance and with minimal labour costs. Biocontrol has been used widely in Australia to successfully control problem weeds such as salvinia and opuntioid cacti. When last analysed, there was a 23:1 financial return for biological control programs in Australia (Page and Lacey, 2006).

Is biocontrol right for your site?

Biological control:

- shouldn't be regarded as an eradication tool
- should only be used where the weed is widespread
- is most effective at sites with a high density of healthy, actively growing weeds – this allows the agent population to build, spread and reach numbers that cause significant damage to the target weed population
- is most effective when integrated with other control methods.

To determine if biocontrol is appropriate for your situation, consider the following questions:

- Does the site contain a dense population of weeds that will support a biocontrol population?
- Can the site remain undisturbed (including no weed control) for approximately three years, so the biocontrol agents can establish a population and spread out into new areas?
- Are biocontrol agents established at the site or nearby? If not, can you source them from elsewhere?

Biocontrol agents for cat's claw creeper and Madeira vine

The following biocontrol best practice information is a modified excerpt from *Biological control of weeds: a practitioner's guide for south-east Australia* (Harvey et al., 2021). Approval from the NSW Department of Primary Industries (DPI) to use this information is gratefully acknowledged.

More detailed information on biological control agents for cat's claw creeper, Madeira vine and many other weed species can be found in this publication. You can request a copy from NSW DPI: dpi.nsw.gov.au/biosecurity/weeds/weed-control.

Below is a summary of the three biological control agents that are currently approved for cat's claw creeper and the single agent currently available for Madeira vine.

Cat's claw creeper biological control

Leaf-feeding tingid (*Carvalhotingis visenda*)

The leaf-feeding tingid was the first agent to be released to control cat's claw creeper in Australia (Dhileepan et al., 2010). It was released in Qld and northern NSW in 2007.

What it does

Adults and nymphs feed on the cellular contents inside the leaves, impacting photosynthesis and reducing plant growth and productivity. The leaf-feeding tingid causes chlorosis – a yellowing of the leaves due to a lack of chlorophyll. This appears as yellow speckling on the leaves.

Distribution and habitat

The leaf-feeding tingid has been distributed through coastal and hinterland areas of eastern Australia north of Sydney. It's now widely established across cat's claw creeper's range (Dhileepan et al., 2010). The agent feeds in the lower canopy and can also be found in ground cover.

Identification

Adults are 3 mm long and are creamy white to grey. They have delicate lace-like wings and two prominent dark marks on their forewings. They're usually solitary.

Nymphs are smaller, wingless and are often seen in groups.

Qld DPI

Young tingid nymphs.

Qld DPI

Adult tingid.

Current impact

Tingids are widely established. However, their populations are very low at most NSW and Qld sites, leading to very low overall impact. They can be damaging when ideal conditions are present, but impact can vary seasonally.

Qld DPI

Qld DPI

Skeletonising or speckling associated with tingid feeding, showing whole plant damage (top), close up of leaf damage (bottom).

Redistribution

Tingids can be collected year round, although cooler months are best. They can be located by looking for affected leaves with obvious speckling. Immediate release into the field is recommended, but adults and nymphs can be stored for a few days if conditions are right.

Follow these tips to collect, rear and release tingids:

- Adults can be collected from established sites by placing a container under a tingid and gently touching it so it falls into the container.
- Collect nymphs and adults by gathering infected leaves and plant runners.
- Tingids can be stored in a cool, dark container until they can be released. Make sure they have sufficient cat's claw creeper plant material to feed on.
- Keep containers cool and fitted with lids that allow adequate ventilation.
- To rear, place potted cat's claw creeper plants into insect-proof cages. Make sure the tingids have plenty of material to eat!
- Release adult tingids or nymphs into the cage, and allow approximately four weeks for tingids to reproduce.
- To release into the field, place infected material amongst healthy cat's claw creeper plants at the new site.
- The ideal release rate is 200 or more adults per site.
- Repeat releases between September and March. This helps to create a balanced age cohort.
- Tingids can be released year round in Qld, and agents establish well in cooler months in riparian areas.

Monitoring

Dispersal from release sites is slow. Look for signs of chlorosis (speckling) on mature leaves or tingids on leaf undersides. It's important to monitor annually and at incremental distances away from the release site to check for successful dispersal.

Jewel beetle (*Hedwigiella jureceki*)

What it does

Adults feed on young leaves, while larvae mine into the leaves, making characteristic blotch-like mines. This damage can reduce flower and seed production. Adults and larvae damage cat's claw creeper plants from the ground level up to the canopy.

Distribution and habitat

First released in South East Qld in 2012 (Snow and Dhileepan, 2014), the jewel beetle is now widely established throughout coastal and hinterland areas of eastern Australia north of Sydney. Beetle populations are variable throughout the year. Establishment is more likely at warmer, moist sites.

Beetles can persist over a wide range of temperatures – below 0°C and above 30°C.

Identification

Adults are 3 mm long and metallic black with wavy white lines across the back.

Larvae are yellow and almost triangular. Their presence is best identified by their characteristic blotch-like mines.

Current impact

Populations tend to be very low at most sites but can build up under ideal conditions. Impact generally remains low. Damage to vine leaves, caused by feeding, benefits native plants by allowing better light penetration.

Redistribution

Beetles are widely distributed and visible to the naked eye. Check the upper side of leaves for beetle presence. Only the adults are suitable for collection. Beetles are able to spread unassisted, with field monitoring indicating they can disperse approximately 100 m over a 15-month period (Snow and Dhileepan, 2014).

Qld DPI

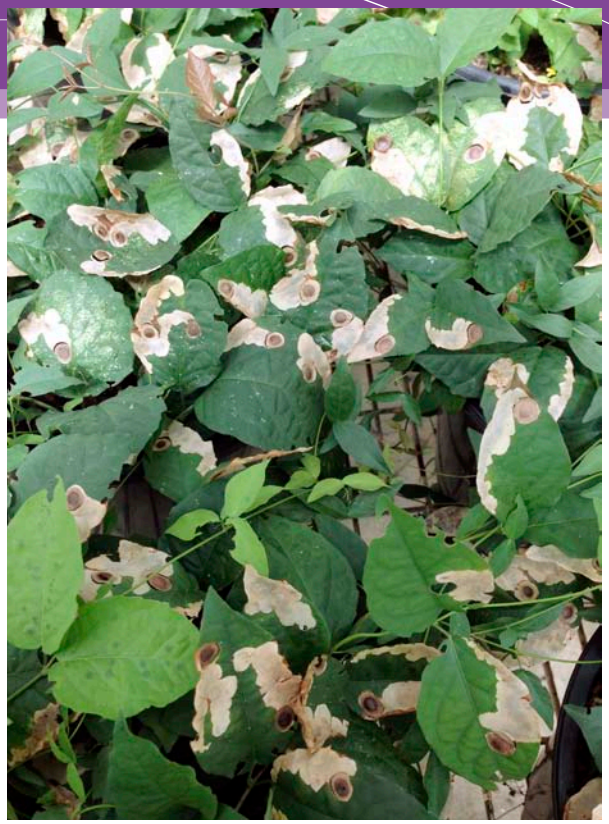
Adult jewel beetle.

Qld DPI

Jewel beetle adults on cat's claw creeper.

Qld DPI

Jewel beetle larval damage.



NSW DPI

Jewel beetle damage showing blotch mines and disc-like pupal cases.

Rachel Hughes

Jewel beetle damage on cat's claw creeper.

Follow these tips to collect, rear and release beetles:

- Collect adults by placing a container underneath and gently touch the leaf underside so they fall into the container. Cover the container to trap the beetle.
- Alternatively, an aspirator can be used for collection.
- Adults can be stored until they can be released. Make sure they have sufficient cat's claw creeper plant material to feed on.
- Keep containers cool and fitted with lids that allow adequate ventilation.
- To rear, place potted cat's claw creeper plants into insect-proof cages. Make sure the beetles have water and plenty of material to eat!
- Release beetles into the field between September and March onto healthy plants which face north and are in full sun (if possible).
- Avoid sites prone to flooding or frosts.
- Ideally, release 400 or more adults per site.
- They'll likely establish from a single release, though multiple releases over many seasons can help.
- Larvae can't be redistributed.

Monitoring

Look for presence and feeding damage at the release site in autumn and spring after release. Adults are usually found on the lower stems in sunlit areas. If establishment occurs, begin monitoring at incremental distances from release sites to monitor dispersal. Monitor annually.

Qld DPI

Leaf-tying moth adult.

Qld DPI

Mature leaf-tying moth larva, and skeletonised leaf damage.

Leaf-tying moth (*Hypocosmia pyrochroma*)

What it does

Larvae feed on and 'tie' the leaves together with silken threads, reducing plant growth and tuber production (Dhileepan et al., 2021). Moth presence is indicated by leaves joined together. In later stages, the leaves become skeletal.

Distribution and habitat

First released in 2007 in South East Qld, the leaf-tying moth has only established at a small number of locations in the region. The agent hasn't established in Central, western or North Qld or in northern NSW (Dhileepan et al., 2021). Based on releases in Qld, riparian environments are the most climatically suitable location for agents to establish and spread (Dhileepan et al., 2021).

Identification

Adults are up to 15 mm long and are pinkish-orange to brownish-orange. A white band is visible across the centre of the wings and a dark v-shaped band across the rear end.

Larvae start out light-grey, turning dark grey as they develop. Larvae reach 2 cm long when mature.

Current impact

Impact in the field is limited to very few locations and has been variable annually. The agent can defoliate patches of cat's claw creeper, but feeding damage is usually only at low levels. In Qld, leaf-tying symptoms were seen only on cat's claw creeper vines that had support from structures like trees, fence posts or fallen trees, up to a height of 15 m. Symptoms weren't seen on vines hanging from tree canopies or spreading along the ground (Dhileepan et al., 2021).

Redistribution

This agent isn't currently available for release or redistribution, due to limited establishment and specialised rearing requirements. NSW DPI is currently rearing agents aiming to establish them at sites in NSW (as at time of publication). Field monitoring indicates the moth can spread up to 23 km from release sites (Dhileepan et al., 2021).

Monitoring

Check plants for leaves tied together with threads. You can also check for larvae inside the leaf bundles. Report any sightings to your local weed officer or via the Biocontrol Hub (see page 86).

Do biocontrol agents attack both forms of cat's claw creeper?

In short, yes! All three biocontrol agents attack both the long-pod and short-pod forms of cat's claw creeper. The long-term impacts of all biocontrol agents require further studies to understand whether there are different levels of control for the two forms of cat's claw creeper. See Chapter 2 for information on the two forms of cat's claw creeper.

Madeira vine biological control

Leaf-feeding beetle (*Plectonycha correntina*)

What it does

Adults and larvae feed on leaves, with larvae being particularly damaging. Leaf damage reduces photosynthesis, causing the vine to draw on energy stored in its tubers. This depletes tuber reserves over time.

Distribution and habitat

First released in South East Qld in 2011, the leaf-feeding beetle is still being distributed in Qld and NSW, with variable establishment.

Identification

Adults are approximately 5 mm long with an orange-to-brown body and orange legs. Adults may or may not have black spots. Adult damage is evident by 'shot holes' and 'windowpane' scars on leaves from feeding from the underside of the leaf.

Larvae are up to 4 mm long with white-to-yellow bodies and black heads. They become covered in a black glutinous substance when feeding. Larvae damage is evident as chewed leaf margins, with larvae eventually eating whole leaves.

Eggs are tiny, creamy yellow and cylinder shaped, often laid in two rows on the underside of leaves.

Current impact

The beetle has had variable establishment success. Their impact is also variable and likely driven by differences in microclimates. Reports from the Port Macquarie area suggest they don't tolerate frost. Adults and larvae can be quite damaging when numbers are high.

Kerrie Odonell

Adult leaf-feeding beetle.

Kerrie Odonell

Liz Snow

Leaf-feeding beetle larva (top) progressing to being covered in a protective gelatinous substance (bottom).

Liz Snow

Shot hole damage and windowpane scars from feeding adult leaf-feeding beetle.

Redistribution

Adults and larvae can be collected between September and March. Adults can be found on the underside of leaves, and leaves with larval slime can be harvested to redistribute larvae.

Follow these tips to collect, rear and release the leaf-feeding beetle:

- Collect adults by placing a container under a beetle and gently touching it so it falls into the container. Adults are most active in the middle of the day.
- Collect larvae by picking individual leaves with larval slime.
- Adults and larvae can be stored for a few days in a container with Madeira vine leaves and small air holes.
- To rear, place potted Madeira vine plants into insect proof cages. Make sure the leaf-feeding beetles have plenty of material to eat!
- Release adults or larvae into the cage and allow approximately 8–12 weeks for reproduction. A layer of potting mix in the bottom of the cage is required for pupation to occur (when larvae become beetles).
- Release adults and larvae into the field between September and March onto healthy plants which face north and are in full sun (if possible). Make a small nest using leaves attached to stems just above the ground, and release onto that.
- Avoid sites prone to flooding or frosts.
- Aim to release 400 or more beetles per site.

Monitoring

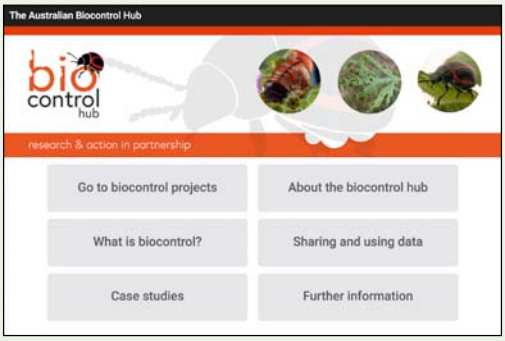
Check for presence of adults and larvae and their damage at the release site within one year from release. Check for eggs on the underside of damaged leaves. If beetles establish, begin monitoring at incremental distances from release sites to monitor dispersal. Monitor annually.

Share and improve your knowledge with the Biocontrol Hub

Assist others in getting access to the right biocontrol agents for their infestations by recording what weed species you're controlling and the locations of sites where you've released biocontrol agents.

The Australian Biocontrol Hub (within the Atlas of Living Australia website) is a one-stop shop for sharing data and information on the biological control of weeds.

For further information visit the website: biocollect.ala.org.au/biocontrolhub



Sourcing and monitoring biocontrol agents

Contact your local weed officer for advice on:

- how to access biocontrol agents
- which release techniques to use
- how to set up the appropriate monitoring protocols to track the effectiveness of each biocontrol agent.

Example monitoring forms can be found in the *Biological control of weeds: a practitioner's guide for south-east Australia* guide linked earlier. However, your local weed authority or biological control rearing facility may have their own forms and guidelines for you to follow.

Follow up

Tubers can resprout vigorously after treatment, so there's no quick fix or one-off solution for managing cat's claw creeper and Madeira vine. You'll need to come back often to re-treat your sites. For successful follow-up:

- Plan for follow-up and monitoring when you create your weed management plan (see Chapter 3).
- Revisit sites at an appropriate frequency.
- Treat regrowth of the target weed using appropriate methods for the situation.
- Monitor and encourage natural regeneration of native plants – increasing ground and canopy cover can reduce regrowth from tubers and invasion from other weeds.
- Monitor for the establishment of any weeds at the early stage of invasion, and treat them appropriately.

For cat's claw creeper, it's important to limit seed set, as that's the primary method of natural dispersal. Manage vines to prevent flowering, which usually occurs when plants are well established. Seed set can be effectively reduced and even prevented through regular follow-up.

For Madeira vine, the main follow-up activities involve controlling regrowth from underground tubers and new tuberlings sprouting from fallen aerial tubers. Follow-up work with Madeira vine isn't as seasonally sensitive as cat's claw creeper, as there's minimal risk of spread via seeds.

Table 4.5 summarises follow-up objectives, frequency and advice for the two species.

Matt Sheehan

Madeira vine tubers sprouting in a flood-out zone.

Table 4.5 Cat's claw creeper and Madeira vine follow-up treatment objectives and frequency.

	Cat's claw creeper	Madeira vine
Objectives	▪ To assess treatment effectiveness ▪ To assess any off-target damage ▪ To manage seed production and exhaust tubers	
Follow-up focus	Limit vine growth, flowering and seed set	Control regrowth from underground tubers and new tuberlings sprouting from fallen aerial tubers Collect and appropriately dispose of aerial tubers that have fallen following disturbance such as high-wind events or storms
Follow-up timing and frequency	Two or three times per year (Johnson, 2011b), including: ▪ in late summer/early autumn to reduce seeding ▪ in spring/early summer to manage seedlings from seed dropped from late autumn to winter. Plants flower in spring, making them easier to locate	Three times per year, noting: ▪ best results are achieved during warmer months, e.g. early spring and late summer/autumn ▪ some weed managers apply an initial control in late winter, allowing for easier access to control again in spring/summer
Follow-up duration	At least five years, noting weeds have persisted at some sites for over 10 years despite frequent control and follow-up (Stockard, 1996)	
Additional advice	If the skirting or cut-stump method was used, control any regrowth before it reaches the bottom end of the hanging cut stems	If stem applications of herbicide were used, check they've been effective in killing the whole plant – re-treat any surviving stems Survey for, remove and appropriately dispose of any aerial tubers that may have been dislodged and transported to the site following storms or flooding events
	Regrowth from underground tubers can sometimes be thin and weak, with insufficient surface area for herbicide uptake relative to tuber size (Stockard, 1996)	

Unsuitable control methods

Table 4.6 lists methods that aren't appropriate for cat's claw creeper and Madeira vine control. They're either ineffective, inefficient or risk spreading the weeds further.

Table 4.6 Methods not recommended for control of cat's claw creeper and Madeira vine

Method	Comments
Defoliation	
Mechanical (e.g. mowing, slashing)	Plants can readily regrow from their underground tubers following mechanical control.
Grazing	Cattle will graze cat's claw creeper. However, this method isn't considered suitable for control, particularly in sensitive sites or riparian areas, where cattle should be excluded. ⚠ Madeira vine leaves can cause diarrhoea in pigs and sheep (NSW DPI, 2023).
Simulated herbivory and defoliation	Trials of simulated herbivory (removal of 100% of leaves and damage to shoots, roots and tubers) and simulated defoliation (removal of various amounts of leaves) on cat's claw creeper found: ▪ tuber biomass increased when herbivory treatments were only applied once ▪ at least two severe defoliation treatments were required to reduce cat's claw creeper stem growth and allocation of resources to tubers (Raghu et al., 2006). Whilst the trial suggests that, over time, defoliation can reduce vine growth (and possibly tuber reserves), this management approach is time consuming and impractical.
Fire	Given their tuberous root systems, it's likely that vines resprout from underground tubers after fire. Fire isn't recommended as a management approach regardless, as these weeds commonly occur in sensitive riparian and rainforest ecosystems. Cat's claw creeper plants were found at a site on the Nymboida River (NSW) following a fire event, suggesting their ability to regrow after fire.

Additional management considerations

It's a complex task to manage sites invaded by cat's claw creeper and Madeira vine. Adverse effects, such as increased site disturbance, can arise during or after weed removal which may hamper recovery at the site.

To maximise site recovery across all habitats impacted by invasive vines, aim to:

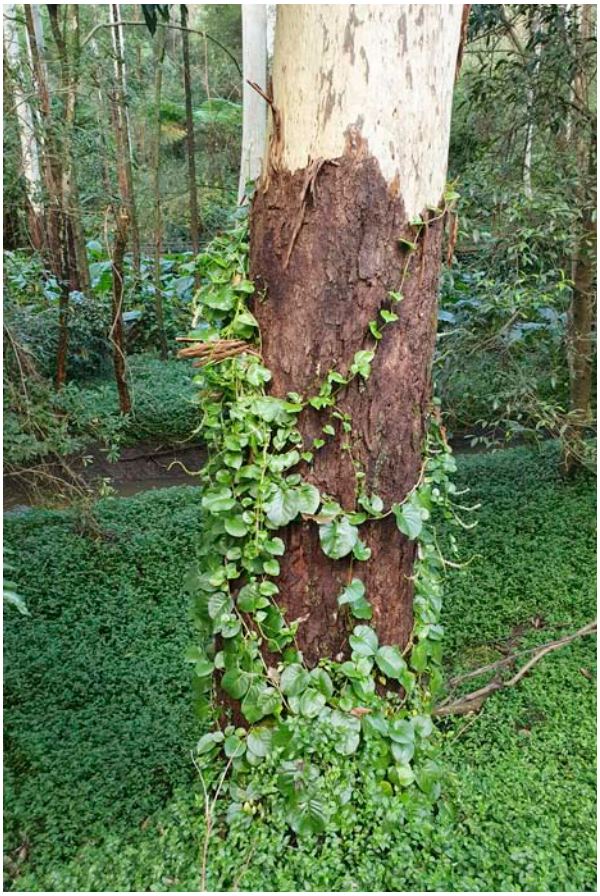
- Limit soil and canopy disturbance.
- Avoid off-target damage.
- Reduce co-occurring or secondary weeds.
- Understand habitats at risk.
- Avoid habitat degradation.

Minimising soil and canopy disturbance

Controlling large and dense infestations of cat's claw creeper and Madeira vine disturbs the canopy. This allows light and nutrients into the site, which may favour further weed invasion. Additionally, large underground tubers are extremely hard to remove, and their removal significantly disturbs the soil.

Sites where the canopy or soil is disturbed are most at risk of secondary weed invasion. To minimise disturbance:

- Remove invasive vines in stages to restrict disturbance to smaller areas and improve the likelihood of native species naturally regenerating. Consider both the rate of regeneration and the amount of follow-up required to control regrowth when thinking about rate of weed removal.
- Prioritise control of invasive vines that are causing high stress to host trees or compromising their structure.
- Choose the right control method for the site. For sensitive bushland sites, consider techniques such as cut and swab for cat's claw creeper and scrape and paint for Madeira vine.



Matt Sheehan

Madeira vine emerging from a blanket of wandering trad, an aggressive invasive scrambler.

- Take care when removing tuberous roots and avoid physical removal of vine stems from host tree canopies. Consider whether alternative techniques are a viable option.
- Plant native species, including perennials, following the removal of invasive vines.
- Mulch to protect revegetation and reduce germination of weeds.

Avoiding off-target damage

Off-target damage to desirable plants is most likely when foliar application of herbicide has been used on dense infestations.

To minimise off-target damage:

- Choose the right control method for your situation – refer to Digure 4.1 and supporting text.
- Understand herbicide rates and application methods – refer to the *Safe use of herbicides* factsheet in Chapter 6, and seek advice if necessary.
- Use skilled and experience weed control operators, or seek out training and advice if controlling vines yourself.

Minimise the likelihood of secondary invasion

Following the control of cat's claw creeper and Maderia vine, it is possible that other weeds may become established and take their place, slowing the process of site recovery. These weeds may have already been at the site but not targeted in the initial control, or they may have arrived post control.

Minimising soil and canopy disturbance will go some way to address secondary weed problems. Additional steps you can take include:

- Developing a list of all co-occurring weeds during the planning process (see Chapter 3).
- Monitoring the site after initial weed control to keep check on co-occurring weeds (as well as the effectiveness of cat's claw creeper and Madeira vine control).
- Recording any new plants that weren't on your list – these may be new arrivals. Seek advice on any action that may be required.

Other potentially problematic weeds can include ground covers and mid-storey species such as wandering trad (*Tradescantia fluminensis*), broad-leaf and narrow-leaf privet (*Ligustrum lucidum* and *Ligustrum sinense*), and other vines such as morning glory (*Ipomoea purpurea*) and balloon vine (*Cardiospermum grandiflorum*).

Refer to Chapter 6 for further information on other vines and scramblers, both native and introduced.

Matt Sheehan

Madeira vine and balloon vine in Lane Cove National Park.

Habitats at risk

A range of habitats are invaded by vines and scramblers such as cat's claw creeper and Madeira vine. Table 4.8 lists broad habitat categories known to be commonly invaded by cat's claw creeper, Madeira vine and other invasive vines. Where possible, specific examples of ecological communities are given, along with general considerations and management advice for these habitats. This table provides examples only and doesn't represent a comprehensive list of habitats impacted by invasive vines. Remember that a management approach that works well in one habitat may be unsuitable in another. It's important to choose a method appropriate to your habitat and situation. Chapter 3 provides guidance on developing a site-specific weed management plan.

Avoiding habitat degradation

Invasive vines can provide shelter and even food for native animals. To help minimise the impact of removing weeds on animal habitat:

- In dense infestations, remove vine stems in stages to allow animals to move to nearby areas while that area is being regenerated.
- Prioritise removing vines from trees that are under pressure from many stems, to avoid branch breakage, tree death and further decline in habitat.
- Leave dead stems in the canopy, providing shelter until they break down.
- Avoid using herbicides that could have flow-on effects to animals. For example, use 'frog-friendly' versions of glyphosate around waterways and rainforests.

Adam Bernich

Madeira vine infestation in Swamp Oak Floodplain Forest, which has low canopy cover compared to rainforests.

Table 4.8 Common habitats invaded by vines and scramblers, including cat's claw creeper and Madeira vine.

Habitat	Examples of commonly occurring invasive vines and scramblers	Considerations	Management
Rainforest (including tropical, subtropical, littoral and temperate)	Cat's claw creeper, Madeira vine, turbina, moth vine, Cape ivy and Dutchman's pipe. Passionfruits, morning glories and balloon vine are abundant along patch edges.	Rainforests are often fragmented and contain vulnerable species or communities. These habitats can be isolated and difficult to access, with very dense understorey trees and shrubs. This reduces the ability to control infestations and monitor and find new infestations. Canopy gaps and edges are particularly vulnerable to weed invasion, due to higher light availability.	Buffer zones around the perimeter can help to minimise edge effects. Regularly monitor high-priority sites that have sensitive species to find weed incursions early. Maintain canopy cover (Harden et al., 2004).
Swamp forests and riparian forests	Species that use water movement for dispersal (e.g. cat's claw creeper, Madeira vine, balloon vine) are common in riparian zones and swamp forests. Coastal morning glory is common in some saline-influenced swamp forests and riparian zones, such as swamp-oak floodplain forest. However, invasive vines and scramblers are rarely seen in mangroves or saltmarsh.	Stream banks are highly susceptible to increased bank erosion and reinfestation following weed removal. Weed populations upstream are a source of rapid reinfestation. Swamp forests can be difficult to access following recent rainfall or flooding.	Minimise disturbance to banks. Manage upstream weed populations. When safe to do so, monitor following flood to look for new weed incursions.
Sclerophyll forests (dry and wet) and woodlands	Invasive vines and scramblers are more common in wet sclerophyll forests, although some species, such as cat's claw creeper, English ivy and Japanese honeysuckle, can be found in drier forests.	Soils with lower nutrients can be a barrier to weed invasion (Leishman and Thomson, 2005). Site-specific fire regimes can impact control and can be altered by increased moisture levels caused by weeds. High levels of invasion can occur after fires – the high rate of germination provides an opportunity to exhaust weed seed banks if seedlings are removed before they set seed. However, if not removed, seedlings will flourish and worsen weed issues.	Avoid increasing soil nutrients through disturbance or planting of nitrogen-fixing plants. When safe to do so, monitor following fire to look for new weed incursions and undertake targeted removal of germinated weeds.
Coastal habitats (dune and headland systems)	Coastal morning glory, turkey rhubarb, glory lily, corky passionflower (*Passiflora suberosa*), asparagus weeds, etc.	Coastal habitats are susceptible to erosion. Some herbicides can leach through sandy soils at a greater rate.	Minimise erosion by weeding areas in stages. Use herbicides sparingly.
Disturbed habitats	Invasive vines and scramblers thrive in disturbed habitats, as they take advantage of increased nutrients and the high light availability afforded by more readily available structures to climb up.	Disturbed areas often contain a large suite of invasive species that need to be controlled. These sites can have different assets to natural sites, requiring a tailored approach.	Prioritise species for removal. Reduce soil nutrients by planting native perennials. Maintain ground cover. Mulching can help in the absence of native ground cover.

Site restoration

Site restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed (SERA, 2017). This can include restoring the structure, function or plant composition of the ecosystem. Depending on your site's natural resilience, restoration can be complex and difficult, with many factors influencing your selected approach and its likely success.

Consider the need for site restoration after control of weeds, particularly if your site has been disturbed (such as by weed invasion) over many years. If intervention is required, the methods you use will depend on the extent of disturbance, environmental risks, land-use requirements and restoration objectives.

During the implementation of your invasive vines management plan, consider what's needed to support site restoration:

- What might happen as a result of weed control (e.g. vine regrowth, secondary weed invasion, bare earth, erosion)?
- What will reduce re-invasion of weeds at your site (e.g. fencing, hygiene protocols, signage)?
- Can you increase your site's resilience to reinvasion?
- Is regular and long-term follow-up weed control enough to enable natural restoration?

Refer to Chapter 3 for other planning considerations.

Site restoration is a specialist undertaking and isn't fully described in this manual. Seek out specialised knowledge and information when considering the restoration requirements of your site. Chapter 6 provides useful links to restoration resources.

Rachel Hughes

Sites with old, dense vine infestations are likely to require restoration after control.

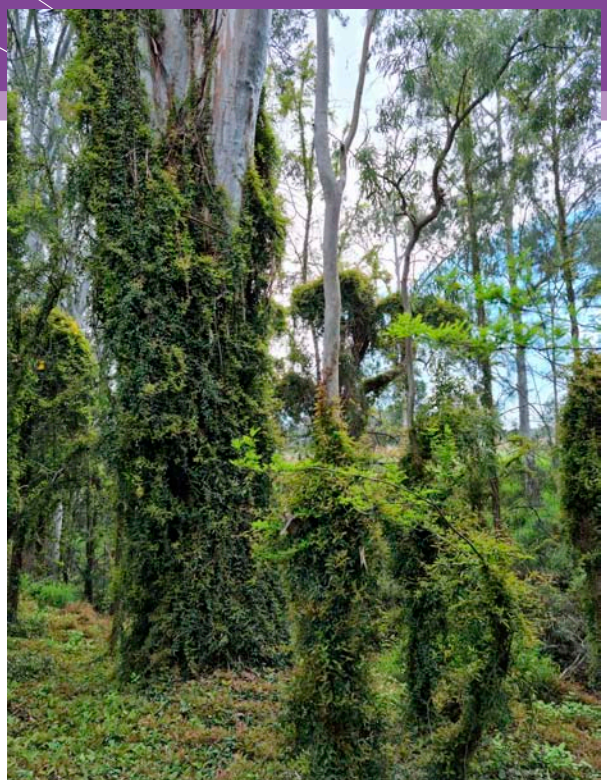
Site resilience

Site resilience refers to your site's ability to recover naturally and without assistance following disturbance (SERA, 2017). Disturbance can be physical – such as fire, flooding or cyclones – or it can be due to weed invasion. Not all ecosystems have the same resilience or capacity for recovery. Native grasslands of south-eastern Australia, for example, are known to be difficult to restore, requiring significant and long-term intervention. Some wetlands, however, can recover naturally once water regimes are restored. Understanding the ecosystem, and exercising patience and good planning, will help achieve your restoration goals.

Resilience can be determined through the:

- amount of seed bank stored in the soil
- cover and quality of remnant vegetation
- connectivity to neighbouring, undisturbed sites
- severity and duration of disturbance, e.g. the density and age of a weed infestation
- occurrence of other disturbances, e.g. erosion, stormwater run-off (OEH, 2013).

Collecting data on these factors can be difficult. In most cases, the density and age of the weed invasion, and abundance of mature native trees will be the simplest indicator of resilience. If your site has a relatively high abundance of native vegetation, it's usually best to allow natural regeneration to occur after weed management, and observe what's growing. From here, make decisions about whether the speed and diversity of native regeneration is appropriate or if you can improve it through supplementary planting or other interventions.



Rachel Hughes

Sites with mature remnant trees can still retain soil-stored seed banks, allowing for regeneration to occur.

Natural regeneration

In many sites, some plant species will regenerate naturally in successional stages after disturbance. The first plants to appear are typically fast-growing plants that can quickly germinate, grow and produce a new crop of seeds. These are often referred to as 'pioneering plants' and may include weeds. It can be beneficial to monitor what emerges over several years of natural regeneration, and be prepared to control any new weeds that grow.

Natural regeneration can make important contributions to site restoration:

- It ensures that regeneration is by plants of local origin.
- Success rates of naturally regenerated plants are generally higher than planted seedlings.
- It's the most economical form of restoration.
- It allows you to target replanting efforts at species that are missing – those that won't regenerate on their own.
- It allows important ecosystem processes to occur – for example, mass germination events followed by natural thinning.

Revegetation

When your site resilience has been compromised to the extent that natural regeneration is unlikely, you may need to undertake some revegetation work. To do this:

- Create a list of the native species growing at the site.
- Compare this list to those growing at a reference site or consult a local plant list or guide, often maintained by local councils or weed management authorities. What characteristic species are missing or uncommon?
- Based on these lists, choose plants for reintroduction that are less likely to establish on their own.
- Consider availability of desired species – contact local nurseries for propagation assistance or to obtain appropriate licenses if you're planning on collecting seeds yourself.
- Consider the origin of the seeds and plants used for revegetation – aim to use locally sourced seeds or plant material.
- Seek advice on the use of threatened species – these species are often difficult to propagate, require specific environmental conditions, and might be protected under legislation. Refer to Chapter 6 for contact information.

Chapter 5

Case study 1

Creeper control at a catchment scale in South East Queensland

Dennis Gannaway and Leonard Ainsworth, Healthy Land & Water

Key points

- Managing cat's claw creeper is a long-term investment, and you need at least five years to achieve positive outcomes.
- Land managers need to know more about the impacts of cat's claw creeper. Managing invasions often becomes a priority only after large trees are conspicuously lost.
- Many catchments are still at risk of invasion by cat's claw creeper.
- Cat's claw creeper impacts the cost of living – particularly the provision of clean water to households, as the weed can ultimately lead to degraded water quality.

The situation

South East Qld (SEQ) is a highly biodiverse sub-tropical region with a rapidly growing population. More than 5.5 million people will likely call the area home by 2040. Land clearing for agriculture and infrastructure is pushing natural vegetation, which provides habitat and movement corridors for native fauna, to the margins of riparian zones. SEQ has five major rivers and many hundreds of smaller creeks and streams. Riparian zones are the last refuge for many of the region's vulnerable fauna and flora.

Cat's claw creeper has been present in SEQ for decades. It has spread prodigiously through the region's riparian zones. It's now found in an estimated two-thirds of SEQ's catchments at various stages of invasion, from new infestations to established ones.

The problem

Cat's claw creeper smothers and kills deep-rooted native riparian vegetation. The long-term presence of the weed is now the direct cause of the large-scale loss of mature riparian vegetation across the region. The loss of these trees causes significant riverbank erosion, which increases the amount of suspended sediments and nutrients in creeks and rivers. This is particularly true during adverse weather events, such as flooding, which regularly occur in the region. These sediments increase instream turbidity and eventually settle in Moreton Bay – an internationally significant wetland site – and smother seagrass.

The impacts of nutrients on water quality within SEQ is also a critical concern for the region's aquatic ecosystems. As urbanisation and agricultural activities continue to expand, riparian vegetation – and its filtering effect – is lost. As a result, nutrients, such as nitrogen and phosphorus, are increasingly found in water bodies. Excessive nutrient levels can trigger eutrophication – a process that leads to harmful algal blooms and oxygen depletion.

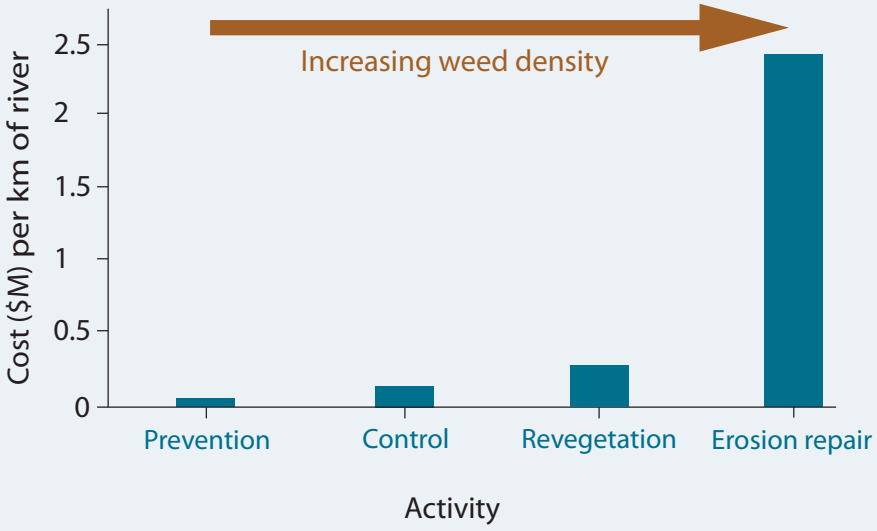


Figure 5.1 Indicative costs of various management approaches for cat's claw creeper in water catchments in South East Queensland.

The combination of sediments and nutrients degrades water quality. This impacts not only environmental and amenity values but also the economic cost of drinking water provision within SEQ. Seqwater, the bulk water supplier within SEQ, has identified that the presence of cat's claw creeper within 5–10 km upstream of a water offtake site increases the costs of water purification at that site. As cat's claw creeper continues to spread, deep-rooted native vegetation is lost, resulting in ever-poorer quality of the water arriving at purification plants. The poorer the water quality, the higher the cost of purification.

Figure 5.1 shows the costs associated with managing the impacts of cat's claw creeper on water quality at an offtake point. Preventing weed incursions – and retaining native vegetation – theoretically has minimal direct costs. As weed presence and density increases, so do weed management costs. If no action is taken and native vegetation is lost, the resulting cost of revegetating and repairing eroded banks is exponentially higher. Even greater are the costs of hard engineering improvements to water treatment plants that are required for the plants to cope with declining water quality.

The approach

Healthy Land & Water, the natural resource management body for SEQ, and Seqwater collaborated to manage cat's claw creeper at 11 sites across SEQ. These are the regional offtake sites for the provision of potable water (Figure 5.2).

At each site, commercial contractors were engaged to control cat's claw creeper in a three-stage process over five years. This included:

- Stage 1 – management in the first year targeted infestations in tree canopies. This protected trees from the imminent threat of being overwhelmed. Vines were controlled using skirting and cut-and-swab methods.
- Stage 2 – management in years 2–4 targeted regrowth from Stage 1 and used herbicide to spray cat's claw creeper on the forest floor. Control occurred 4–6 times per year, depending on regrowth.
- Stage 3 – management in the final year of the project focused on reinvasion and regrowth in managed areas.

Primary control used the cut-and-swab method, integrated with skirting (refer to Chapter 4 for more information). Foliar spray was used for follow-up

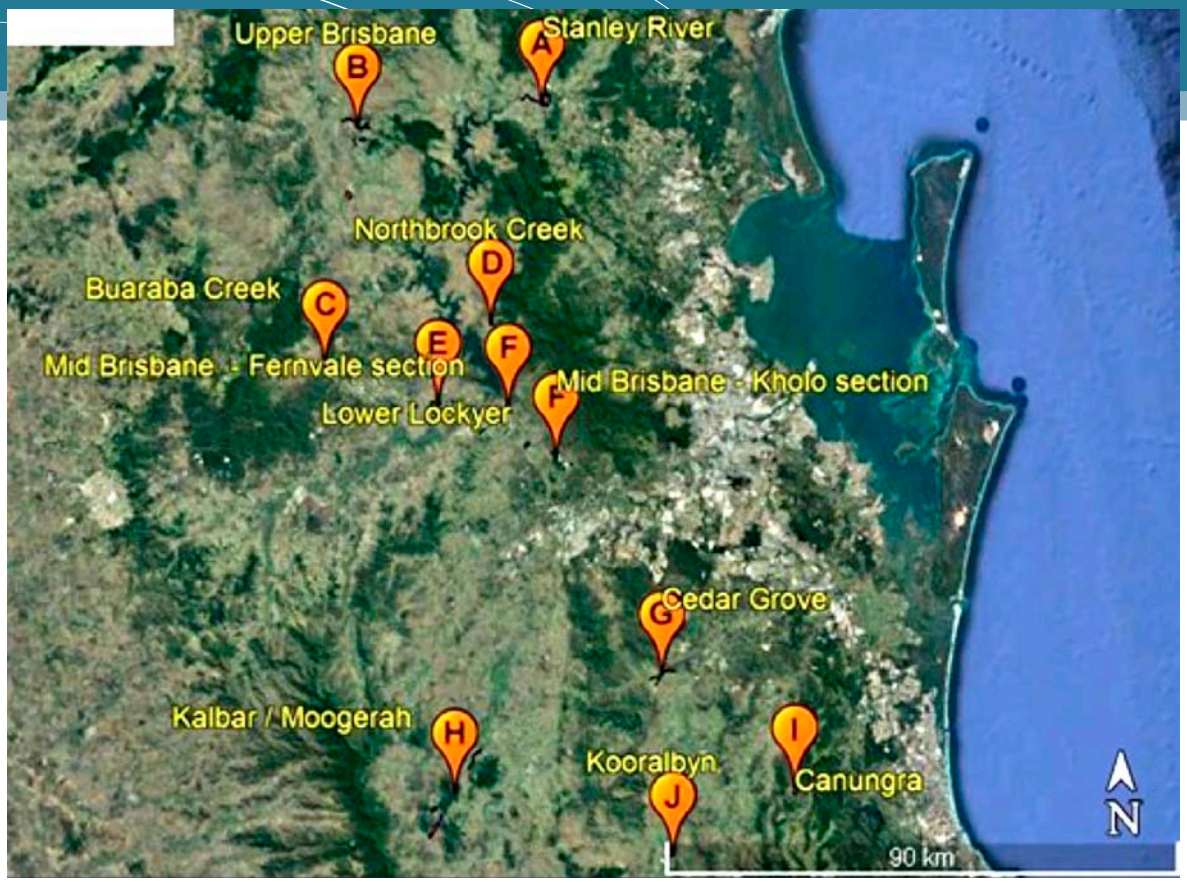
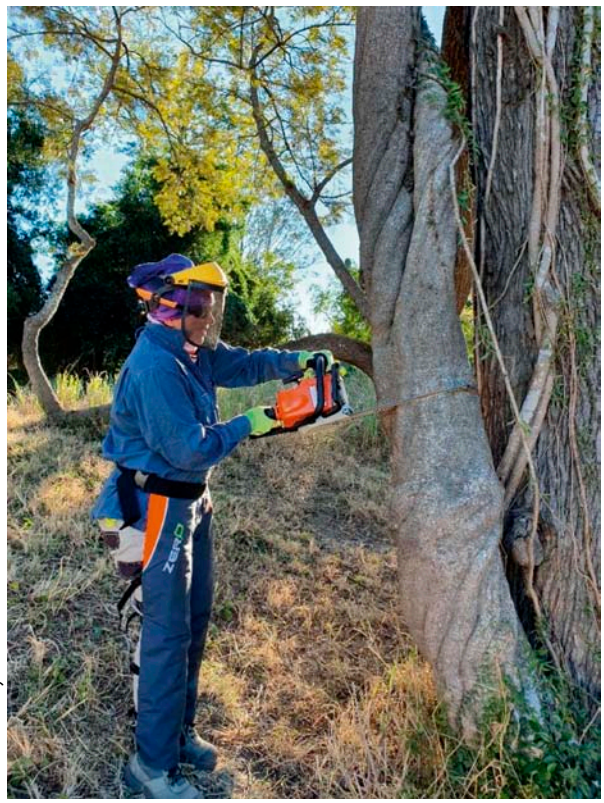


Figure 5.2 The location of cat's claw creeper management sites in South East Queensland.



Dennis Gannaway

A contractor cutting a very large cat's claw creeper stem.

Dennis Gannaway

Skirting vines for control.

Case study 1

control. All methods were integrated with biocontrol for areas that were difficult to access.

Chemical control of cat's claw creeper was supported by the release of a biocontrol agent, the jewel beetle (*Hedwigiella jureceki*), purchased from community-run Landcare groups. These beetles were released in weed infestations surrounding the managed sites, where other weed management actions were unlikely to be undertaken. These release areas were typically on private property, nearby tributaries, or areas unsafe for subcontractors to access. The objectives were to slow the expansion of these weed infestations and reduce the risk of them providing seed for reinvasion into the managed sites. This action also resulted in the establishment of viable populations of the beetle, which will eventually spread across the region.

Chapter 4 has more information on the jewel beetle.

The result

Over the project's five years, 154 km of creek bank were physically treated, and more than 300,000 leaf-mining jewel beetles were released at 60 sites.

Infestation levels were significantly reduced in areas where chemical control occurred. Only minor regrowth is now present. This reduction in weed pressure significantly improved the health of native vegetation, and native seedlings are now growing in areas that had been dominated by weedy groundcover.

Results were mixed at the sites where jewel beetles were released as a biocontrol agent. Some sites now have well-established beetle populations, with extensive damage to the vines. Beetles have disappeared entirely from other sites, or have been found in infestations kilometres away from release sites. It's still too early to evaluate the impact of biocontrol releases.

Dennis Gannaway

Contractors managing an on-ground infestation.

Dennis Gannaway

Native species regenerated after management.

The future

While the project had five years of funding and made significant gains to suppress cat's claw creeper in the managed sites, ongoing maintenance is critical. Despite best efforts, cat's claw creeper hasn't been eradicated. Regrowth from underground tubers remains a constant threat, as does reinfestation from seed originating from untreated areas. Continued investment in maintenance is key. Collaboration with landholders and interest groups in adjacent areas will encourage action at a catchment scale. This is the best chance to achieve a long-term solution to the loss of native riparian vegetation caused by cat's claw creeper. On-ground management must also be supported by the release of biocontrol agents, despite the jewel beetles not having significant impact on weed populations. Research must continue to find more effective agents. For more information, visit hlw.org.au/news/combating-the-vine-invasion-a-success-story-in-south-east-queensland.

Case study 2

Lessons learnt protecting remnant rainforest at 'Coombra', Far North Queensland

Leasie Felderhof, land owner

Key points

- Extensive surveying to determine weed extent on your property and surrounding areas is essential to making good management decisions.
- It's important to be realistic about your management objectives and have the flexibility to change your objectives or your management approach.
- Conduct annual, ongoing control efforts where cat's claw creeper is well established.
- Vine control needs to be carried out by experienced and dedicated managers. It requires detailed attention to see individual seedlings and vines among other vegetation on difficult and sometimes precarious terrain.
- Control work is made more difficult by factors such as temperature and environmental hazards such as snakes, ticks, mosquitoes and leeches.
- Management requires a concerted effort from all landholders.

The situation

'Coombra' is a 350-ha grazing property on the outskirts of Atherton in Qld's wet tropics. The property contains a mixture of basalt and clay soils that previously supported rainforest and eucalypt woodlands. 'Coombra' is divided by Mazlin Creek (perennial) and Middle Creek (intermittent). The average rainfall is 1,500 mm per year, with most rain falling during the wet season (December to April). There can be extensive periods of drizzle between April and July, and occasional frosts in late July and August, but these don't occur every year.

Mazlin Creek has rainforest vegetation along most of its riparian area within and bordering the property. This is the result of both natural regeneration and an active revegetation program to widen the rainforest corridor and connect the creek lines to the adjoining state forest.

The problem

In the early 1990s the property owners, Leasie and Bill, noticed a smothering vine climbing rainforest trees along the creek near the farm house. They identified the vine as cat's claw creeper – a well-established weed in South East Qld but with limited occurrence in Far North Qld.

Case study 2

'This was pre-internet, so we consulted hard-copy books for information. The pictures of the impacts to rainforests elsewhere concerned us greatly and motivated us to place the control of this plant to one of the highest land management priorities on the farm'. Leasie Felderhof

Leasie Felderhof

Management at 'Coombra' is preventing current infestations reaching high densities and impacting on the rainforest.

The approach

Following confirmation of the presence of cat's claw creeper, Leasie and Bill immediately commenced planning their control by surveying the extent and density of the infestation on the property. The initial survey was largely limited to the creek line near the house. The weed was thought to be contained to an approximately 300-m stretch of riparian vegetation and an infestation in the house yard, climbing up 100-year-old mango trees along the driveway. The vines had reached the canopies of the trees, but there was no sign of tree loss. From this initial assessment, the decision was made to manage the infestation for eradication from the property.

'Many of the vines were as thick as a man's thumb, and the problem was more extensive once we looked in greater detail'. Leasie Felderhof

The second step was to decide how to control it. Leasie and Bill obtained advice from the local agricultural supplies shop and chose to undertake cut-stump (cut-and-swab) treatment (refer to Chapter 4 for more information). This involved walking up and down the creek line, cutting mature vines with secateurs and applying herbicide to the stems at label rates. The majority of the vines were left in the tree – these died after cutting the bases. Seedlings weren't removed, as the creek banks are steep and the task appeared overwhelming, especially in conjunction with other farm work.

'The initial control effort was intensive with all hands on deck (four people) over a few weeks. During control, an additional isolated infestation was found further up the creek line, which was also treated'. Leasie Felderhof

Follow-up treatment occurred opportunistically for the next two years, using the same method, until vines (tree-top flowers or living stems on trees) were no longer readily apparent. At this time, attention shifted to other land management and income-producing priorities.

A few years later, during a recreational walk on the property, cat's claw seedlings were noticed in the understorey of the rainforest along the creek. Further investigation revealed a few large vines had been missed in the initial control. These were likely the source of new seedlings. Vines were also making their way up trees in previously treated areas. An extensive property survey – beyond the initial surveyed area – helped inform the second phase of control. The survey concluded that the weed was also present on neighbouring residential properties that backed onto the creek. This meant that seeds would continue to arrive onto the property.

Leasie Felderhof

Cat's claw creeper resprouting from tubers and beginning to climb towards the tree canopy.

This new discovery led to a reassessment of the control approach and the management objective.

> *'We needed to ask ourselves if eradication on our property was achievable, given the weed's density on adjoining properties. We decided it wasn't, so the next best thing was to make sure our management would minimise the impact on the rainforest on our side of the creek. This meant managing existing infestations to prevent flowering and seeding, as well as minimising how much cat's claw creeper was getting to the canopy of the rainforest. We also wanted to stop spread beyond current infestation areas'.* Leasie Felderhof

The renewed program consisted of daily control for a two-month period, working methodically up and down the creek banks. This time, control focused on pulling vines from trees where they hadn't established in the canopy and it was safe to do so. Stems were left attached to tubers, gathered on the ground in a pile, and sprayed with glyphosate at label rates. Any seedlings or small plants were also sprayed. The cut-stump technique wasn't used, because vines were only slender. This approach was carried out along both sides of the creek bank, from the water's edge to where the rainforest abutted the paddock. Follow-up treatment of spraying with glyphosate and opportunistically digging up small plants was undertaken the following year and continues today, around once per year as any new plants or re-sprouting tubers are spotted.

Leasie Felderhof

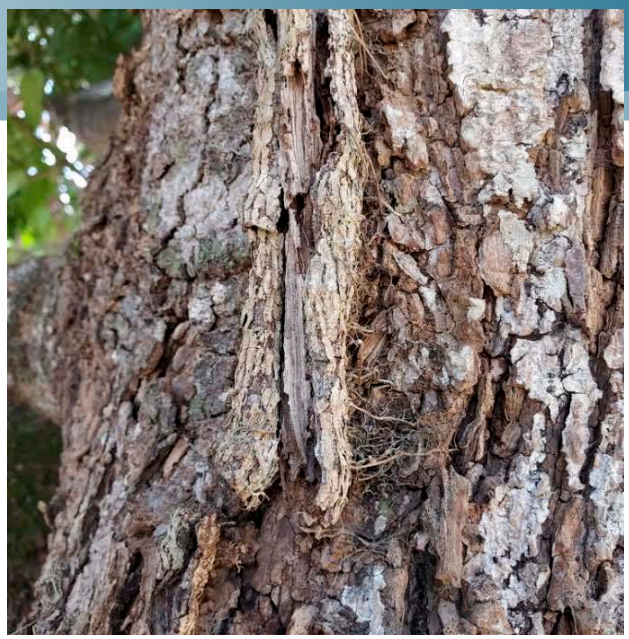
Small tubers were dug out by hand.

In addition to treating vines on 'Coombra', permission was also sought to treat an infestation on a neighbouring property for one year.

The result

This intensive control program successfully prevented flowering and seeding of established infestations, and it's curbed cat's claw creeper from re-entering and modifying the canopy of the rainforest. Even though cat's claw creeper is present, its density is very low, and there's minimal impact on the rainforest. Annual surveillance and treatment is required to maintain the infestation at low levels.

The level of success demonstrates that, by integrating control of cat's claw creeper into broader farm or property management plans, individuals can protect assets on properties from invasive vines and scramblers.



Leasie Felderhof

Leasie Felderhof

Remnants of cat's claw creeper stems remain on tree trunks for years after control. This can be useful for locating historical infestations and knowing where to be extra vigilant with surveillance.

The success of this control has also increased local awareness of the potential impacts of cat's claw creeper, and invasive vines and scramblers more generally, however ongoing awareness raising is needed.

The future

Cat's claw creeper will be managed into the future by annual inspection and control. This has been incorporated into the farm and weed management plan.

> '*I have since found seedlings in crow's nest ferns, high up in the trees, after the tree has fallen. This highlights the impossibility of eradicating cat's claw from my property and my acceptance that annual control will be required long into the future. However, the success of the effort to date means cat's claw creeper is no longer flowering, the population is greatly diminished, and the rainforest is extremely healthy. This means we are achieving our management objective and this motivates me to continue. The main difficulty is finding people active and energetic enough to climb up and down steep creek banks covered in roots and vines, and tolerating scratches, ticks, leeches and the anticipation of a big carpet snake where you next place your hand*'. Leasie Felderhof

Continued surveying, monitoring and adaptive management will be key to success at the farm scale. But what happens on the farm is influenced by the surrounding landscape. Control can't be maintained outside the property boundary without significant coordinated effort and public education. This is beyond the scope of an individual property owner. Cat's claw creeper is now well established in parts of north-east Qld, and it will require a concerted ongoing effort by land managers to minimise its impacts.

Cat's claw creeper doesn't have a high profile in the region. Some landholders are unaware of its impacts, while others may not share the same values or have the financial or physical capacity to manage it.

> '*Individual neighbours all have their own busy lives and interests, and without a strong push or support, the level of landscape-scale impact reduction that is needed will not be achieved. I hope the future may bring an organisation that can help raise the awareness of all weed issues impacting these important rainforests and coordinate actions of individuals – that's what we need for long-term success*'. Leasie Felderhof

Case study 3

Madeira vine control in the Deua River Valley on the New South Wales South Coast

Emma Patyus and Paul Martin,
Eurobodalla Shire Council

Key points

- A cross-tenure approach takes careful planning and is best supported by working groups to ensure that surveys, control work, follow-up and monitoring are conducted on a broad scale to prevent reinvasion.
- Follow up is essential, so only begin control if you can commit to long-term maintenance.
- Mapping and monitoring are important to track change and celebrate success.
- The site featured in this case study is remote and subject to extreme climatic conditions, so it may not be indicative of change experienced in more stable and accessible environments.
- Staff continuity is important for building relationships and developing trust when working with land managers in rural areas.

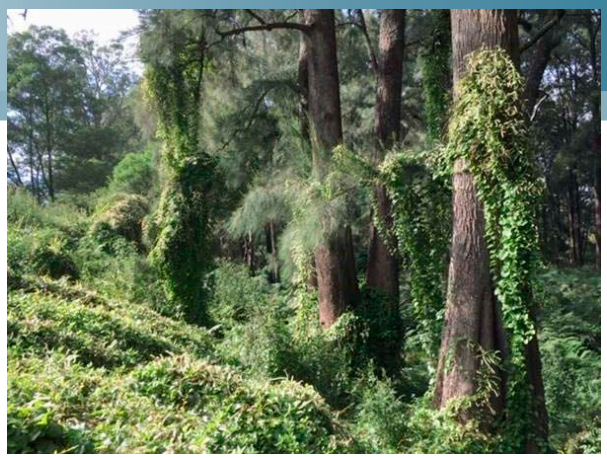
The situation

The 124-ha Schmidt family property is located within the Merricumbene area of the Deua River Valley, roughly 40 km west of Moruya on the South Coast of NSW. The property consists of several lots, including 20 ha of mostly cleared land managed for viticulture and 104 ha managed for biodiversity conservation. Colluvial soils support Lowland Grassy Woodland across most of the property, while alluvial soils closer to the Deua River support River-Flat Eucalypt Forest. Both ecological communities are listed as endangered in NSW. Madeira vine occurs on the alluvial soils at the upper flood mark in the riparian zone, where soil moisture levels are typically higher. Average rainfall in the Merricumbene area is around 900 mm per year, with severe flood events associated with east coast lows often exceeding minor flood levels and distributing topsoil across the alluvial flats.

The problem

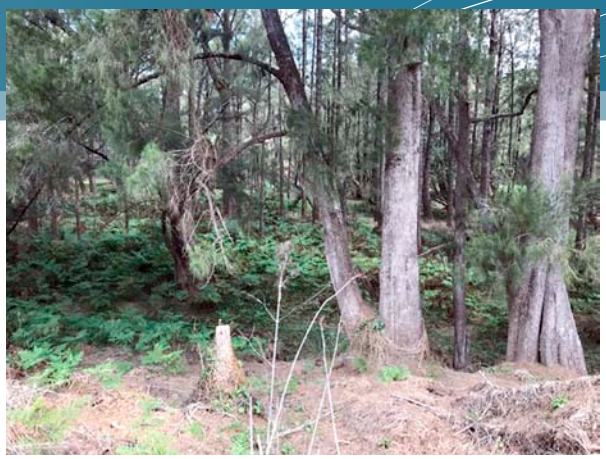
Helgi Schmidt and his family have been on the land for many decades, managing their property for viticulture and conservation purposes. Madeira vine originally colonised a 40-m long area along the top of the bank of the Deua River, where it adjoins the property. Madeira vine has been present in the property's riparian zone for at least 10 years, and plants had climbed into the canopy of the River Oak Open Forest and were smothering the forest floor.

The origins of Madeira vine at the property are unclear. Historical records indicate Madeira vine was most likely introduced to the Deua River Valley in the latter half of the 1900s, and it's since become



Eurobodalla Shire Council

Before: Madeira vine scrambling along the ground and climbing up the trees along the Deua River (May 2019).



Eurobodalla Shire Council

After: Site following Madeira vine control.

established there. Despite Madeira vine being present in the valley for more than 50 years, its distribution remains scattered, and it's considered in the early stages of invasion. It's establishment may be limited or slowed by the climate, soil type or some other localised factor.

Madeira vine greatly impacts the vegetation communities it invades by climbing into the canopy and smothering native trees, reducing their ability to photosynthesise. Over time, mature trees senesce and die. Additionally, infestations of Madeira vine that smother the ground reduce germination of desirable species. The loss of seedling recruitment and mature trees would result in the collapse of the vegetation communities at the property. Plant diversity, visual amenity, and flood and erosion mitigation would be lost. This would increase the delivery of sediments and nutrients to the river, contributing to downstream impacts on seagrass meadows, which support estuarine life and economically important activities such as recreational angling.

While access to this site isn't problematic, many similar riparian sites in the Deua River Valley feature steep escarpments, flood water, landslides and impenetrable scrub, limiting or preventing access for control purposes.

The approach

Planning

The multi-pronged approach to Madeira vine control started in 2015, when infestations were first mapped via kayak. Additional kayak surveys were undertaken in 2018 and 2021, supplemented by foot-based surveys.

Permits to enter and conduct control work were obtained and contractors engaged through the Deua River Maintaining Momentum and Bridging Gaps project, funded by the NSW Government's Environmental Trust.

Surveys over multiple years assistied with weed mapping and planning. Source: Eurobodalla Shire Council.

Herbicides

A range of application techniques were used at the property, based on the location and height of Madeira vine plants.

- Stem-scraping (scrape-and-paint) was conducted using Apparent Glyphosate Green 360 (200 mL) mixed with Apparent Woody (80 mL) and a penetrant (20 mL), neat with dye.
- Low-volume knapsack foliar spraying (spot-spraying) of plant material on the ground was carried out with Apparent Woody at 5 mL/L, plus penetrant.

Refer to Chapter 4 for more information on control options.

Follow-up control has been critical, with five applications between 2019 and 2023. The use of stem-scraping followed by low-volume foliar spraying has proven to be a very effective method of control for various invasive vines such as cat's claw creeper and Madeira vine, provided follow-up is conducted.

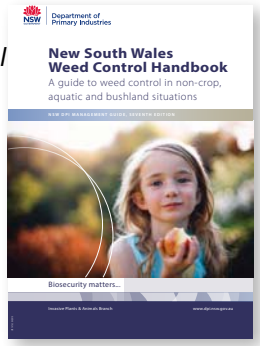
Monitoring

Photo-point monitoring was established at the early stages of the project to visually measure change over time.

Partnerships and advice

The Deua Rivercare Group has been controlling Madeira vine as part of a five-year tenure-neutral program over a 42-km stretch of the Deua River, both upstream and downstream of the Schmidt property. Working with neighbours is critical in preventing reinvasions from tubers and stem fragments, which are a major mechanism for long-distance dispersal of Madeira vine. Getting help and advice from experts has also been important. The NSW Department of Primary Industries *Weed control handbook* was consulted, in addition to local expert advice and control trials elsewhere.

The NSW Department of Primary Industries *Weed control handbook* provides guidance on control methods for Madeira vine. It can be found at: dpi.nsw.gov.au/__data/assets/pdf_file/0017/123317/weed-control-handbook.pdf



Learning from other experiences

Biological control with the leaf-feeding beetle (*Plectonycha correntina*) has been trialed without

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Photo-point monitoring demonstrating change over time. (a) Wildfires burnt the property, scorching many trees (January 2020). (b) The site after fire, showing the annual weed load (May 2020).

Eurobodalla Shire Council

Annual weeds germinating in autumn.

Eurobodalla Shire Council

Casuarinas recovering after fire, with grasses and forbs forming most of the groundcover.

success elsewhere in the Eurobodalla Shire. While it would be interesting to trial this control method in the Deua River Valley, it won't be used at this stage, primarily due to the local eradication goals.

The result

Through chemical control, Madeira vine is being successfully managed at this site. Photo-point evidence from 2021 shows casuarina trees starting to regenerate (after fire), with herbs and forbs covering the ground where once there was a carpet of Madeira vine.

Black Summer fires burnt through almost 80% of the shire in 2019–20, including the Schmidt property. Although other weed species, such as turkey rhubarb and wild tobacco, have since expanded across the site, Madeira vine appears unaffected by the fires. Madeira vine vigorously regrew in areas previously treated, but infestations haven't spread. It's assumed that any aerial tubers present on site were burnt during the fire. However, it's unknown whether the heat rendered them unviable.

Monitoring in 2023 indicates that Madeira vine is climbing back up the casuarinas, demonstrating the tenacity of this weed and the need for continual surveillance and ongoing maintenance.

The future

The Deua River is a true wild river, with High Ecological Value Aquatic Ecosystem status (NSW DCCEEW, 2024). Recent environmental DNA sampling of the river detected the Australian grayling (*Prototroctes maraena*), a fish listed as vulnerable under the Australian *Environment Protection and Biodiversity Conservation Act 1999*. Madeira vine at this site will continue to be controlled through the Rivercare Group, who intend to trial different herbicides to assess any difference in efficacy, including combinations of glyphosate, fluroxypyr and metsulfuron-methyl.

A significant amount of work has been undertaken on this section of the Deua River over the past decade. However, timing and grant funding is important to support this community in their vision for a healthier riparian zone.

Eurobodalla Shire Council

Despite five years of control and wildfires, vigilance is needed to manage Madeira vine regrowth (July 2023).

Case study 4

Eradicating Madeira vine from Bana Gindarja Creek in Far North Queensland

Kea Lewry and Dave Lloyd, Cairns Regional Council

Key points

- Understanding the extent of an infestation, through surveys, is a critical first step in an eradication program.
- Finding an appropriate control method, or integrating a range of methods, will greatly assist your successful control. This may involve trialing methods or herbicides to find the right approach.
- Thoroughly removing underground tubers will limit or prevent regrowth.
- Regularly follow up at established sites to manage Madeira vine tuberlings.
- Engaging experienced weed managers in control programs brings a range of benefits, even when dealing with new weed incursions.

The situation

Bana Gindarja Creek in Far North Qld runs through Edmonton, a former sugarcane-growing town that's now a suburb of Cairns. The name 'Bana Gindarja' refers to the cassowary, an important cultural species to the Gimuy Walubara Yindinji people, Traditional Owners of the area.

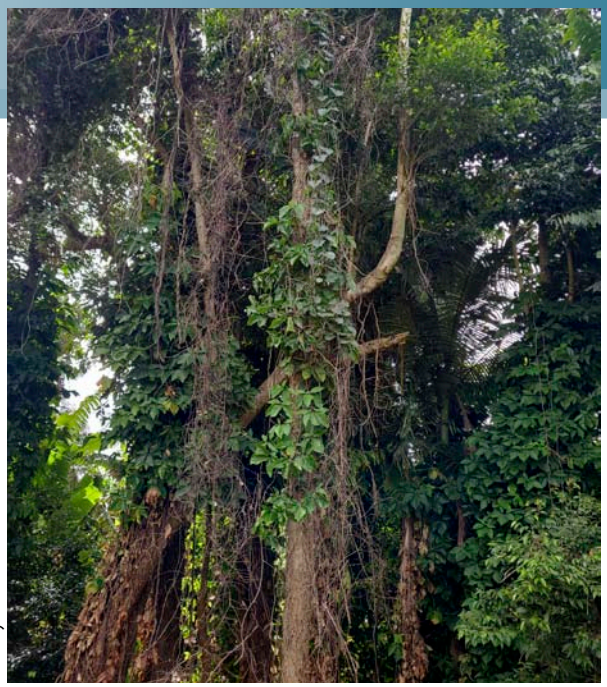
Edmonton is located in the wet tropics of Far North Qld. It has a tropical climate, with hot and humid summers and milder, drier winters. Average temperatures range from 17°C to 30°C throughout the year. Over 2,000 mm of rain can fall between December and March, sometimes leading to flooding of local creeks and rivers.

Bana Gindarja Creek, managed by Cairns Regional Council, begins in the foothills west of Edmonton, eventually flowing out to the Trinity Inlet in Cairns. The creek features non-remnant riparian forest with a disturbed canopy. The creek is in an urban area, surrounded primarily by housing. It neighbours a cane plantation.

The problem

The Cairns Regional Council was first alerted to the Madeira vine infestation along Bana Gindarja Creek around 2018 following a report from a visitor who knew of the weed from the Brisbane area. Herbarium records indicate Madeira vine has been present around Edmonton since at least 1999. Initially, plants were found near an old fruit orchard. Council staff suspect it was planted as a food source (leaves and tubers of Madeira vine are eaten in its native South America and elsewhere).

Madeira vine isn't known to occur anywhere else in the Cairns region, and this infestation is considered the weed's northern-most occurrence in Australia.



K. Lewry

Madeira vine climbing into the creek-line canopy, among native and other weedy plants.

Due to its extremely limited distribution in the Cairns region, Madeira vine is considered a priority weed and is targeted for eradication by the council.

Madeira vine plants are scattered along approximately 3 km of creek line, with plants occurring in discrete patches. The creek substrate is generally rocky, with Madeira vine preferring to grow in the pockets of alluvial sediment that are deposited in wash-out areas of the creek. A mown buffer runs alongside the creek, containing Madeira vine to the creek line itself.

The discovery of Madeira vine in the region represents a new incursion, and the focus is on eradicating it. The primary concern for the council is mitigating the potential for further spread of Madeira vine throughout the region. Although plants are believed to be less aggressive than in other parts of Qld (possibly because it's growing on the northern edge of its range of suitability), Madeira vine spreads easily and rapidly along riparian areas. There's also concern about the potential impact Madeira vine may have on riparian vegetation and watercourse health, which is already under pressure from other invasive vines such as thunbergia (*Thunbergia grandiflora*) and kudzu (*Pueraria montana* var. *lobata*), and aquatic weeds.

The approach

Once they became aware of the presence of Madeira vine, council staff surveyed the creek line to determine the extent of the infestation. The survey began upstream of the detected plants, to ensure all propagules were detected, reducing the chance of downstream reinvasion.

Once the infestation was delimited, staff researched the appropriate control methods and the herbicides that were permitted for use. Control work began on mature vines – some stems were as thick as forearms. Initial control included the following approaches.

Treatment of mature vines

- Large, mature vines were cut and underground tubers dug out. Fortunately, council staff had experience managing thunbergia and knew the importance of removing the whole tuber to prevent regrowth.
- Smaller vines were treated with the scrape-and-paint method, using a vegetable peeler to expose the cambium layer of the plant and applying Vigilant® gel to the exposed plant.

Treatment of tubers

- Fallen aerial tubers and tuberlings (sprouted aerial tubers) were raked into piles and bagged for disposal.
- Tarps were laid on the ground and vines shaken to dislodge aerial tubers for collection and disposal.
- Tuberlings were spot-sprayed (using a quick-spray unit) with a tank mix of 200 mL of glyphosate and 1.5 g of metsulfuron-methyl per 10 L of water.

Plant material was bagged and disposed of at the council-managed deep-burial waste facility. Refer to Chapter 4 for more information on weed control and disposal options.

K. Lewry

A vegetable peeler and Vigilant® herbicide were used to control vines with the scrape-and-paint method.

In some instances, a foliar spray was applied to the areas to open up the already-weedy groundcover to search for tuberlings. Care was taken in sensitive sites to reduce off-target damage. Fortunately, Madeira vine plants typically occur on the edge of the riparian vegetation and are relatively easy to access for control.

K. Lewry

Aerial tubers are a helpful way to identify Madeira vine plants in thick riparian vegetation, where many other vine species are present.

K. Lewry

Searching for tuberlings for bagging and disposal.

Weed surveys along Bana Gindarja Creek captured Madeira vine and other weed infestations. Source: Cairns Regional Council (internal mapping).

Case study 4

The result

Council staff know there are still aerial tubers at the site, and that flooding can spread aerial tubers downstream. As a result, the site is revisited as frequently as possible (approximately monthly) to control any tubers that have sprouted. Staff start work at the top of the infestation and move downstream. Staff are now grubbing out very small numbers of tuberlings during each visit.

Control methods have been very successful. There are now no mature vines and no vines with aerial tubers at the site, which significantly reduces the risk of further spread. Young plants (with stems finger-width or less in size) and tuberlings still remain and are controlled on a regular basis. Staff believe they've removed all underground tubers from previously treated mature vines, with no regrowth observed.

Many aerial tubers that drop to the ground rot before they can sprout. Although Cairns experiences a similar temperatures and rainfall to Madeira vine's native range in South America, staff believe the wet climate assists in the fast breakdown of tubers, with tubers either sprouting straight away or rotting. Other observations indicate a staggered sprouting of tubers (not all sprout at once), with possible reasons including light availability or warmth.

Although staff are limited to the herbicides available for use in riparian areas, Vigilant® has given excellent results. Extended wet seasons can impact on timing of follow-up visits, with some sites inaccessible at times due to flooding. Staff need to remain flexible and visit the site when the opportunity presents.

The future

The priority is to manage the potential for further spread throughout the region. Council staff are very happy with the results and plan to continue with current methods of hand removal or spot-spraying of tuberlings, depending on their location and density.

K. Lewry

Carpets of tuberlings are spot-sprayed for efficiency.

K. Lewry

Management is now focused on manual removal or spot-spraying of tuberlings.

K. Lewry

Small tuberlings can grow vigorously.

Chapter 6

Further information

Identification of other vines and scramblers

While cat's claw creeper and Madeira vine are two of the most impactful invasive vines and scramblers, many other species also pose a threat to biodiversity in Australia. Rubber vine (*Cryptostegia grandiflora*) and the asparagus weeds are also listed as WoNS and have best practice management resources available (Doak and Deveze, 2004; OEH, 2013).

Plant profiles for some of Australia's introduced and native vines and scramblers, including information on their distribution and key identification characteristics, can be found below. Plants featured are sometimes found to co-occur with cat's claw creeper and/or Madeira vine.

Introduced species

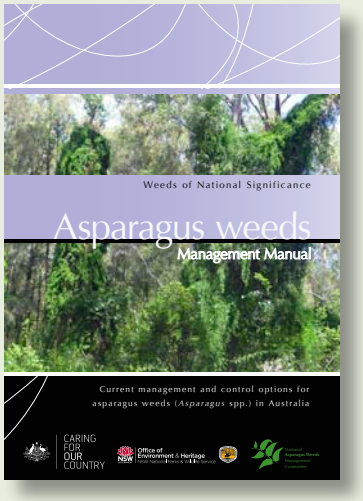
WoNS
WEEDS OF NATIONAL SIGNIFICANCE

Asparagus weeds—*Asparagus* spp.

Seven species in the genus *Asparagus* are listed as WoNS and several other species are present in Australia as potential future weeds (OEH, 2013). All species are either climbers or scramblers; their shoots are modified into leaf-like structures called 'cladodes'; and they often have extensive root and underground tuber systems that make control difficult.

The species that climb into the canopy of forests are climbing asparagus (*Asparagus africanus*), climbing asparagus fern (*A. plumosus*) and bridal creeper (*A. asparagoides*). The common scrambling species are ground asparagus (*A. aethiopicus*) and bridal veil (*A. declinatus*).

For more information on the identification and management of asparagus weeds, see the *Asparagus weeds Management Manual: Current management and control options for asparagus weeds (Asparagus spp.) in Australia* (OEH, 2013).



The Asparagus weeds Management Manual is a great resource for managing asparagus weeds.

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M. Fagg 2006

*Climbing asparagus (*A. africanus*).*

R.G. & F.J. Richardson

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R.G. & F.J. Richardson

*Bridal creeper (*A. asparagoides*).*

R.G. & F.J. Richardson

*Ground asparagus (*A. aethiopicus*).*

Matt Sheehan

Leaves and flowers (left), and mature fruit (right) of C. grandiflorum. *Note that immature fruit are green.*

Balloon vines—*Cardiospermum grandiflorum* and *C. halicacabum*

Two closely related invasive vine species have the common name balloon vine (*Cardiospermum grandiflorum* and *C. halicacabum*). *Cardiospermum grandiflorum* has larger leaves and leaflets, fruit and flowers, but it is best to differentiate the two species by hairs: *C. grandiflorum* is densely hairy and *C. halicacabum* is finely hairy to almost hairless.

Cardiospermum grandiflorum is widely distributed in eastern Australia, from south-eastern NSW to northern Qld, and some populations are present in south-eastern SA and around Perth in WA. *C. halicacabum* mainly occurs in northern Australia from northern WA to northern Qld, though it is also present in southern Qld and NSW.

Key ID characteristics:

- compound leaves arranged in three groups of 3 leaflets
- tendrils growing out of the end of flower spikes
- papery balloon-shaped fruit.

© M. Fagg 2012

C. halicacabum *fruits*.

© M. Fagg 2012

C. halicacabum *leaves and flowers*.

Blue thunbergia—*Thunbergia grandiflora*

Blue thunbergia is a scrambling vine that can grow to 15 m in height. It is native to India and was introduced to Australia as an ornamental plant. It now is a major threat to native vegetation in northern Qld, and scattered populations are present in South East Qld (Brisbane City Council, n.d.).

Key ID characteristics:

- oppositely arranged leaves, variable in shape from almost triangular with entire margins, to oval shaped with irregular pointed lobes
- trumpet-shaped flowers, blue with a white throat; clustered in inflorescences on drooping branches.

© J.W. Wrigley 1983

Trumpet-shaped, blue flowers of blue thunbergia.

Brazilian nightshade—*Solanum seaforthianum*

Brazilian nightshade is a common vine or scrambler in coastal eastern Australia, with records from southern NSW to North Qld.

Key ID characteristics:

- leaves that are pinnatisect (resemble compound leaves, but are simple leaves with lobes almost to the midrib)
- large inflorescences that hang below stems and contain 10–50 purple flowers
- bright red, glossy berries, 1 cm wide.

R.G. & F.J. Richardson

Brazilian nightshade pinnatisect leaves (left) and clustered purple flowers (right).

R.G. & F.J. Richardson

Brazilian nightshade berries.

Cape ivy—*Delairea odorata*

Cape ivy is an herbaceous climber introduced from South Africa. It is present in moist, shady areas in south-eastern Australia (coastal areas of SA, Vic, NSW and Tas) as well as south-western WA.

Key ID characteristics:

- glossy green leaves with 5–7 points
- succulent texture to stems and leaves
- small yellow flowers, present in many flowered clusters.

The leaves of Cape ivy are similar to those of English ivy, though Cape ivy is a fleshier plant, while English ivy is woody.

R.G. & F.J. Richardson

Twining stems and leaves of Cape ivy.

R.G. & F.J. Richardson

Cape ivy flowers.

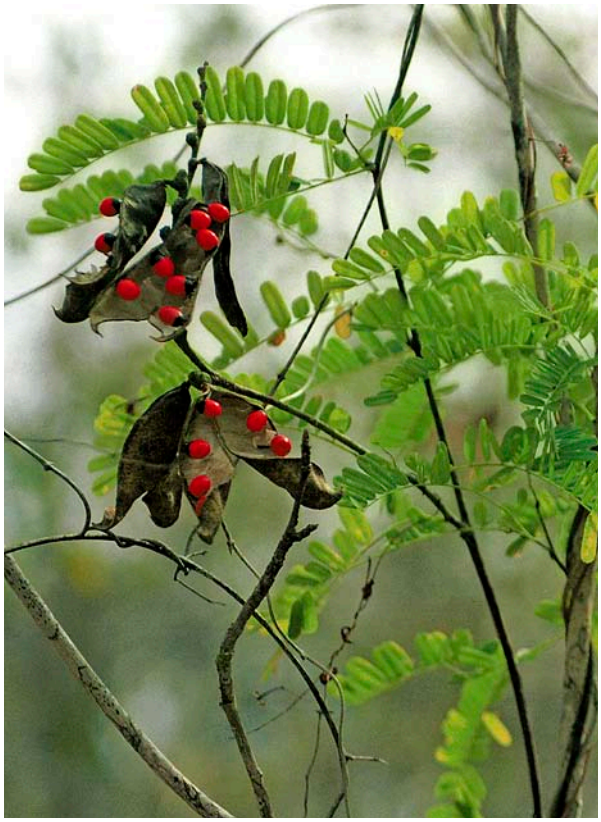
Crab's eye creeper—*Abrus precatorius* subsp. *africanus*

Crab's eye creeper is a woody twiner up to 10 m tall with characteristic red seeds with black dots that resemble crabs' eyes. It is mainly found in South East Qld, though there are populations in coastal Central Qld as well (Atlas of Living Australia 2022).

Key ID characteristics:

- compound leaves with 5–17 leaflets, 5–25 mm long, 2–8 mm wide and oblong in shape
- pink to purple flowers
- brown seed pods, broad, sparsely hairy with a rough texture
- bright red seeds that can remain on the plant for several months.

It should be noted that there is a native form of crab's eye creeper (*Abrus precatorius* subsp. *precatorius*) that is very similar in appearance to the exotic. The native form is distributed across tropical northern Australia, and there is currently minimal overlap in the distribution of the two forms, though this could change in the future. The best way to tell the two forms apart is the texture of the pod, which is rough in the exotic (subsp. *africanus*) and smooth in the native (subsp. *precatorius*).



R.C.H. Shepherd

The pinnately compound leaves of crab's eye creeper.

© M. Fagg 2017

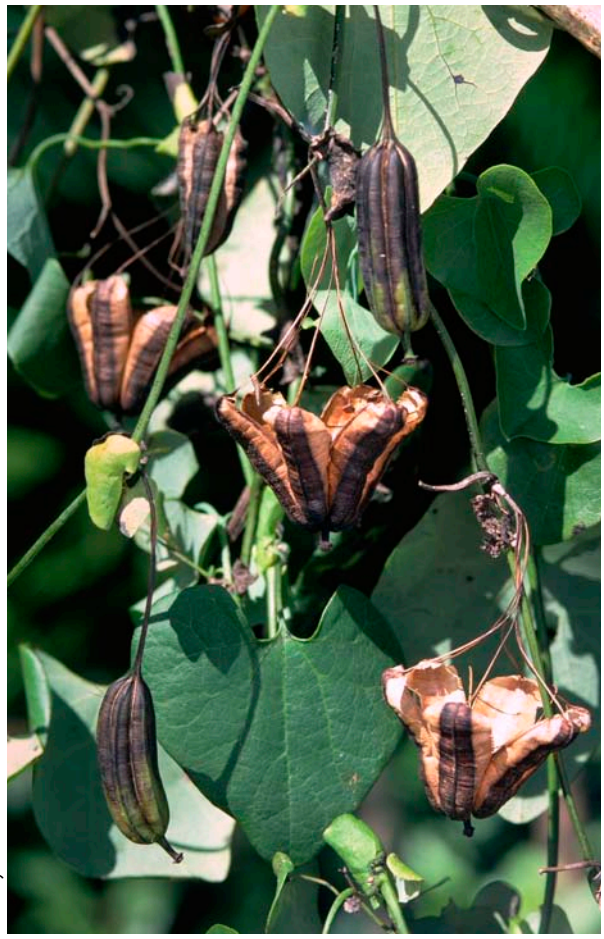
Crab's eye creeper's bright red seeds with black dots that remain on dried pods.

Dutchman's pipe—*Aristolochia elegans*

Dutchman's pipe is a vigorous woody climber with showy leaves and fruit, and kidney-shaped leaves that release an unpleasant smell when crushed. It is mainly present on the north coast of NSW and coastal Qld, where it displaces native vines and is poisonous to the larvae of birdwing butterflies.

Key ID characteristics:

- large, purple flowers
- long, channelled seed pods that open up from the top
- kidney-shaped leaves
- ear-shaped stipules (appendages at the base of the leaf stalk).



Seed pods open from the top.

Forest & Kim Starr

Dutchman's pipe's spectacular flower.

Forest & Kim Starr

Dutchman's pipe kidney-shaped leaves.

Forest & Kim Starr

Dutchman's pipe leaf with ear-shaped stipule at stalk base.

English ivy—*Hedera helix*

English ivy is a common ornamental plant in gardens. As such it has become a garden escape and is often growing in disturbed areas such as parklands in southern Australia (NSW, Vic, ACT, SA and Tas).

Key ID characteristics:

- leaves dark green, often with variegations of white throughout, and with 3–5 pointed tips
- grows up structures using aerial roots along the stem.

R.G. & F.J. Richardson

English ivy foliage.

R.G. & F.J. Richardson

English ivy growing up a tree trunk using aerial roots.

Glory lily—*Gloriosa superba*

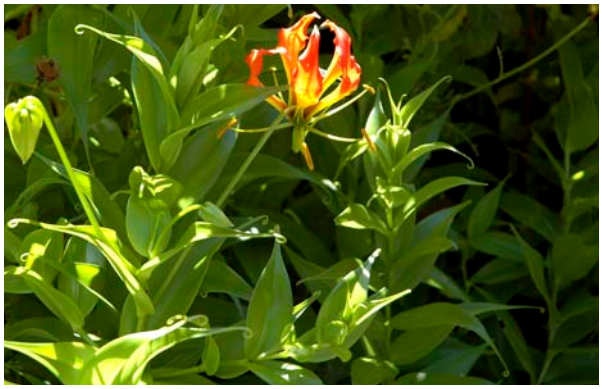
Glory lily is a perennial scrambler with annual stems that die back each winter and re-sprout from an underground tuber in the summer. It is widely cultivated as an ornamental because of these flowers, and several cultivars are still present for sale in Australia. In subtropical and tropical coastal eastern Australia it is a major invader of sandy coastal forests, such as littoral rainforest and coastal scrub, with heavy infestations containing 70–100 tubers/m^2, which can re-sprout new stems (Weeds of Australia, 2022). All parts of glory lily are poisonous and potentially fatal to humans and animals.

Key ID characteristics:

- striking flowers with six yellow to red petals that sit above 6 lengthened yellow to orange stamens
- leaves are fleshy and have a coiled tendril at the tip.

R.G. & F.J. Richardson

Glory lily flower.



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Glory lily leaves with coiled tendril at tips.

Glycine—*Neonotonia wightii*

Glycine is an herbaceous climber or scrambler that can become woody at the base. It invades disturbed areas and the edges of rainforest in tropical and subtropical areas of eastern Australia.

Key ID characteristics:

- stems densely hairy to hairless
- compound leaves with 3 oval leaflets, 1–10 cm long and 1–7 cm wide
- white to mauve flowers, turning orange with age
- seed pods 1–4 cm long and 0.5 cm wide; rusty in colour and densely hairy.

Hairy seed pods of glycine.

Japanese honeysuckle—*Lonicera japonica*

Japanese honeysuckle was introduced to Australia as an ornamental, but it now invades forests on the east coast from South East Qld to Tas, and from Perth to Albany in WA.

Key ID characteristics:

- leaves oppositely arranged, oval shaped, 2–8 cm long and 1–4 cm wide, variable in shape (often deeply lobed in young plants, though entire on older plants)
- young stems densely hairy, older stems hairless, woody and often with strings of bark peeling off
- tube-shaped flowers, 2–3 cm long, starting white and becoming yellow or orange with age.

Japanese honeysuckle leaves and flowers.

Kudzu—*Pueraria lobata*

Kudzu is a native of China and Japan that caused large scale impacts as an invader in the USA; however, in Australia its distribution is limited. This is likely because of its limited dispersal ability: it rarely produces viable seeds and relies on vegetative reproduction (Lindgren et al., 2013). In the USA it was promoted as a pasture crop and for erosion control, which caused it to become widespread, smothering vegetation and crops thanks to its extremely fast growth rates (Lindgren et al., 2013). In Australia, it might not achieve a wide distribution, but its rapid growth can cause serious local impacts. There are currently significant infestations in north-eastern NSW and South East Qld.

Key ID characteristics:

- leaves large, divided into three leaflets, lobed or unlobed
- flowers in clusters on a spike growing out of the leaf axis, pink to purple with a yellow spot at base
- deep roots and large underground tubers that reach almost 2 m in length and can weigh 180 kg.

Forest & Kim Starr

Purple flowers and slightly lobed leaves of kudzu.

Mikania vine—*Mikania micrantha*

Mikania vine is listed as one of the top 100 worst environmental weeds in the world (GISD, 2024). However, its distribution is Australia is limited: it is recorded only in coastal northern Qld and Christmas Island. Nonetheless, it is important to be on the lookout for new infestations because of the species' invasiveness in other countries.

Key ID characteristics:

- oppositely arranged heart-shaped to triangular leaves with toothed margins
- flowers in fluffy white clusters that grow out of the leaf axils or at the end of branches.

© M. Fagg 2012

Leaves and flowers of mikania vine.

Morning glories—*Ipomoea* spp.

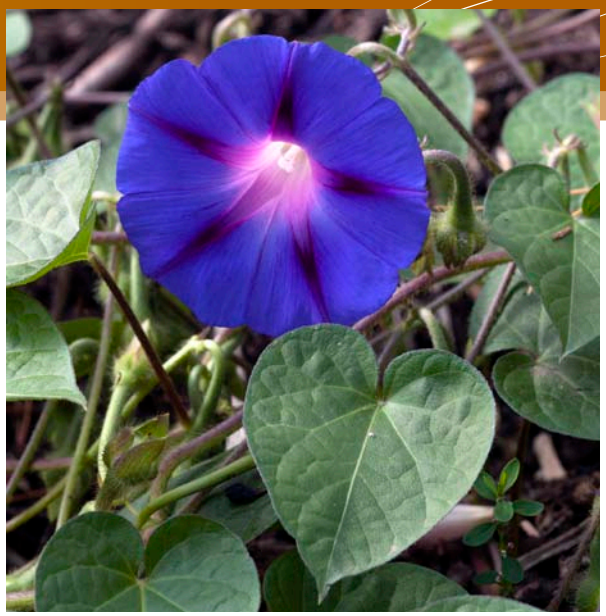
Multiple morning glory species are present in Australia as invasive vines. The main ones that threaten biodiversity are coastal morning glory (*Ipomoea cairica*), common morning glory (*I. purpurea*) and morning glory (*I. indica*). All morning glory species have showy trumpet-like flowers that differ in colour between species.

Coastal morning glory (*Ipomoea cairica*) is widely spread across eastern Australia, and less so in WA. It invades disturbed forests and riparian areas. It has:

- pink flowers
- palmate (hand-shaped) leaves with 5–7 points.

R.C.H. Shepherd

*Coastal morning glory (*I. cairica*) leaves with five finger-like lobes and pink flowers.*



© M. Fagg 2009

*Purple flowers and heart-shaped leaves of common morning glory (*I. purpurea*).*

Common morning glory (*Ipomoea purpurea*) is an annual climber mainly found in temperate and subtropical coastal NSW and Qld. It has:

- hairy stems
- large (10 cm wide) heart-shaped leaves
- deep purple flowers with a pale throat.

Morning glory (*Ipomoea indica*) is mainly found in coastal NSW and Qld, though there are records of populations in all states except NT and ACT. It has:

- 3-pointed lobed leaves
- purple flowers with a pink centre.

R.G. & F.J. Richardson

*Purple flowers and 3-lobed leaves of morning glory (*I. indica*). Note the pink centre of these flowers compared with the white centre seen in common morning glory (*I. purpurea*) (above).*

Other *Ipomoea* species that are potential threats to biodiversity include *I. alba*, *I. quamoclit*, *I. hederifolia* and *I. triloba*.

Moth vine—*Araujia sericifera*

Moth vine is a common weed in NSW and South East Qld, and is also naturalised in Vic, SA and south-western WA. It grows up to 5 m into the canopy. All parts of moth vine are poisonous to humans and livestock.

Key ID characteristics:

- leaves are spear shaped, 3–12 cm long and 1–6 cm wide
- undersides of the leaves are pale green to white with a dense covering of tiny hairs, producing a felty texture. The tip of the leaf is usually twisted
- fruit are large and resemble chokos (though are toxic), and contain many wind-dispersed seeds.

Leaves and choko-like fruit of moth vine.

Flower of moth vine.

Moth vine is very similar in appearance to the native milk vine (*Leichhardtia rostrata*) but can be differentiated by the underside of the leaves: milk vine has hairless, glossy undersides, unlike the hairy undersides of moth vine leaves.

Native milk vine leaves and flowers.

Passionfruits—*Passiflora spp.*

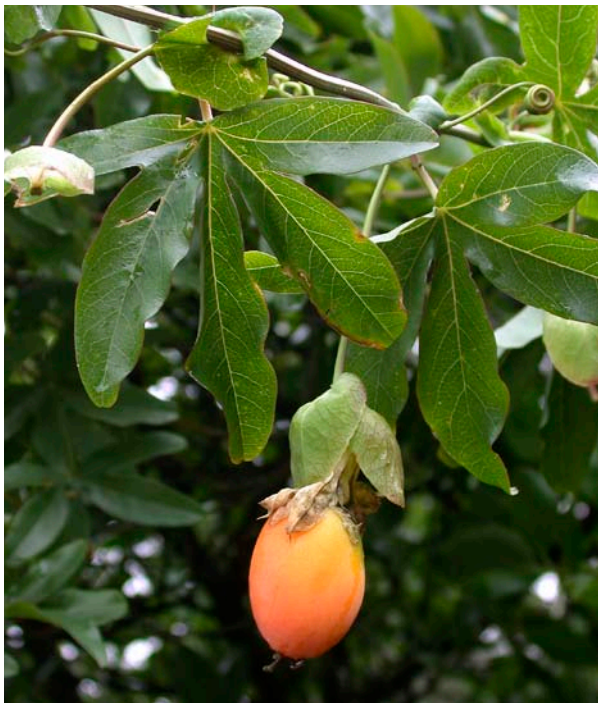
There are multiple *Passiflora* species present in Australia, with some native and some exotic. The main exotic weeds are:

- blue passionfruit (*P. caerulea*).
- corky passionfruit (*P. suberosa*)
- stinking passionfruit (*P. foetida*)
- white passionfruit (*P. subpeltata*).

All *Passiflora* species are tendril climbers and usually have lobed leaves on long leaf stalks, though they show variation in most other characteristics. Identification of *Passiflora* species can primarily be undertaken through examination of leaf characteristics, the presence of glands along leaf stalks, stipules and the colour and size of flowers and fruits.

Blue passionfruit is primarily present along the edges of rainforests and disturbed sites, from South East Qld along the coast through NSW, Vic, SA and Tas. It has:

- leaves with 5 deep, rounded lobes
- 2–4 glands in the middle of the leaf stalk
- leafy stipules, 1–2 cm long
- flowers 6–8 cm wide, blue to purple
- fruit 6 cm long, yellow to orange.



R.G. & F.J. Richardson

The five-lobed leaves and orange fruit of blue passionfruit.

R.G. & F.J. Richardson

M. Fagg 2013

Blue passionfruit has striking flowers (left) and leafy stipules.

Corky passionfruit invades the edge of forests and other disturbed areas from north of Wollongong, NSW to north Qld and across to Darwin, NT. It has:

- mature stems that are corky; younger stems are slender and herbaceous
- leaves with three pointy lobes
- 2 raised glands in the middle of the leaf stalk
- smaller flowers and fruit than most other *Passiflora* species (both around 15 mm in diameter).

© M. Fagg 2013

Flower, fruit and 3-lobed leaves with pointy tips of corky passionfruit.

Adam Bernich

The corky stem of a mature corky passionfruit.

Stinking passionfruit is a major weed in the north-west of Australia (Webber et al. 2014), where it overtops trees up to 14 m in height and can form mats of stems along the ground that are over 80 cm thick and contain up to 1 km of stems in 1 m^2. It also occurs in tropical and subtropical coastal regions of WA, NT and Qld. It has:

- shallow, rounded-lobed leaves (3 lobes)
- no glands on the leaf stalk
- hairy stems, often rusty in colour
- flowers 3–5 cm wide, white to purple
- fruit 2 cm in diameter, hairy and yellow.

Hairy fruit of stinking passionfruit.

Stinking passionfruit flower and 3-lobed leaf.

White passionfruit is widespread in coastal eastern Australia, from Rockhampton, Qld to Ulladulla, NSW; primarily growing on the margins of rainforests and other disturbed areas. It has:

- leaves with 3 deep lobes with rounded ends
- 1–3 glands along the leaf stalk and leafy stipules
- white flowers, 5 cm in diameter
- green fruit, 4 cm long.

White passionfruit flower.

Fruit and 3-lobed leaves of white passionfruit.

Other exotic *Passiflora* species include edible passionfruit (*P. edulis*), banana passionfruit (*P. tarminiana*) and crimson passionfruit (*P. morifolia*).

WoNS
WEEDS OF NATIONAL SIGNIFICANCE

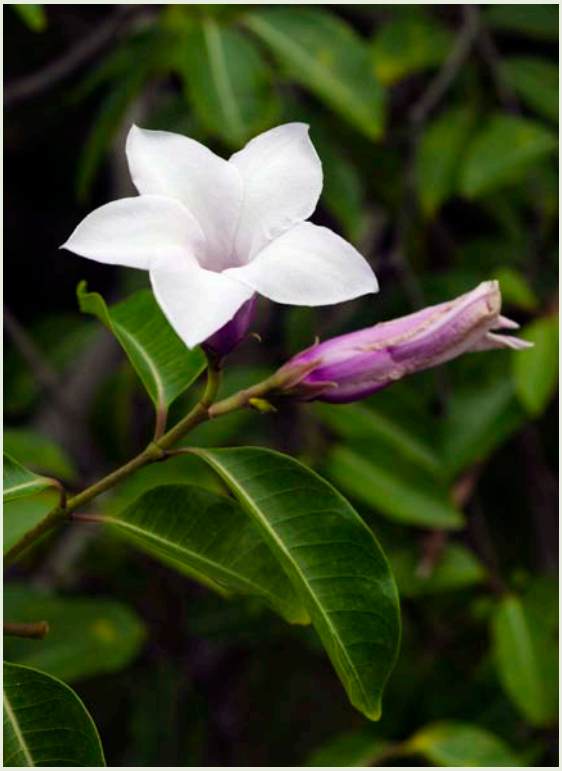
Rubber vine—*Cryptostegia grandiflora*

A woody shrub or climber that can reach 30 m into the canopy. It forms dense thickets that can damage and kill native vegetation, as well as restrict the movement of animals and people. It is mainly found in tropical northern Australia, in WA, NT and Qld. There have also been infestations found in Central and South East Qld. Rubber vine is listed as a WoNS. Best practice management methods can be found at weeds.org.au/profiles/rubber-vine-rubbervine/.

Key ID characteristics:

- oval-shaped leaves that are glossy, dark green and have reddish-purple stalks
- flowers that are trumpet shaped with 5 white to purple petals
- paired seed pods that are 12 cm long, 4 cm wide and rigid.

Rubber vine invading and killing native vegetation.



Rubber vine flowers.

Paired seed pods of rubber vine.

Silverleaf desmodium—*Desmodium uncinatum*

Silverleaf desmodium is a weed of disturbed areas. In Australia it is mainly found in South East Qld and north-eastern NSW. It has a dense covering of hooked hairs on its stems, which allows it to attach to surfaces, including clothing.

Key ID characteristics:

- compound leaves with 3 leaflets, 2–10 cm long and 1–6 cm wide
- distinct silver stripe on upper surface of leaflets
- flowers clustered in spikes towards the end of stems
- seed pods slightly curved, 1–3 cm long and covered in hooked hairs.

Sheldon Navie

Silverleaf desmodium trifoliate leaves with distinct silver stripe.

Sheldon Navie

Flowers of silverleaf desmodium.

Turbine vine—*Turbina corymbosa*

Turbine vine is a perennial, scrambling vine growing to at least 8 m in height. It was introduced as an ornamental plant and is becoming a serious problem in North Qld, where it establishes at rainforest margins and along waterways, displacing native vines and shrubs.

Key ID characteristics:

- heart-shaped leaves, alternately arranged
- clusters of white, tubular flowers usually with dark reddish-purple or dark brownish coloured throats
- fruit are papery, oval capsules with a short beak at end, along thin dead stems
- mature stems are woody, deeply fissured and rope like.

Turbine vine flowers.

© Centre for Australian National Biodiversity Research 1998

Turbine vine leaves.

Turbine vine fruit.

Matt Sheehan

Turbine vine mature twisted stems.

Turkey rhubarb—*Rumex sagittatus*

Turkey rhubarb is a vigorous scrambling vine, found in coastal regions of eastern Australia. It spreads via masses of windblown seeds.

Key ID characteristics:

- arrow-shaped leaves, 6–10 cm long and 3–5 cm wide
- ribbed stems, red or green
- fruit is small and surrounded by papery wings that have a pinkish edge; large numbers of fruit can be seen during fruiting.

R.G. & F.J. Richardson

Leaf (left) and ribbed stem (right) of turkey rhubarb.

R.G. & F.J. Richardson

Turkey rhubarb fruit.

Native species

Some species of native vine can form dense thickets under the right conditions, and thus appear 'weedy'. It is important to be able to identify native vines and scramblers. They can sometimes dominate degraded sites and their impact on other plants may need to be considered in the planning stage and during restoration efforts. Some common native vine species known to reach high abundance are detailed below.

Austral sarsaparilla, lawyer vine, barbwire vine—*Smilax australis*

Austral sarsaparilla is a common semi-woody vine found around coastal Australia, in Vic, NSW, Qld, NT and north-eastern WA. It grows up to 8 m long and can be abundant with many prickly stems trailing between plants, making it very difficult to walk through dense thickets.

Key ID characteristics:

- tough leaves with five longitudinal veins
- coiled tendrils
- green prickly stems
- berries clustered in umbrella-shaped inflorescence, turning black with age.

© M. Fagg 1987

Fruit and leaves of Austral sarsaparilla.

Common silkpod—*Parsonsia straminea*

Common silkpod is a large woody vine found in NSW and Qld. It is present and abundant in many vegetation communities but is most associated with Swamp Oak Forests. It begins to climb using aerial roots, and larger individuals twine.

Key ID characteristics:

- adult leaves oval-shaped, 4–24 cm long and 2–8 cm wide; juvenile leaves 1–5 cm long with a round or heart-shaped base and a purplish colour
- fruit is a long (10–20 cm) green capsule filled with a large number of windblown seeds.

Common silkpod adult leaves.

Common silkpod fruit.

Kangaroo vine—*Cissus antarctica*

Kangaroo vine is a large woody vine that grows vigorously and has large stems often greater than 5 cm in diameter, and sometimes more than 15 cm in diameter. It is common in warmer rainforests north of Tathra in NSW, often in high abundance and biomass.

Key ID characteristics:

- leaves alternately arranged and serrated, 4–12 cm long and 2–5 cm wide
- tendrils opposite to leaves
- fruit is a purple berry, 15 mm in diameter.

Native grape—*Cayratia clematidea*

Native grape is a slender herbaceous climber up to 10 m long. It is often seen in disturbed areas such as rainforest edges, usually in high abundance. Present in coastal NSW and Qld.

Key ID characteristics:

- compound leaves (5 leaflets)
- branched tendrils opposite leaves
- fruit a small, black berry.

Kangaroo vine leaves and tendrils.

Native grape flowers and leaves.

Snake vine—*Stephania japonica* var. *discolor*

Snake vine is a slender twiner with woody stems. It occurs in coastal NSW and Qld, and is also present in Eastern Asia.

Key ID characteristics:

- shield-shaped leaves, almost triangular in shape
- leaf stalk attached to the underside of the leaf, not the leaf edge.

Snake vine fruit and leaves.

Wonga wonga vine—*Pandorea pandorana*

Wonga wonga vine is a common native woody climber with stems as large as 10 cm in diameter. It is distributed throughout coastal NSW and inland, often in rainforests, moist areas of sclerophyll forests, as well as rocky sites.

Key ID characteristics:

- compound leaves with 3–9 leaflets
- leaflet margins entire in adult plants, though bluntly toothed and 'fern like' in juveniles
- inflorescences have white flowers often with purple blotches.

Wonga wonga vine leaves and flowers.

Legal requirements to control cat's claw creeper and Madeira vine

The table below provides an overview of the declaration status and management requirements of cat's claw creeper and Madeira vine throughout Australia (as at April 2024).

State/ Territory	Legislation	Declaration	Goals/Actions
Australian Capital Territory	*Pest Plants and Animals Act 2005*	Declared Schedule 1	Both Madeira vine and cat's claw creeper are prohibited and must be suppressed. Madeira vine is a notifiable pest plant in the ACT.
New South Wales	*Biosecurity Act 2015*	Declared	All of NSW: Both species must not be imported into the state, sold, bartered, exchanged or offered for sale. General biosecurity duty to ensure a biosecurity risk is prevented, eliminated or minimised, so far as is reasonably practicable. Regional strategic weed management priorities vary throughout the state for both species (see detail below).
			Cat's claw creeper regional priorities: Asset protection in Central West, Greater Sydney, Hunter and North West, eradication in the South East. Refer to Weed Wise for further detail on regional requirements: weeds.dpi.nsw.gov.au/Weeds/CatsClawCreeper
			Madeira vine regional priorities are eradication in the Central Tablelands and asset protection in the North West. Refer to Weed Wise for further detail: weeds.dpi.nsw.gov.au/Weeds/MadeiraVine
Northern Territory	*Weeds Management Act 2001*	Declared Class A and C	Cat's claw creeper is a Class A (to be eradicated) and Class C (not to be introduced) weed in all parts of the Northern Territory. It is illegal to grow, sell, transport or use a declared species in the NT.
		Declared Class C	Madeira vine is a Class C weed, not to be introduced to the Territory.
Queensland	*Biosecurity Act 2014*	Declared Category 3 – restricted	Both species must not be given away, sold or released into the environment. The Act requires everyone to take all reasonable and practical steps to minimise the risks associated with invasive plants under their control. Local government biosecurity plans detail requirements at the local level.
South Australia	*Landscape South Australia Act 2019*	Declared Category 2	Both species are declared to prohibit sale and movement anywhere in South Australia. This includes the sale of nursery stock, seeds or other propagating material.
Tasmania	*Biosecurity Act 2019 and Biosecurity Regulations 2022*	Declared	The importation, sale and distribution of both species is prohibited in Tasmania. The legal responsibilities of landholders and other stakeholders in dealing with these species are laid out in the relevant Weed Management Plans. See nre.tas.gov.au/invasive-species/weeds/weeds-index/declared-weeds-index/cats-claw-creeper and nre.tas.gov.au/invasive-species/weeds/weeds-index/declared-weeds-index/madeira-vine for more information. Report any cat's claw creeper or Madeira vine plants (or suspected plants) to Biosecurity Tasmania.
Victoria	*Catchment and Land Protection Act 1994*	Declared Schedule 2	Both species are restricted weeds in the whole of the State. Restricted weeds pose an unacceptable risk of spreading and are a serious threat to another state or territory of Australia. Trade in these weeds and their propagules (either as plants, seeds or contaminants in other materials) is prohibited.
Western Australia	*Biosecurity and Agricultural Management Act 2007*	Declared C1 Prohibited – s12	Cat's claw creeper should be excluded from all of Western Australia. It may only be imported and kept subject to permits.
		Permitted – s11	Madeira vine is permitted entry for the **whole of state** and is currently not assigned to any control category for a local government area.

Herbarium contact details

	Phone	Email	Website
ACT	(02) 6246 5084	canbr-info@anbg.gov.au	cpbr.gov.au/cpbr/herbarium
NSW	(02) 9231 8111	feedbackRrbgsyd@rbgsyd.nsw.gov.au	rbgsyd.nsw.gov.au/Science-Conservation/Herbarium
NT	(08) 8999 4516 (Darwin) (08) 8951 8791 (Alice Springs)	herbarium@nt.gov.au	nt.gov.au/environment/native-plants/native-plants-and-nt-herbarium
Qld	(07) 3199 7699	Queensland.Herbarium@qld.gov.au	qld.gov.au/environment/plants-animals/plants/herbarium
SA	(08) 8222 9311	stateherbsa@sa.gov.au	environment.sa.gov.au/topics/science/science-research/state-herbarium
Tas	(03) 6226 2635	herbarium@tmag.tas.gov.au	tmag.tas.gov.au/collections_and_research/tasmanian_herbarium
Vic	(03) 9252 2300	rbg@rbg.vic.gov.au	rbg.vic.gov.au/science/herbarium/
WA	(08) 9219 8000	herbarium@dpaw.wa.gov.au	dbca.wa.gov.au/science/research-tools-and-repositories/western-australian-herbarium

Weed control and biodiversity management contacts

	Organisation	Phone	Email	Website
National	Department of Agriculture, Fisheries and Forestry	1800 900 090	Online enquiry: agriculture.gov.au/about/contact/online-enquiry	agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/weeds
	Department of Climate Change, Energy, the Environment and Water	1800 920 528	Online enquiry: dcceew.gov.au/about/contact	dcceew.gov.au/environment/invasive-species
	Weeds Australia	–	–	weeds.org.au
ACT	Environment, Planning and Sustainable Development Directorate – Environment	13 22 81	ACTBiosecurity@act.gov.au	environment.act.gov.au/parks-conservation/plants-and-animals/biosecurity/invasive-plants
NSW	Department of Primary Industries and Regional Development	1800 680 244	weeds@dpi.nsw.gov.au	dpi.nsw.gov.au/biosecurity/weeds
	Department of Climate Change, Energy, the Environment and Water - Environment and Heritage	(02) 9995 5000	info@environment.nsw.gov.au	environment.nsw.gov.au/topics/animals-and-plants
	Local Land Services	1300 795 299	lls.nsw.gov.au/i-want-to/contact-my-local-office/online-customer-inquiry-form	lls.nsw.gov.au
NT	Department of Lands, Planning and Environment	(08) 8999 4567	weedinfo@nt.gov.au	nt.gov.au/environment/weeds nt.gov.au/environment/native-plants
Qld	Department of Primary Industries	13 25 23	info@daf.qld.gov.au	daf.qld.gov.au/business-priorities/biosecurity/invasive-plants-animals/plants-weeds
	Department of the Environment, Tourism, Science and Innovation	13 74 68	desi.qld.gov.au/contactus/feedback-forms/feedback-form-enquiry	environment.desi.qld.gov.au/
	NRM Regions Queensland	0419 790 943	admin@nrmrq.org.au	nrmrq.org.au/
	Local Government Association of Queensland	1300 542 700	ask@lgaq.asn.au	lgaq.asn.au

Table continued on next page/…

	Organisation	Phone	Email	Website
SA	Department of Primary Industries and Regions	(08) 8303 9620	invasivespecies@sa.gov.au	pir.sa.gov.au/biosecurity/weeds
	Department for Environment and Water	(08) 8204 1910	environment.sa.gov.au/contact-us	environment.sa.gov.au/
	Landscape SA	Search the website for contact details of your local Landscape Board		landscape.sa.gov.au/
Tas	Department of Natural Resources and Environment Tasmania	1300 368 550	Biosecurity.Tasmania@nre.tas.gov.au	nre.tas.gov.au/invasive-species/weeds nre.tas.gov.au/environment
Vic	Agriculture Victoria	13 61 86	Refer to: agriculture.vic.gov.au/about/contact-us	agriculture.vic.gov.au/biosecurity/weeds/weeds-information
	Department of Energy, Environment and Climate Action		deeca.vic.gov.au/our-department/contact-us	deeca.vic.gov.au
WA	Department of Primary Industries and Regional Development	1300 374 731	enquiries@dpird.wa.gov.au	agric.wa.gov.au/pests-weeds-diseases/weeds
	Department of Biodiversity, Conservation and Attractions	(08) 9219 9000	dbca.wa.gov.au/contact	dbca.wa.gov.au

Table 6.1 Herbicides registered for use on cat's claw creeper and Madeira vine.

Application method	Active ingredient	Commercial product	Rate	Situation	State or territory	Comments
Stem injection	Aminopyralid + picloram (4.47 + 44.7 g/L)[4] gel product	Vigilant® II gel	Immediately apply a 3–5 mm layer	Non-crop areas, including native vegetation, conservation areas, gullies, reserves and parks	All	Large plants: Cut a series of blazes 15–20 mm deep around main trunks of the tree using an axe or pruning saw. Blazes should be evenly spaced with no more than a 20–40 mm gap between blazes. Use and squeeze the brush-bottle, as the applicator, to apply a 5 mm layer of Vigilant® II over the lower cut surface of the blaze.
Cut stump						Small plants: Cut stems horizontally 20 mm, and preferably no higher than 100 mm, above ground level. Use and squeeze the brush-bottle, as the applicator, to apply a 3–5 mm thick layer of Vigilant® II over the cut surface remaining on the plant. On stems of 20 mm diameter or greater, use and squeeze the brush-bottle, as the applicator, to apply a 5 mm thick layer of gel. In the case of multi-stem plants, treat at least 80% of stems including all main stems. Picloram and aminopyralid can remain active in the soil for extended periods depending on rate of application, soil type (clay content), rainfall, temperature, humidity, soil moisture and soil organic matter. Following application of this product, the localised regeneration or establishment of sensitive species may be adversely affected by soil residues.
Basal bark	Fluroxypyr (333 g a.i./L)[2]	Starane® Advanced Herbicide	2.1 L/100 L diesel or Biosafe only	Agricultural non-crop areas, commercial & industrial areas, forests (including softwood plantations), pastures and rights of way	All	Always treat vines away from the host tree as injury to the host tree may occur.
Foliar			300 mL/100 L water high volume			

Table 6.2 Herbicides permitted for use on cat's claw creeper and Madeira vine.

Permit holder	Situation	Active ingredient	Commercial products[1]	Rate	Application	Comments
Permit PER13914 Control of Madeira vine and cat's claw creeper in riparian zones. Expires 31 March 2026. NSW & Queensland only. Can be used by persons generally. 						
NSW Department of Primary Industries	Riparian zones	Triclopyr + picloram (300 + 100 g/L)[4]	Nufarm Conqueror®	400 mL/ 100 L water	Foliar spray	Apply by high volume handgun to vines on the ground. Cat's claw creeper is difficult to detach so juvenile vines attached to the host can be sprayed with the mixture providing no spray comes into contact with the hosts' leaves. Spraying may be required once per year for cat's claw creeper and up to three times per year for Madeira vine. DO NOT use within 5 m of a waterway. DO NOT use the product near desirable vegetation. DO NOT allow spray to drift onto non-target species and sensitive areas including, but not limited to, natural streams, rivers, wetlands or waterways. Minimise spray drift using very coarse to coarse droplets by reducing pressure to 500 kPa (approx. 5 Bar) and using large nozzle plates in the handgun.
		Triclopyr + picloram + aminopyralid (300 + 100 + 8 g/L)[3]	Grazon® Extra Herbicide			

Permit holder	Situation	Active ingredient	Commercial products[1]	Rate	Application	Comments
Permit PER9907 Control of environmental and noxious weeds in areas of native vegetation, non-crop areas and public open spaces.* Expires 31 March 2025. NSW & ACT only. Can be used by persons generally. 						
NSW Office of Environment & Heritage	Forests including native vegetation areas, bushland reserve areas, national park areas and non-cropland (including rights of way, commercial and industrial areas, domestic and urban areas, public service areas and botanic gardens)	Glyphosate (360 g/L) only	Weedmaster® Duo	1:1.5 with water to undiluted herbicide	Cut stump, basal bark spray or cut/scrape and paint	Follow the label. Re-apply according to rate of weed growth and re-infestation. These herbicides have no residual soil activity when used at label rates.
		Glyphosate 360 g a.i./L + metsulfuron-methyl 600 g a.i./kg	Weedmaster® Duo and Brush-Off®	Tank mixes of 1:1.5 glyphosate + 1 g metsulfuron-methyl per 1 L water	Cut-and-paint	
		Fluroxypyr (333 g a.i./L)	Starane® Advanced Herbicide	21 mL per 1 L diesel/kerosene	Basal bark spray	
		Fluroxypyr (200 g a.i./L)	Nufarm Comet 200 Herbicide	35 mL per 1 L diesel/kerosene	Basal bark spray	
		Fluroxypyr (333 g a.i./L)	Starane® Advanced Herbicide	300–600 mL per 100 L water; or 3–6 L/ha; or label rate for specific weed	Spot spray	
		Metsulfuron-methyl 600 g a.i./kg	Brush-Off®	10–20 g per 100 L water plus surfactant	Spot spray	

Permit holder	Situation	Active ingredient	Commercial products[1]	Rate	Application	Comments
Permit PER11916 Control of various weeds in urban bushland, forests and coastal areas. Expires 31 March 2025. NSW only. Can be used by persons generally.						
NSW Department of Primary Industries	Urban bushland Forests Coastal reserves	Glyphosate (360 g/L) only Approved for use in aquatic areas only	Weedmaster® Duo	1:50 water surfactant	Spray seedlings	For the control of weeds at coastal reserves only, registered products that are approved for use in aquatic areas may be used. For the control of weeds in non-aquatic areas such as urban bushland and forests, any registered product containing 360 g/L glyphosate as the only active constituent may be used.
				1:1.5 with water	Cut stump/ scrape stem/inject	
				1:100 water + surfactant	Spray (to kill regrowth)	
				Undiluted	Cut stump/ scrape stem/ inject	
Permit PER14249 Control of various environmental weeds in national parks and nature reserves. Expires 31 March 2025. NSW & ACT only. Used only by staff or contractors employed/contracted by NSW Department of Planning, Industry and Environment and agencies/organisations represented on NSW Regional Weed Committees and staff or contractors employed by the ACT Government, who are qualified and experienced in the handling and use of agricultural chemicals.						
NSW National Parks & Wildlife Service	Areas of native vegetation and non-cropland areas	Triclopyr + picloram (300 + 100 g/L)[3]	Nufarm Conqueror®	250 to 500 mL / 100 L water	Spray thoroughly	A maximum number of three applications per year is permitted with a minimum re-treatment interval of 60 days between consecutive applications. Apply to the foliage of target species via knapsack or handgun. Use higher rates for larger plants. Apply to plants less than 1.5 m tall. Apply from October to May unless stated otherwise.
		Triclopyr + picloram + aminopyralid (300 + 100 + 8 g/L)[3]	Grazon® Extra Herbicide			

Permit holder	Situation	Active ingredient	Commercial products[1]	Rate	Application	Comments
Permit PER11463 Control of environmental weeds in non-crop areas. Expires 30 April 2027. Queensland only. Can be used by persons generally.						
Biosecurity Queensland	Non-agricultural areas, domestic and public service areas, commercial and industrial areas, bushland/ native forests, roadsides, rights of way, vacant lots, wastelands, wetlands, dunal and coastal areas	2,4-D 300 g/L[2]	Conquest Amine 300 Selective Herbicide	Up to 95 mL / 15 L water or up to 625 mL / 100 L water or up to 6.25 L/ha	Spot spray	Refer to product label for critical use comments.
		2,4-D 300 g/L + picloram 75 g/L	Tordon 75-D Herbicide	Up to 150 mL / 15 L water or up to 1 L / 100 L water	Spot spray	Apply using a minimum of 1500 L/ha water. Use a wetting agent as per label instructions for non-crop situations. Consult label for critical use comments.
		Dicamba 500 g/L	Kamba 500 Selective Herbicide	Up to 130 mL / 15 L water or up to 600 mL / 100 L water or up to 8.8 L/ha	Spot spray	Apply using a minimum of 1500 L/ha water. Use a wetting agent as per label instructions for non-crop situations. Consult label for critical use comments.
		Diesel	N/A	Sufficient amount as required to treat target weeds	Paint or spot spray crowns	
		MCPA 500 g/L	Nufarm MCPA 500 Selective Herbicide	75–150 mL / 15 L water or 500 mL–1 L / 100 L water or 5–10 L/ha	Spot spray	Add a wetting agent as per label instructions.
		Triclopyr 200 g/L + picloram 100 g/L + aminopyralld 25 g/L OR Triclopyr 200 g/L + picloram 100 g/L	Tordon Regrowth Master Herbicide OR Apparent Slogger Herbicide	75 mL / 15 L water or 500 mL / 100 L water	Spot spray	Spot spray where residual weed control is required away from waterways.
				1 L / 4 L water	Drill, frill, axe or stem injection	
				750 mL / 15 L water	Cut stump	Cut stumps to less than 10 cm above the ground and immediately paint stump after cutting OR spot spray cut stump.

Biosecurity Queensland continued on next page/. . .

Permit holder	Situation	Active ingredient	Commercial products[1]	Rate	Application	Comments
Biosecurity Queensland continued/. . .	(see previous page)	Triclopyr 240 g/L + picloram 120 g/L	Access	250 mL per 15 L in diesel or other suitable carrier as per product label general instructions	Cut stump Basal bark	Either paint stump immediately after cutting OR paint OR spray basal bark.
				1 L per 10 L diesel.	Basal bark	Thinline application method: Spray the bark around the stem from ground level up to 5 cm high. Refer to product label for further instruction.
		Triclopyr 300 g/L + picloram 100 g/L + aminopyralid 8 g/L OR Triclopyr 300 g/L + picloram 100 g/L	Grazon Extra OR Conquerer	53–75 mL / 15 L water or 350–500 mL / 100 L water	Spot spray	Spot spraying where residual weed control is required. Add a wetting agent or spray oil according to label instructions.
				350–500 mL / 10 L water plus wetting agent	Foliar application	Low volume / high concentration application; e.g. Drench, splatter gun, sprinkler sprayer or gas-powered gun. Refer to product label for appropriate wetter. Read product label thoroughly.
		Triclopyr 600 g/L[3]	Garlon 600	50 mL / 15L water or 330 mL / 100 L water	Spot spray	
				17 mL per 1 L diesel, kerosene OR Biosafe	Basal bark Cut stump	
		Glyphosate 360 g/L	Roundup	10 mL/L	Spot spray	Apply to healthy, actively growing vines only. Apply as a foliar application, up to twice a year. Apply only when supporting plant and understory is dead. Apply early autumn (March-April). Do not spray beyond point of run off.
				1 part product to 2 parts water (e.g. 10 mL in 20 mL water)	Cut stump	Apply as cut stump application, in spring to summer, before tubers proliferate. Apply second application if necessary.

Permit holder	Situation	Active ingredient	Commercial products[1]	Rate	Application	Comments
Permit PER82307 Control of environmental and declared noxious weeds in areas of native vegetation, bushland reserves and revegetation areas, non-crop areas and open public spaces. Expires 31 August 2027. Queensland only. Can be used by persons generally. 						
Council of the City of Gold Coast	Forests including native vegetation areas, bushland reserves, revegetation areas, national park areas and non-cropland (including rights of way open spaces commercial and industrial areas domestic and urban areas public service areas and botanic gardens)	Glyphosate (360 g a.i./L)	Weedmaster® Duo OR Roundup bioactive	1:1.5 with water to undiluted herbicide	Cut stump; cut, scrape and paint; scrape and paint	Re-apply according to rate of weed growth and re-infestation. Only products registered for use in aquatic situations may be used in aquatic situations under this permit.
		Glyphosate (360 g a.i./L) + metsulfuron-methyl (600 g a.i./kg)	Weedmaster® Duo + Associate®	Tank mixes of 1:1.5 glyphosate + 1 g metsulfuron-methyl per 1 L water		
Permit PER87321 Control of Madeira vine in non-agricultural bushland/natural ecosystems. Expires 31 May 2025. NSW only. Council officers, contractors or bushcare volunteers acting under the direction of a NSW local government council only. 						
City of Parramatta Council	Bushland / natural ecosystems (non-agricultural)	Glyphosate (360 g/L) only	Weedmaster® Duo	1:1 with water	Cut and immerse stem for prolonged herbicide uptake	Sever primary feeder stems near ground line and insert the cut stem into a labelled and dedicated receptacle containing a mixture of glyphosate 360 g/L herbicide and water in the ratio of 1:1. This herbicide receptacle is placed inside a secured, chained and locked storage box. The receptacle should be monitored and replenished with herbicide solution on an as-needed basis, which is dependent on plant uptake – this usually lasts for 7 days when the solution is no longer taken up from the container. DO NOT make more than one (1) application.

Permit holder	Situation	Active ingredient	Commercial products[1]	Rate	Application	Comments
Permit PER10533 Control cat's claw creeper in pasture and non-crop situations. Expires 21 July 2028. Queensland only. Can be used by persons generally.						
Biosecurity Queensland	Pastures and non-crop situations	Glyphosate (360 g/L) only	Weedmaster® Duo	83 mL/1 L water	Cut stump	Ensure vines are actively growing at time of treatment and not under stress of drought, waterlogging or cold conditions. Cut vine close to ground and immediately wet stump surface thoroughly using splatter gun, spray, swab or brush. Remove any branches on the stump and treat any cut surface.
		Dicamba (500 g/L) only	Kamba® 500 Selective Herbicide	33 mL/1 L water		
		Glyphosate (360 g/L) only	Weedmaster® Duo	10 mL/ 1 L water	Foliar spray	Ensure vines are actively growing at time of treatment and not under stress of drought, waterlogging or cold conditions. Apply to vines up to 2 m in height by high volume application using calibrated knapsack or handgun. Spray to wet foliage ensuring complete coverage over top of growing terminals.
		Dicamba (500 g/L) only	Kamba® 500 Selective Herbicide	4 mL/1 L water		

[1] Commercial products listed here are examples only; visit apvma.gov.au.

[2] Products containing different concentrations of the active ingredients are registered for this use; for example, products containing the active fluroxypyr are available at 200, 333 and 400 g/L concentrations. Check the permit/label for rates.

[3] Picloram and aminopyralid remain active in soil for extended periods and may leach into groundwater. Avoid high application rates where possible.

* When interpreting permits for declared or environmental weeds only, refer to 'vines' in the weed column of the tables when determining herbicide and rate.

NOTE: Not all currently registered herbicides are commercially available. Check the company website for a current label.

NOTE: Herbicides are not to be used for any purpose or in any manner contrary to the label unless authorised under appropriate legislation. By law, you must read the label (or have it read to you) before using any herbicide product. The same applies for minor use permits. Always follow the label and permit directions.

SAFE USE OF HERBICIDES FACTSHEET

Herbicide labels and legislation

The Australian Pesticides and Veterinary Medicines Authority (APVMA) regulates the availability of all pesticides, including herbicides. Herbicides are registered with the APVMA for specific applications as stated on the label, and state or territory governments regulate the use of herbicides after sale. A herbicide label is a legal document that defines where, when and how a herbicide may be used, on which weed species and at what rate. This is referred to as 'on label' use.

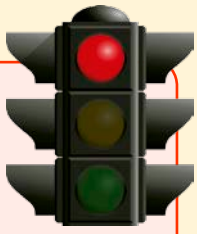
By law, you must read the label (or have it read to you) before using any herbicide product.

Table 6.1 provides information on herbicides registered for use on cat's claw creeper and Madeira vine (current at time of publication).

Off-label use

Off-label use is the use of a registered chemical to address a specific issue that is not covered by an APVMA-approved label or permit, such as to control a different weed, to protect a different host (such as a crop) or to apply at a different rate or frequency.

Off-label use is permitted in all states and territories; however, conditions vary in each jurisdiction. For more information and advice, refer to Chapter 6 for state and territory government contact details.



Warning!

Off-label practices DO NOT exclude or override product maximum residue limits, work health and safety or environmental safety.

If intending to use the product off-label, the user must consider the rate of pesticide, the time and frequency of application, the likelihood of residues and the potential for worker exposure.

'Off-label use' does not override Directions for Use 'DO NOT' statements on labels and permits, such as 'DO NOT use in the urban home garden' or 'DO NOT use if rain is likely to fall within 12 hours of application'.

The pesticide manufacturer is not liable for off-label use of its product.

Minor use and emergency use permits

The APVMA may issue minor use and emergency use permits for herbicide applications that are not otherwise registered for that particular use. Minor use permits can also be referred to as 'off-label' permits. Minor use and emergency permits are valid ('in force') for a limited time. See the APVMA website to find current permits.

Some states/territories also have permits for declared weed control but may not specifically list the weed species to be controlled. These permits will often list a range of herbicides that can be used for declared or environmental weed control.

Table 6.2 provides a summary of permits for use on cat's claw creeper and Madeira vine (current at time of publication).

To find current permits for your state/territory go to:

- the APVMA permits search
- enter 'declared weeds' or 'environmental weeds' in the 'key words' box
- click the search term 'Pest/purpose'
- click 'Search'.

If you are unsure which herbicides can legally be used on a particular weed in your state/territory, contact the relevant section of your agriculture department (refer to the 'Herbicides and the law' contacts section of this chapter).

Safe use of herbicides

Take care to minimise off-target herbicide damage to desired plants and animals, the environment, yourself and other workers.

Operator safety

Herbicide labels will indicate the personal protective equipment (PPE) required for operator safety. This may include:

- impervious gloves
- eye protection
- respirator (with a filter appropriate to the level of herbicide toxicity)
- clothes, hat and boots that cover the whole body.

For herbicides with a higher risk to operator safety, additional PPE and precautions may apply, including wearing a full-face respirator and chemical-resistant overalls.

NESP Resilient Landscapes Hub

Always follow the herbicide label requirements and consult the Safety Data Sheet on the health risks of exposure and PPE recommendations.

Withholding periods

Certain herbicides have withholding periods, during which livestock must be excluded from grazing treated areas, and cutting pastures for hay or silage should be avoided. Do not introduce stock within the withholding period stipulated by the product label.

Environmental protection

Herbicide labels provide the mandatory measures an operator should adopt to protect the environment and non-target plants during product use. This may include instructions for preventing spray drift.

Herbicide users have a legal obligation to avoid spray drift damage and to ensure that the applied chemical stays within the target area. This is to avoid 'off-target' impacts to crops, native vegetation and other plants, and 'chemical trespass' onto neighbouring properties.

Measures to reduce the risk of spray drift include:

- spraying when the wind is 3–15 km per hour, or when no surface temperature inversion conditions exist
- using a coarse to very coarse spray quality nozzle type
- avoiding the use of high pump/sprayer pressures that create small droplets that float in the air
- having buffer zones.

Using herbicides near water

Riparian zones are sensitive habitats and therefore a licence may be required to conduct weed control works within these zones. Use only herbicides that are registered or permitted for use in and around aquatic areas; some are formulated to be lower risk when used near water, for example, Roundup® Biactive. Never:

- spray herbicides over waterbodies or plants standing in water
- add adjuvants to herbicides to be used near water.

Chemical use training and certification

Chemical use training is required for people using herbicides as part of their job or business. Training is also recommended for community groups and may be required if working on public land. Commercial weed control operators need to be licenced in most states/territories.

Effective use of herbicides

Successful herbicide control is dependent on:

- selecting the right herbicide for the target species
- the growth stage of the target species
- the weather conditions during and after spraying
- how thoroughly the herbicide is applied
- the herbicide mix and application rate.

For spraying, wind speeds should be low (<15 km/h but above 3 km/h), and no rain should be expected in the following six hours.

Do not apply herbicide to plants that are under any sort of stress because it will not be absorbed and translocated effectively, resulting in a reduced level of control. Plants may be stressed owing to:

- dry soil
- low humidity
- air temperatures above 30°C
- frost
- waterlogged soils.

Herbicide effectiveness can be maximised by:

- mixing it with dye to help minimise missed areas and prevent overspraying (double spraying). Similarly, a foam marker or GPS can be used to indicate the edges of boom spraying.
- using an adjuvant – an additive that improves herbicide uptake
- ensuring spray equipment is correctly calibrated and maintained, including by thoroughly cleaning it between uses.

If an adjuvant is used, always read the product label to ensure it is compatible with the herbicide and there are no restrictions on its use; for example, adjuvants should not be used near waterways.

Where to get help

Refer to details found within this chapter for more information on contacts, chemical use training and certification.

Herbicide Treatment Record Sheet				
Contractor		Date/Time		
Operator Names		Property/GPS Location		
Area Description (landmarks, etc.)				
Growth Stage (✓)				
Target Species	Seedling	Juvenile	Flowering	Fruiting
1				
2				
3				
Plant Growth/Comments (✓)				
Target Species	Active Growth	No Active Growth	Under Stress (comments)	
1				
2				
3				
Environmental Conditions				
Soil Conditions **(circle)**		Dry	Damp	Wet
Rainfall – Previous 12hrs **(Y/N)** None expected in next 12hrs **(Y/N)**				
Wind Direction				
Wind Speed				
Temperature				
Application Method (**circle**)				
Foliar Spray	Cut & Swab	Scrape & Paint	Other	
Operator signature		Project Officer signature		

Herbicides and the law

In addition to the regulatory role of the Australian Pesticides and Veterinary Medicines Authority, herbicide use is regulated by state and territory legislation; see below for contact details.

	Department	Phone	Email	Website
National	Australian Pesticides and Veterinary Medicines Authority (APVMA)	02 6770 2300	enquiries@apvma.gov.au	apvma.gov.au
ACT	Environment, Planning and Sustainable Development Directorate – Environment	13 22 81	environment.protection@act.gov.au	ablis.business.gov.au/service/act/agvet-code-of-the-australian-capital-territory/3650
NSW	NSW Environment Protection Authority (EPA)	131 555	info@epa.nsw.gov.au	epa.nsw.gov.au/your-environment/pesticides/pesticides-nsw-overview/regulating-pesticides-nsw
NT	Department of Industry, Tourism and Trade	08 8999 2344	chemicals@nt.gov.au	nt.gov.au/industry/agriculture/farm-management/using-chemicals-responsibly
Qld	Business Queensland	13 74 68	qld.gov.au/contact-us	business.qld.gov.au/industries/farms-fishing-forestry/agriculture/sustainable/chemical
SA	Department of Primary Industries and Regions	1300 799 684	PIRSA.RuralChemicals@sa.gov.au	pir.sa.gov.au/biosecurity/rural_chemicals
Tas	Department of Natural Resources and Environment Tasmania	03 6777 2133	Stuart.Bowman@nre.tas.gov.au	nre.tas.gov.au/agriculture/agvet-chemicals
Vic	Department of Energy, Environment and Climate Action	136 186	agriculture.vic.gov.au/about/contact-us	agriculture.vic.gov.au/farm-management/chemicals
WA	Department of Primary Industries and Regional Development	1300 374 731	enquiries@dpird.wa.gov.au	agric.wa.gov.au/pests-weeds-diseases/control-methods/chemicals

Chemical use training

A number of providers offer accredited training in the use of chemicals for weed control. To find a provider near you, visit the following website and search for the code AHCPMG301 under the 'NRT' search function. Follow the link to find Registered Training Organisations (RTOs) approved to deliver this training package: training.gov.au/Search.

Safety and welfare

A risk management tool called Running the Risk? is available from Volunteering Australia at volunteeringaustralia.org/wp-content/files_mf/1377053059VAManagersrunningtherisk.pdf

Further information on safety and welfare policy, standards, guidelines and legislation can be accessed by contacting the following government departments and volunteer organisations.

	Website	Contact
National	safeworkaustralia.gov.au	info@swa.gov.au
	volunteeringaustralia.org	03 9820 4100 volaus@volunteeringaustralia.org
ACT	worksafe.act.gov.au/Home	13 22 81 worksafe@worksafe.act.gov.au
NSW	safework.nsw.gov.au	13 10 50
NT	worksafe.nt.gov.au/home	1800 019 111 ntworksafe@nt.gov.au
Qld	worksafe.qld.gov.au	1300 362 128 worksafe.qld.gov.au/contact/general-enquiries
SA	safework.sa.gov.au	1300 365 255 help.safework@sa.gov.au
Tas	worksafe.tas.gov.au	1300 366 322 wstinfo@justice.tas.gov.au
Vic	worksafe.vic.gov.au	1800 136 089 myworksafe.vic.gov.au/s/customer-enquiry
WA	commerce.wa.gov.au/WorkSafe	1300 307 877 wscallcentre@dmirs.wa.gov.au

Site restoration

The Society of Ecological Restoration Australasia (SERA) has drafted national standards for ecological restoration (see seraustralasia.com/standards/NationalStandards2_2.pdf). These standards can be used as a best practice guide to strive for ecological restoration.

Florabank.org.au publish best practice guidelines, along with free short courses, on sourcing, collecting and propagating seeds for restoration projects.

The Australian Association of Bush Regenerators is a member-based organisation that promotes the practice of restoration. A range of resources can be found on their website (see aabr.org.au).

References

Atlas of Living Australia. (2022). *Abrus precatorius* subsp. *africanus*. Occurrence records. https://biocache.ala.org.au/occurrences/search?q=lsid:https://id.biodiversity.org.au/node/apni/2916143#tab_mapView

Australian Plant Society (APS) NSW. (2020). Vines and scramblers. https://resources.austplants.com.au/plant-database/climbers/

Bari, I. N., Kato-Noguchi, H., Iwasaki, A., & Suenaga, K. (2019). Allelopathic potency and an active substance from *Anredera cordifolia* (Tenore) Steenis. Plants, 8(5), 134. https://doi.org/10.3390/plants8050134

Batianoff, G. N., & Butler, D. W. (2002). Assessment of invasive naturalized plants in south-east Queensland. *Plant Protection Quarterly*, 17(1), 27-34.

Batianoff, G. N., & Butler, D. W. (2003). Impact assessment and analysis of sixty-six priority invasive weeds in south-east Queensland. *Plant Protection Quarterly*, 18, 11-17.

Bernich, A., French, K. & Bedward, M. (2024). Assessing the invasion potential of five common exotic vine species in temperate Australian rainforests. *NeoBiota* 90. 79-96. 10.3897/neobiota.90.110659.

Blood, K., James, R., Panetta, F. D., Sheehan, M., Adair, R., & Gold, B. (2019). Early invader manual: Managing early invader environmental weeds in Victoria. Victorian Department of Environment, Land, Water and Planning.

Boyne, R. L., Osunkoya, O. O., & Scharaschkin, T. (2013). Variation in leaf structure of the invasive Madeira vine (*Anredera cordifolia*, Basellaceae) at different light levels. *Australian Journal of Botany*, 61(5), 412-417. doi.org/10.1071/BT13083

Brisbane City Council. (n.d.). Weed identification tool – Blue thunbergia. https://weeds.brisbane.qld.gov.au/weeds/blue-thunbergia

Buru, J. C., Dhileepan, K., Osunkoya, O. O., & Scharaschkin, T. (2014). Seed germination may explain differences in invasiveness and prevalence: A case study using cat´s claw creeper (*Dolichandra unguis-cati*). In M. Baker (Ed.), *Proceedings of the 19th Australasian Weeds Conference (2014): Science, Community and Food Security: The Weed Challenge* (pp. 223-226). Tasmanian Weed Society.

Coutts-Smith, A., & Downey, P. O. (2006). Impact of weeds on threatened biodiversity in New South Wales [CRC for Australian Weed Management Technical Series]. Pest Management Unit, Parks and Wildlife Division, NSW Department of Environment and Conservation.

Csurhes, B. S., & Edwards, R. (1998). Potential environmental weeds in Australia: Candidate species for preventative control. Queensland Department of Natural Resources.

da Silva, P., Coeti, J., Ferrari, A., Melo, K., Dias, R., Schedenffeldt, B., Monquero, P., Salmazo, P., Medeiros, E., Bicalho, C., & Mauad, M. (2023). Management strategies for *Anredera cordifolia* in coffee culture. *Revista Brasileira de Engenharia Agrícola e Ambiental*, 27, 585-592. 10.1590/1807-1929/agriambi.v27n8p585-592

Department of Agriculture and Fisheries (DAF) (2023). Cat's claw creeper fact sheet. Queensland Government. www.publications.qld.gov.au/ckan-publications-attachments-prod/resources/3b1dfe71-8d68-409a-a2ad-a9e2739432c0/cats-claw-creeper.pdf?ETag=0167385ad2e69f2c7f0b664fd76697e1

Department of Environment, Science and Innovation (DESI) (2013). *Oakview National Park management statement 2013*, DESI, Queensland Government. https://parks.desi.qld.gov.au/__data/assets/pdf_file/0031/165694/oakview.pdf

Dhileepan, K., Snow, E. L., Shi, B., Gray, B., Jackson, K., & Senaratne, W. K. A. D. (2021). Establishment of the biological control agent *Hypocosmia pyrochroma* for

Dolichandra unguis-cati (Bignoniaceae) is limited by microclimate. *Journal of Applied Entomology*, 145(9), 890-899. https://doi.org/10.1111/jen.12901

Dhileepan, K., Taylor, D. B. J., Treviño, M., & Lockett, C. J. (2013). Cat's claw creeper leaf-mining beetle *Hylaeogena jureceki* Obenberger (Coleoptera: Buprestidae), a host specific biological control agent for *Dolichandra unguis-cati* (Bignoniaceae). *Australian Journal of Entomology*, 52(2), 175-181.

Dhileepan, K., Treviño, M., Bayliss, D., Saunders, M., Shortus, M., McCarthy, J., Snow, E. L., & Walter, G. H. (2010). Introduction and establishment of *Carvalhotingis visenda* (Hemiptera: Tingidae) as a biological control agent for cat's claw creeper *Macfadyena unguis-cati* (Bignoniaceae) in Australia. *Biological Control*, 55, 58-62. doi.org/10.1016/j.biocontrol.2010.06.016

Doak, A., & Deveze, M. (2004). *Rubber vine management: Control methods and case studies*. https://www.environment.gov.au/biodiversity/invasive/weeds/publications/guidelines/wons/pubs/c-grandiflora.pdf

Downey, P. O., Scanlan, T. J., & Hosking, J. (2010). Prioritising alien plant species based on their ability to impact on biodiversity: A case study from New South Wales. *Plant Protection Quarterly*, 25, 111-126.

Downey, P. O., & Turnbull, I. (2007). The biology of Australian weeds 48. *Macfadyena unguis-cati* (L.) A.H. Gentry. *Plant Protection Quarterly*, 22, 82-91.

Ernst, C. M., & Cappuccino, N. (2005). The effect of an invasive alien vine, *Vincetoxicum rossicum* (Asclepiadaceae), on arthropod populations in Ontario old fields. *Biological Invasions*, 7, 417-425. doi.org/10.1007/s10530-004-4062-4

Estrada-Villegas, S., & Schnitzer, S. A. (2018). A comprehensive synthesis of liana removal experiments in tropical forests. *Biotropica*, 50, 729-739. doi.org/10.1111/btp.12571

French, K., Robinson, S., Smith, L., & Watts, E. (2017). Facilitation, competition and parasitic facilitation amongst invasive and native liana seedlings and a native tree seedling. *NeoBiota*, 36, 17-38. doi.org/10.3897/neobiota.36.13842

Gallagher, R. V., Hughes, L., Leishman, M. R., & Wilson, P. D. (2010). Predicted impact of exotic vines on an endangered ecological community under future climate change. *Biological Invasions*, 12, 4049-4063. doi.org/10.1007/s10530-010-9814-8

Global Invasive Species Database (GISD). (2024). 100 of the world's worst invasive alien species. http://www.iucngisd.org/gisd/100_worst.php

Grice, A. C., & Setter, M. J. (2003). *Weeds of Rainforests and Associated Ecosystems*. Cooperative Research Centre for Tropical Rainforest Ecology and Management.

Harden, G. J., Fox, M. D., & Fox, B. J. (2004). Monitoring and assessment of restoration of a rainforest remnant at Wingham Brush, NSW. *Austral Ecology*, 29, 489-507. doi.org/10.1111/j.1442-9993.2004.01421.x

Harvey, K. J., McConnachie, A. J., Sullivan, P., Holtkamp, R., & Officer, D. (2021). Biological control of weeds: A practitioner's guide for south-east Australia. New South Wales Department of Primary Industries.

Harris, C. J., Murray, B. R., Hose, G. C., & Hamilton, M. A. (2007). Introduction history and invasion success in exotic vines introduced to Australia. *Diversity and Distributions*, 13, 467-475. doi.org/10.1111/j.1472-4642.2007.00375.x

Holm, L. G., Pancho, J. V., Herberger, J. P., & Plucknett, D. L. (1991). *A geographical atlas of world weeds*. Krieger Publishing Company.

Johnson, K. (2011a). *Weed management guide – Madeira vine* (Anredera cordifolia). Queensland Department of Agriculture, Fisheries and Forestry.

Johnson, K. (2011b). *Weed management guide – Cat's claw creeper* (Dolichandra unguis-cati). Queensland Department of Agriculture, Fisheries and Forestry.

King, A. M., Williams, H. E., & Madire, L. G. (2011). Biological control of cat's claw creeper, *Macfadyena unguis-cati* (L.) AH Gentry (Bignoniaceae), in South Africa. *African Entomology*, 19(1), 366-377.

Langeland, K. A., & Burks, K. C. (1998). *Identification and biology of non-native plants in Florida's natural areas* [Institute of Food and Agricultural Sciences Publication SP 257]. University of Florida.

Leishman, M., & Thomson, V. (2005). Experimental evidence for the effects of additional water, nutrients and physical disturbance on invasive plants in low fertility Hawkesbury Sandstone soils, Sydney, Australia. *Journal of Ecology*, 93, 38-49.

Lindgren, C. J., Castro, K. L., Coiner, H. A., Nurse, R. E., & Darbyshire, S. J. (2013). The biology of invasive alien plants in Canada. 12. *Pueraria montana* var. *lobata* (Willd.) Sanjappa & Predeep. *Canadian Journal of Plant Science*, 93, 71-95. doi.org/10.4141/CJPS2012-128

NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW). (2024). *High ecological value waterway and water dependent ecosystems – South Coast catchments of NSW* [Dataset]. https://datasets.seed.nsw.gov.au/dataset/south-coast-catchments

NSW Department of Primary Industries. (2023). Madeira vine control. https://weeds.dpi.nsw.gov.au/Weeds/MadeiraVine#control

NSW Scientific Committee. (2006). *Invasion and establishment of exotic vines and scramblers – key threatening process listing*. www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/nsw-threatened-species-scientific-committee/determinations/final-determinations/2004-2007/invasion-and-establishment-of-exotic-vines-and-scramblers-key-threatening-process-listing

Office of Environment and Heritage (OEH). (2013). *Asparagus weeds management manual: Current management and control options for asparagus weeds* (Asparagus *spp*.) *in Australia*. https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Pests-and-weeds/asparagus-weeds-management-manual-130486.pdf

Osmond, R., Verbeek, M., McLaren, D. A., Michelmore, M., Wicks, B., Grech, C. J., & Fullerton, P. (2008). *Serrated tussock – National best practice manual*. Victorian Department of Primary Industries.

Osunkoya, O. O., Pyle, K., Scharaschkin, T., & Dhileepan, K. (2009). What lies beneath? The pattern and abundance of the subterranean tuber bank of the invasive liana cat's claw creeper, *Macfadyena unguis-cati* (Bignoniaceae). *Australian Journal of Botany*, 57(2), 132-138. doi.org/10.1071/BT09033

Page, A. R., & Lacey, K. L. (2006). *Economic impact assessment of Australian weed biological control* [Technical Series 10]. CRC for Australian Weed Management.

Pagnoncelli, F. de B., Trezzi, M. M., Brum, B., Vidal, R. A., Portes, Á. F., Scalcon, E. L., & Machado, A. (2017). Morning glory species interference on the development and yield of soybeans. *Bragantia*, 76(4), 470-479. doi.org/10.1590/1678-4499.2016.338

Phillips, O. L., Vasquez Martinez, R., Arroyo, L., Baker, T. R., Killeen, T., Lewis, S. L., Malhi, Y., Mendoza, A. M., Neill, D., Nunez Vargas, P., Alexiades, M., Ceron, C., Fiore, A. Di, Erwin, T., Jardim, A., Palacios, W., Saldias, M., & Vinceti, B. (2002). Increasing dominance of large lianas in Amazonian forests. *Nature*, 418, 770-774. doi.org/10.1038/nature00926

Prentis, P. J., Sigg, D. P., Raghu, S., Dhileepan, K., Pavasovic, A., & Lowe, A. J. (2009). Understanding invasion history: Genetic structure and diversity of two globally invasive plants and implications for their management. *Diversity and Distributions*, 15, 822-830. doi.org/10.1111/J.1472-4642.2009.00592.X

Queensland Government. (2020). Richmond birdwing butterfly. https://www.qld.gov.au/environment/plants-animals/conservation/threatened-wildlife/threatened-species/featured-projects/richmond-birdwing-butterfly

Rafter, M. A., Wilson, A. J., Senaratne, K. A. D. W., & Dhileepan, K. (2008). Climatic-requirements models of cat's claw creeper *Macfadyena unguis-cati* (Bignoniaceae) to prioritise areas for exploration and release of biological control agents. *Biological Control*, 44(2), 169-179. doi.org/10.1016/j.biocontrol.2007.10.015

Raghu, S., & Dhileepan, K., & Treviño, M. (2006). Response of an invasive liana to simulated herbivory: Implications for its biological control. Acta *Oecologica*, 29, 335-345. 10.1016/j.actao.2005.12.003

Richardson, D. M., Pyšek, P., Rejmánek, M., Barbour, M. G., Dane Panetta, F., & West, C. J. (2000). Naturalization and invasion of alien plants: Concepts and definitions. *Diversity and Distributions*, 6, 93-107. doi.org/10.1046/j.1472-4642.2000.00083.x

Riahi, K., Van Vuuren, D. P., Kriegler, E., Edmonds, J., O'Neill, B. C., Fujimori, S., Bauer N., Calvin, K., Dellink, R., Fricko, O., Lutz, W., Popp, A., Cuaresma, J. C., Samir, K. C., Leimbach, M., Jiang, L., Kram, T., Rao, S., Emmerling, J., … & Tavoni, M. (2017). The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. *Global Environmental Change*, 42, 153-168. doi.org/10.1016/j.gloenvcha.2016.05.009

Schnitzer, S. A., Kuzee, M. E., & Bongers, F. (2005). Disentangling above- and below-ground competition between lianas and trees in a tropical forest. *Journal of Ecology*, 93, 1115-1125. doi.org/10.1111/j.1365-2745.2005.01056.x

Sheehan, M. R., & Potter, S. (2017). Managing *Opuntioid Cacti in Australia – Best practice control manual for* Austrocylindropuntia, Cylindropuntia *and* Opuntia *species*. Department of Primary Industries and Regional Development (WA). https://www.agric.wa.gov.au/invasive-species/opuntioid-cacti-best-practice-control-manual

Sherley, G. (2000). *Invasive species in the Pacific: A technical review and draft regional strategy*. South Pacific Regional Environment Programme.

Shortus, M., & Dhileepan, K. (2010). Two varieties of the invasive cat's claw creeper, *Macfadyena unguis-cati* (bignoniaceae) in Queensland, Australia. *Proceedings of the Royal Society of Queensland*, 116, 13-21.

Snow, E. L., & Dhileepan, K. (2013). Update of biological control research for cat's claw creeper and Madeira vine. In M. O'Brien, J. Vitelli, & D. Thornby (Eds.), *Proceedings of the 12th Queensland Weed Symposium* (pp. 15-18). The Weed Society of Queensland.

Snow, E. L., & Dhileepan, K. (2014). The Jewel beetle (*Hylaeogena jureceki*): A new biocontrol for cat's claw creeper (*Dolichandra unguis-cati*) in Queensland. In M. Baker (Ed.), *Proceedings of the 19th Australasian Weeds Conference* (pp. 50–54). Tasmanian Weed Society.

Snow, E. L., Palmer, W. A., & Senaratne, K. A. D. W. (2012). The release of *Plectonycha correntina*, a leaf feeding beetle for the biological control of Madeira vine. In V. Eldershaw (Ed.), *Proceedings of the Eighteenth Australasian Weeds Conference* (pp. 339-342). Weed Society of Victoria.

Society for Ecological Restoration Australasia (SERA) Standards Reference Group. (2017). National *Standards for the Practice of Ecological Restoration in Australia* (2nd ed.). Society for Ecological Restoration Australasia.

Sparks, H. E. (1999). The initiation of a biological control programme against *Macfadyena unguis-cati* (L.) Gentry (Bignoniaceae) in South Africa. *African Entomology Memoir*, 1, 153-157.

Starr, F., Starr, K., & Loope, L. (2003). *Andredera cordifolia*. United States Geological Survey. http://www.hear.org/starr/hiplants/reports/pdf/anredera_cordifolia.pdf

Stockard, J. D. (1996). Restoration of Wingham Brush 1980–1996. In R. C. H. Shepherd (Ed.), *Proceedings of the 11th Australian Weeds Conference 1996* (pp. 432-436). Weed Science Society of Victoria.

Swarbrick, J. T. (1991). Towards a rating scheme for environmental weeds. *Plant Protection Quarterly*, 6, 185.

Threatened Species Scientific Committee. (2010). *Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on Amendments to the List of Key Threatening Processes under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*. https://www.dcceew.gov.au/sites/default/files/env/pages/215ddf2d-5955-4974-b2c3-a7e99c14f5e3/files/garden-plants-listing-advice.pdf

Vivian-Smith, G., Lawson, B. E., Turnbull, I., & Downey, P. O. (2007). The biology of Australian weeds. 46. *Anredera cordifolia* (Ten.) Steenis. *Plant Protection Quarterly*, 22, 1-10.

Vivian-Smith, G., & Panetta, F. D. (2004). Seed bank ecology of the invasive vine, cats claw creeper (*Macfadyena unguis-cati* (L.) A. Gentry). In B.M. Sindel and S.B. Johnson (eds.), *Proceedings of the 14th Australian Weeds Conference: Weed management – Balancing people, planet, profit* (pp. 531-534). Weed Society of New South Wales

Watson, G. M., French, K. O., Burley, A. L., Brading, M. B., & Hamilton, M. A. (2021). *Monitoring manual for invasive and native flora: Guidance for field monitoring and reporting. NSW Department of Planning, Industry and Environment*. https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Pests-and-weeds/monitoring-manual-for-invasive-and-native-flora-210638.pdf

Webber, B. L., Yeoh, P. B., & Scott, J. K. (2014). *Invasive* Passiflora foetida *in the Kimberley and Pilbara: Understanding the threat and exploring solutions* [Phase 1 Final Report]. CSIRO.

WeedFutures.net. (2014). Species profile. https://weedfutures.net/species.php?id=2050

Weeds of Australia. (2022). *Gloriosa superba*. https://keyserver.lucidcentral.org/weeds/data/media/Html/gloriosa_superba.htm

Zhang, X., Wei, H., Zhao, Z., Liu, J., Zhang, Q., Zhang, X., & Gu, W. (2020). The global potential distribution of invasive plants: *Anredera cordifolia* under climate change and human activity based on random forest models. *Sustainability (Switzerland)*, 12(4), 1491. doi.org/10.3390/su12041491

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