

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.

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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



Madreia 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.

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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).



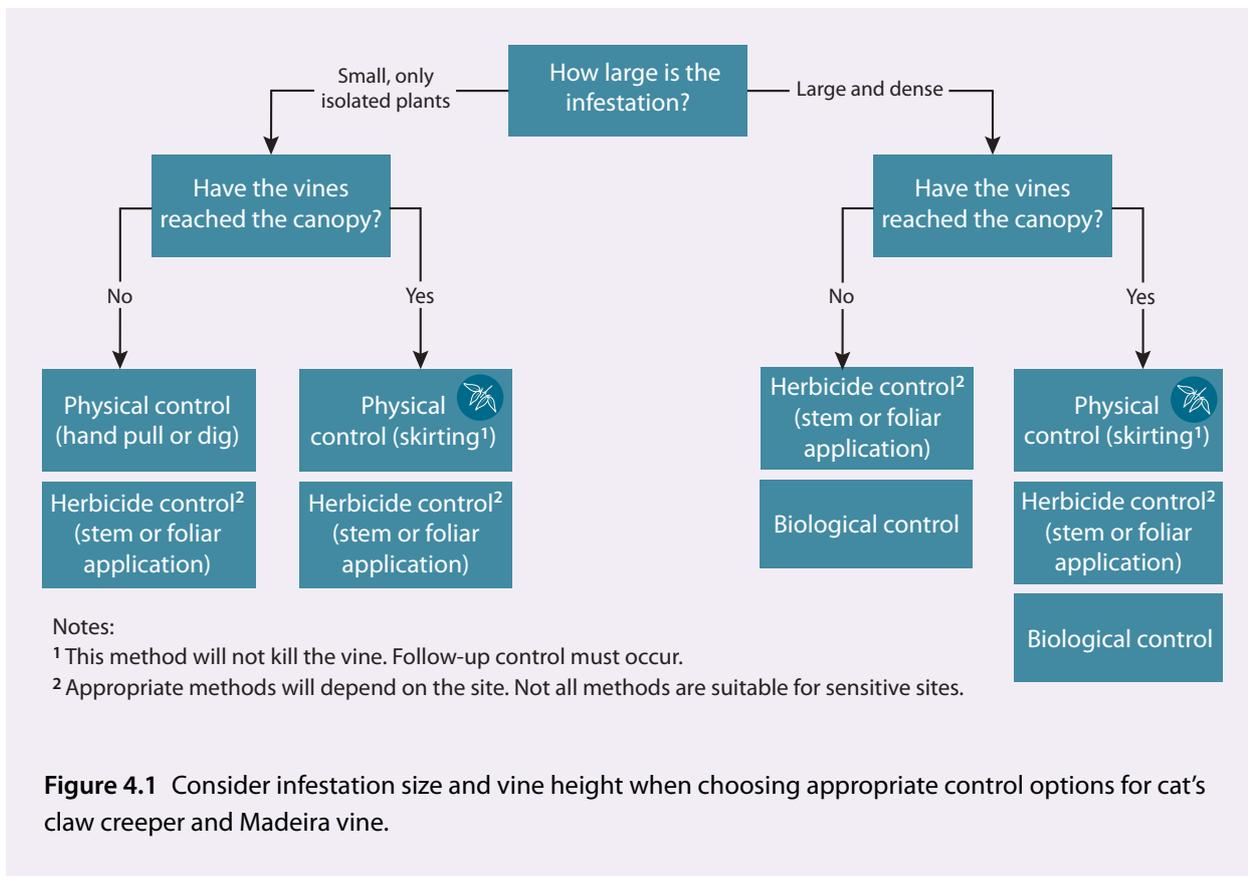
Clusters of Madeira vine aerial tubers.

Sheldon Navie



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

Leslie Feldehof



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.

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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	<ul style="list-style-type: none"> prevents weed entry and spread avoids future costs and impacts low ongoing cost 	<ul style="list-style-type: none"> ongoing time commitment to manage spread pathways ongoing effort needed to obtain everyone's compliance 	<ul style="list-style-type: none"> difficult to limit natural pathways of spread 	<ul style="list-style-type: none"> year round 	<ul style="list-style-type: none"> all on-site activities all other control measures
 Surveillance	<ul style="list-style-type: none"> reduces impacts and costs 	<ul style="list-style-type: none"> time consuming and ongoing 	<ul style="list-style-type: none"> can be hard to detect new infestations in inaccessible areas, such as riparian zones and in tree canopies 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> all other control measures
PHYSICAL REMOVAL					
 Hand removal	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> all other control measures
 Skirting	<ul style="list-style-type: none"> can prevent vines from setting seed kills aerial vines and stems no chemicals and minimal equipment required causes negligible impact to desirable vegetation 	<ul style="list-style-type: none"> doesn't kill plants secondary treatment required time consuming and labour intensive 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> year round often applied prior to flowering/seeding 	<ul style="list-style-type: none"> herbicide control

	 Advantages	 Disadvantages / limitations	 Caution!	 Timing	 Integrate with
HERBICIDE CONTROL					
 Stem application – all methods	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> read herbicide label avoid herbicide application to desirable vegetation 'tuber rain' from cut and swab in Madeira vine infestations requires significant follow-up 	<ul style="list-style-type: none"> best done when plants are actively growing (spring) and not under stress 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> relatively time and labour efficient can cover large areas some methods suitable for use in hard to access locations (splatter gun) minimal soil disturbance 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> read herbicide label minimise spray drift minimise residual chemicals remaining in the soil 	<ul style="list-style-type: none"> warmer months when plants are actively growing and not under stress at least twice per year in early spring and summer/early autumn 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> most labour-efficient and cost-efficient method can reduce density and impact of cat's claw creeper and Madeira vine in the long term 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> generally between September and March 	<ul style="list-style-type: none"> use in dense infestations and combine with stem applications and physical control to treat outlying individuals and populations

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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: dceew.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.

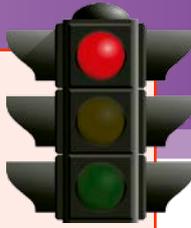
Established plants may not be suitable for physical removal. Consider other options before proceeding.

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.

- 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.

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.

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](https://www.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.

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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

Madreia 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.

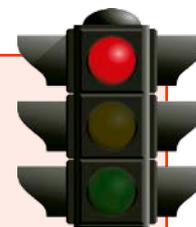
You must check the label and permit carefully to ensure your intended use meets requirements.

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.

Application methods

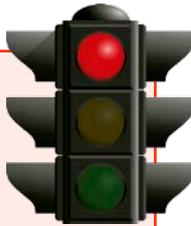
Two main methods are used for applying herbicides for the control of cat's claw creeper and Madeira vine:

- 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.

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.



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

James Martin

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

Situation	Method	Species	Considerations
Sites where: <ul style="list-style-type: none"> 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	 	<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> large vines – use large tools for cutting (e.g. axe, machete, handsaw, chainsaw) small vines – use hand tools (e.g. secateurs)
	Scrape and paint	 	<ul style="list-style-type: none"> best for vines with thinner stems more commonly used for Madeira vine
	Stem injection		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> 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	 	<ul style="list-style-type: none"> take care to avoid off-target damage not suitable for controlling seedlings or large infestations
Hard-to-reach, dense infestations	Splatter gun		<ul style="list-style-type: none"> 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

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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 is 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

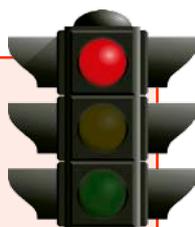


The cut and swab method targets the underground tuber and root systems and is primarily suited to cat's claw creeper. Use this method when stems are actively growing and not stressed (e.g. by drought, waterlogging, cold conditions). In dense infestations with many large stems, work in pairs, with one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

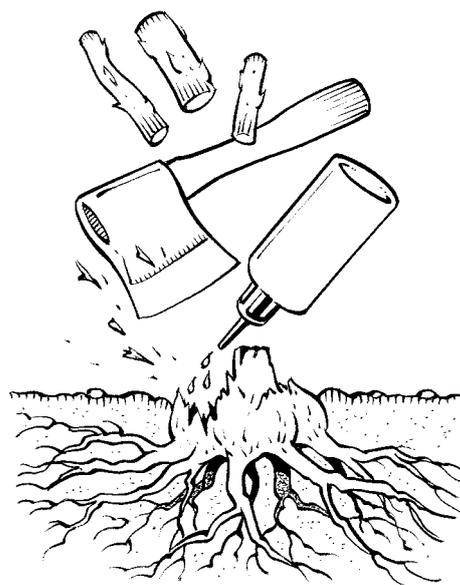
Consider an alternative chemical-control technique, such as scrape and paint or foliar spraying, that may help to control aerial tubers.



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).

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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 understory, 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.



Preparing vines for herbicide application using the skirting method.



Applying herbicides to cut vines on mature trees.

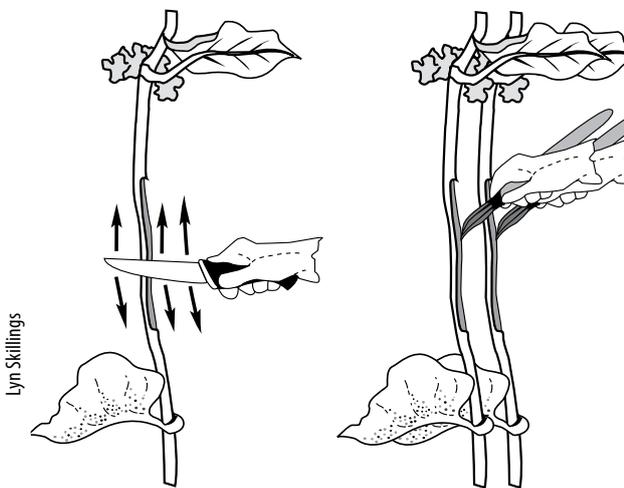
Chapter 4

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).



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=6iKYFUvvhHQ

A longer video of the Pittwater Ecowarriors controlling Madeira vine can be viewed at youtube.com/watch?v=hSX1jTzwyA0



OPWS

Madiera 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.

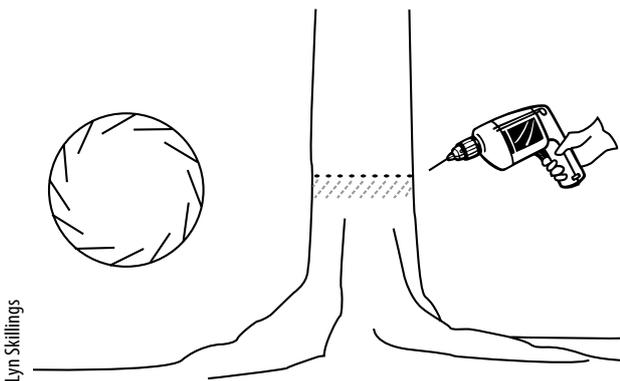
Application

- 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.

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Timing

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



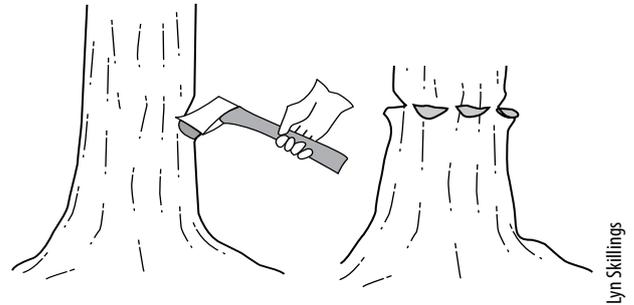
Stem injection (drill and fill) method.

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.

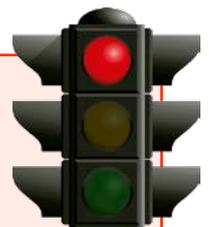
Timing

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](https://www.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.

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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.

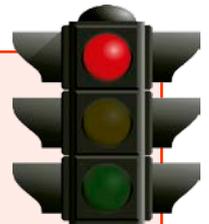
The DiBak AM capsule is not currently registered for use on cat's claw creeper, and a research permit will be sought for its future application. Keep an eye out for research results at the Cedar Grove Landcare website cedargrovelandcare.org.au

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.

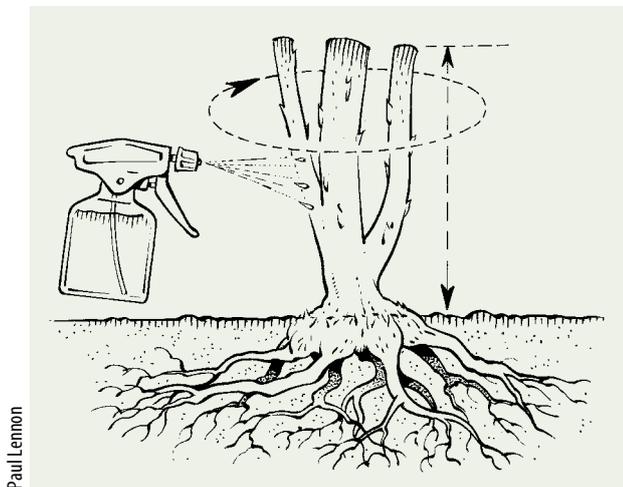
This is a less commonly used control method – use with care when vines are growing up or amongst desirable plants. For this reason, it's unsuitable for sensitive sites with high biodiversity value or other areas where off-target damage is undesirable.



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](https://www.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.

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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
<ul style="list-style-type: none"> ▪ seedlings/tuberlings ▪ regrowth (small) ▪ ground runners ▪ vines climbing structures or non-desirable vegetation ▪ sites with a high level of weed invasion 	<ul style="list-style-type: none"> ▪ 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 	<ul style="list-style-type: none"> ▪ best suited to disturbed areas. Use cautiously in sensitive sites ▪ can be used to control regrowth following 'skirting' method (see page 57)
<ul style="list-style-type: none"> ▪ small to medium vines that have begun to attach to or climb host ▪ regrowth 	<ul style="list-style-type: none"> ▪ gently pull vines off desired plants ▪ curl them at the base of the tree and spray with herbicide 	<ul style="list-style-type: none"> ▪ consider alternative control methods when: <ul style="list-style-type: none"> • 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

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

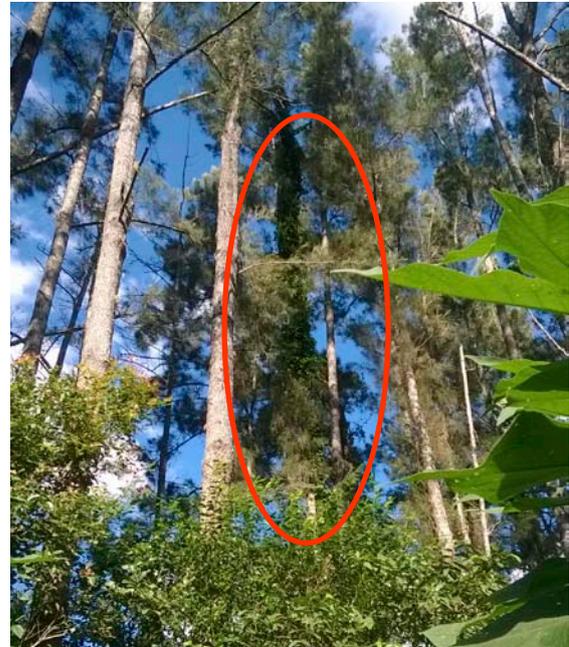
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Chapter 4

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

Madiera 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



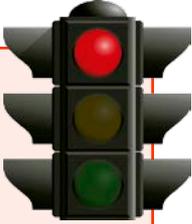
The splatter-gun method uses a pressurised gun to deliver low volumes of highly concentrated herbicide to plant foliage. The splatter gun administers large droplets of herbicide solution in one direct stream and so uses more concentrated herbicide solutions than other foliar applications, such as spot 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.



Splatter gun equipment.

Hillary Cherry

Chapter 4

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.

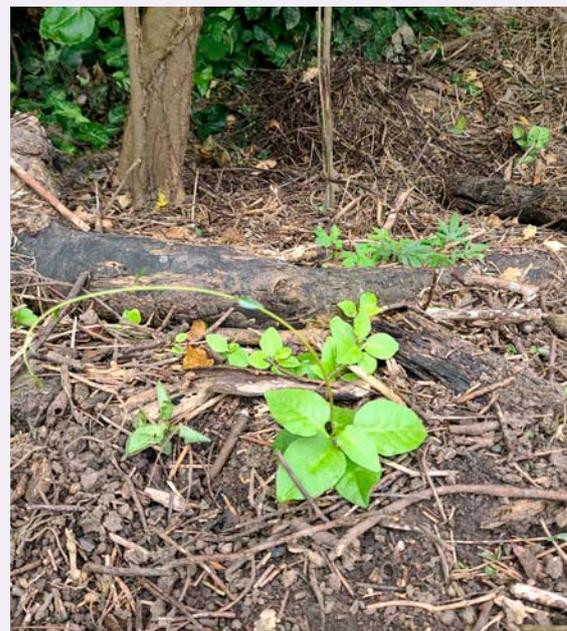
Madeira vine

- 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 throughout 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.

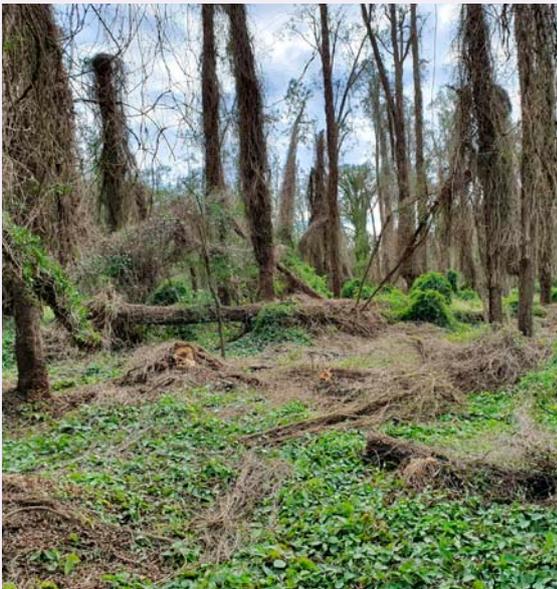


K. Lewry

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 operators 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 limits 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 initial 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.

Chapter 4

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).

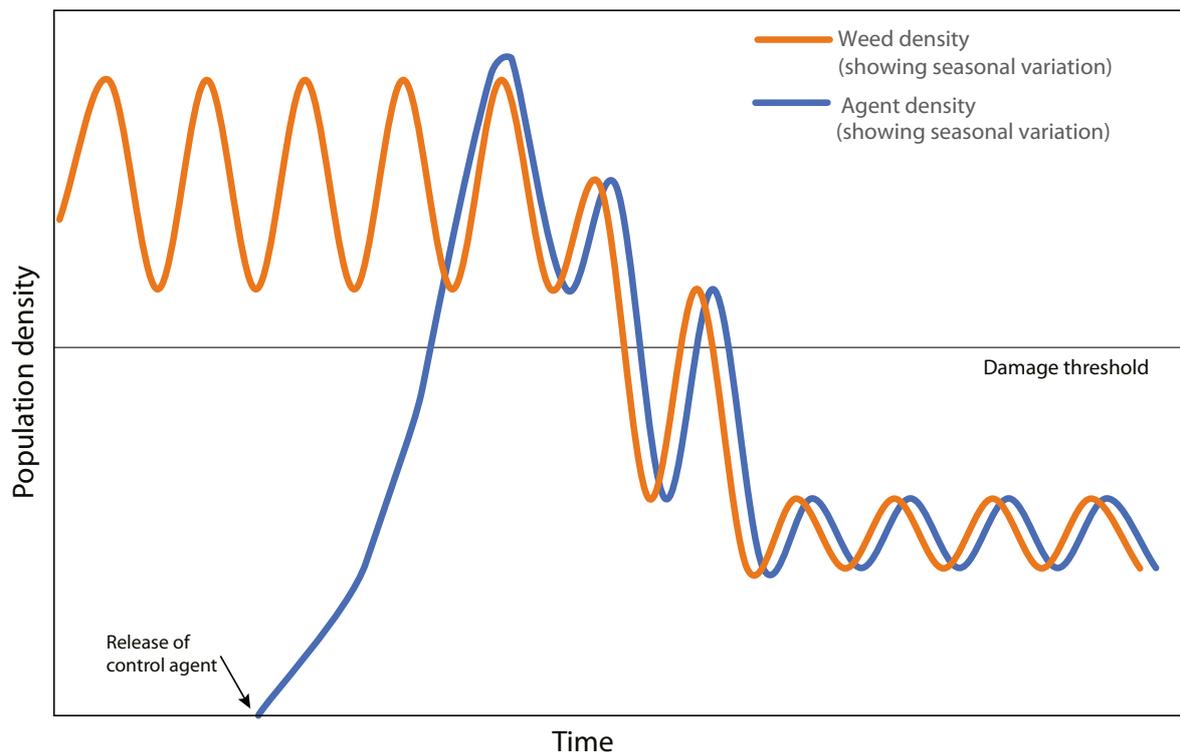


Figure 4.2 The relationship between a weed and its biocontrol agent, illustrating when the agent starts to reduce weed density (source Sheehan and Potter, 2017).

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 opuntoid 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.

Chapter 4



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.



Young tingid nymphs.

Qld DPI



Adult tingid.

Qld DPI

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.

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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).



Adult jewel beetle.

Qld DPI



Jewel beetle adults on cat's claw creeper.

Qld DPI



Jewel beetle larval damage.

Qld DPI



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.

Chapter 4

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



Leaf-tying moth adult.

QldDPI



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

QldDPI

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.

Chapter 4

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

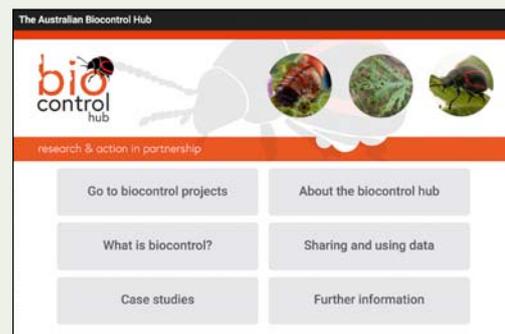
Check for presence of adults and larvae and their damage at the release site within one year from release. Check for eggs on the underside of damaged leaves. If beetles establish, begin monitoring at incremental distances from release sites to monitor dispersal. Monitor annually.

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.

Chapter 4

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

	Cat's claw creeper 	Madeira vine 
Objectives	<ul style="list-style-type: none"> ▪ 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 tuberslings 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: <ul style="list-style-type: none"> ▪ 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: <ul style="list-style-type: none"> ▪ 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: <ul style="list-style-type: none"> 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.

Chapter 4

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 Figure 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 experienced 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 Madeira 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.



Madiera vine and balloon vine in Lane Cove National Park.

Matt Sheehan

Chapter 4

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

Madiera 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 (<i>Passiflora suberosa</i>), 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.

Chapter 4

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.

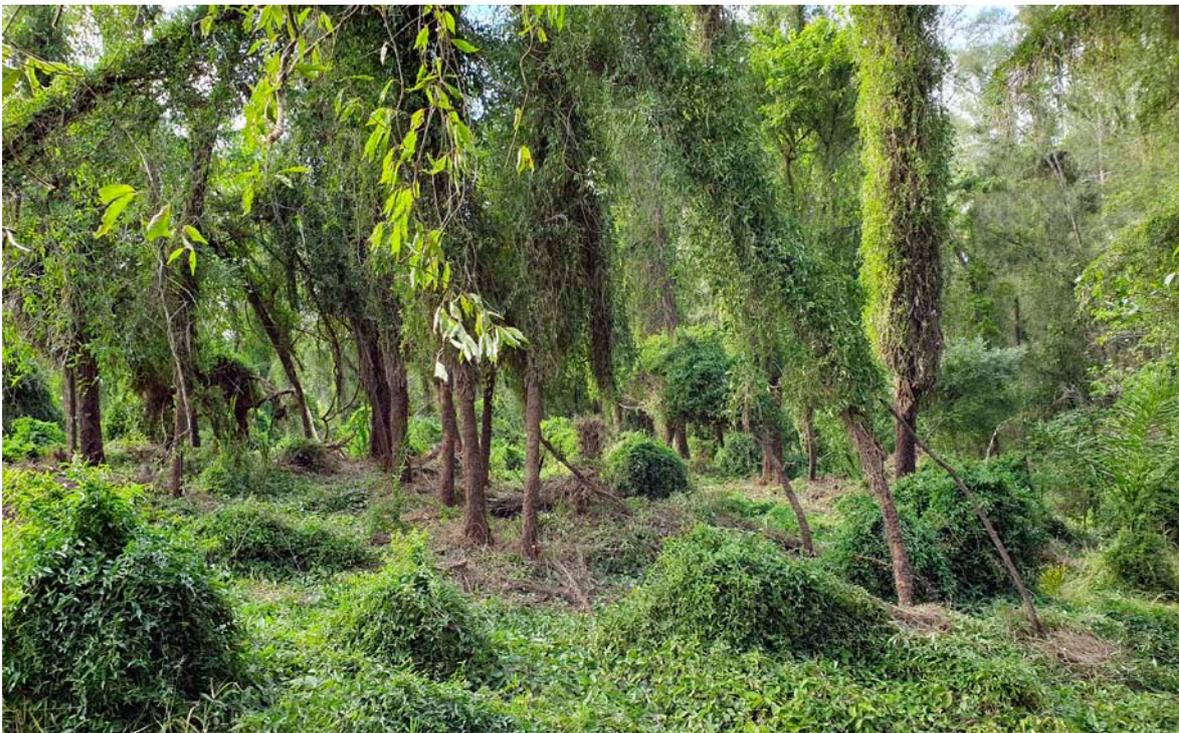
Consider the need for site restoration after control of weeds, particularly if your site has been disturbed (such as by weed invasion) over many years. If intervention is required, the methods you use will depend on the extent of disturbance, environmental risks, land-use requirements and restoration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

Chapter 4

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.