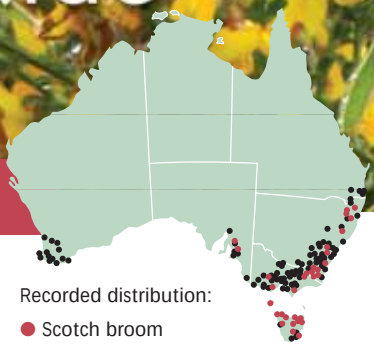
Weed Management Guide

Managing weeds for biodiversity



Scotch broom (*Cytisus scoparius*) and other introduced brooms

The problem

Brooms are shrubs in the pea family (Fabaceae) that are widely cultivated for ornamental or other purposes. A number of species, mostly native to Europe or Africa have been introduced to Australia and become weeds. Scotch (or English) broom (*Cytisus scoparius*) and Montpellier (or Cape) broom (*Genista monspessulana*) are widespread weeds that have formed major infestations in southern Australia. Most studies of broom in Australia have focused on these and they are the main species profiled here. Other species that currently have a more limited distribution are covered in less detail but may be of equal or greater threat in certain situations.

Scotch broom and Montpellier broom are promoted by disturbance but are spreading into intact native vegetation. They outcompete native understorey through their rapid growth rate and high seed output, increase soil fertility and dominate the soil seedbank. It is particularly difficult to restore native vegetation long invaded by brooms.

Several insects that feed selectively on Scotch broom plants or seeds have been introduced to Australia, but their impacts have generally been limited. Biological control may become a useful tool, where it is integrated with other measures for long-term rehabilitation of broom-infested sites, and for reducing spread. Research has also commenced into organisms with potential for controlling Montpellier broom.

White weeping broom (*Retama raetam*) and white Spanish broom (*Cytisus multiflorus*) are on the Australian Alert List because they currently have a limited distribution but have potential to become threats to biodiversity. They are the subject of their own weed management guides under the Alert List series. These and other brooms are still cultivated in gardens. Tagasaste (or tree lucerne) (*Chamaecytisus palmensis*) is commonly planted for fodder in WA but is also a weed of native vegetation.

Key points

- Broom species invade native vegetation in southern Australia, some are widespread and others localised at this stage.
- They can grow rapidly, outcompete native plants and increase soil nitrogen.
- Brooms reproduce from seed and plants resprout if damaged. They often form a long-lived seedbank.
- Biological control agents have been released for Scotch broom.
- Removing broom stands generally creates conditions that initially promote the weed. To restore native vegetation, it is necessary to take this into account.
- It is most effective to remove plants before they seed and before broom replaces native plants.
- Correct weed identification is essential. Some native plants resemble brooms.
- Many broom species, cultivars and hybrids are commonly grown, mainly in gardens.

Scotch broom (*Cytisus scoparius*) is invading native woodland at high elevations in the Australian Alps. Its seeds are carried by people, native and introduced animals (including stock), vehicles, machinery and water. Detection and removal of isolated patches is a management priority.
Photo: Parks Victoria

Several colour forms or hybrids of Scotch broom (*Cytisus scoparius*) occur in the wild. Photo: Matthew Baker, Tasmanian Herbarium

The weeds

Scotch broom is an erect shrub to 3 m tall with green stems, five-angled young branches and leaves that are shed in times of stress. The large, showy pea-flowers are borne singly on stalks along the branches. They are usually bright yellow but in some forms the petals may be splashed with red, or pink in colour. Pods are oblong, hairy along the opening and black when mature. Foliage can be browsed by livestock. Research has indicated that Scotch broom grows rapidly when moisture is available, outgrowing common native shrubs. Dense broom stands produce relatively high, homogeneous levels of leaf litter in comparison with diverse native vegetation, and this may disadvantage native species. In eastern NSW, dense Scotch broom harbours feral pigs that dig the soil, promoting broom regeneration.

Brooms generally have numerous straight, flexible young branches that give them their common name. While the different introduced brooms vary in their environmental tolerances and other aspects of their biology, in general they are able to resprout, are tolerant of dry summers, have been deliberately planted and have high seed production, including some dormant seed. All brooms have root nodules that fix nitrogen, assisting their growth in relatively infertile soils and modifying the soil environment. These features are major considerations in planning their management. Features of the main broom species naturalised in Australia are summarised in the table on pages 4 and 5.

How they spread

Brooms grow from seed. In Scotch and Montpellier brooms most seed set results from cross pollination by honey bees or other large insects. A small proportion of flowers set seed but mature stands can produce abundant seed in favourable seasons due to many-seeded pods, large plants, dense populations and prolific flowering. Spanish broom has a similar breeding system. White weeping broom also produces abundant seed with high viability and a high percentage are initially dormant.

Scotch broom and some other species have pods that burst open in hot weather when mature, ejecting seeds up to several metres. Seed is also carried by run-off or floods and can roll downhill or be buried by ants. It can be carried inadvertently in soil by humans, animals or vehicles and outliers may be found in native vegetation at some distance from parent populations. Brooms planted in gardens can spread into bushland. Various species have also been planted as hedge, soil binding, medicinal or fodder plants. Disturbance assists broom invasion by removing competing vegetation and stimulating broom seed germination.

Where they grow

Scotch broom is native in Europe and Macronesia and the other introduced brooms are native in the general region of Europe, the Mediterranean, Middle East and Macronesia. Various brooms have become naturalised elsewhere including southern Africa, North and South America, New Zealand and parts of Asia.

Species such as Montpellier broom have become weeds across southern Australia, others have a more limited distribution and some are currently quite localised. Most brooms generally grow in regions with rainfall in winter and a Mediterranean or temperate climate, with some extending into southeastern Qld. Brooms can grow in relatively infertile sand or loam. Scotch broom is spreading rapidly in subalpine woodlands with a mainly herbaceous understorey. It invades a range of shrubby or grassy native vegetation types; grassland, woodland, sclerophyll forest, and riparian vegetation that is not densely shaded, with an average annual rainfall of 600 mm or more. Montpellier broom occurs in a similar range of habitats, has been recorded in swamps but extends into drier areas with an annual rainfall of 500 mm or more. Flax-leaf broom has a similar range to Montpellier broom but is less common. Spiny broom, white Spanish broom and Spanish broom generally occur in lowland grasslands, woodlands and dry sclerophyll forest.

Tagasaste requires acid to neutral soil and an average annual rainfall of 350 mm or more, and grows in a wide range of vegetation types. White weeping broom originated from desert regions and is tolerant of low rainfall, occurring in SA and WA where the annual rainfall averages 300–500 mm. It can grow in sand and in alkaline soils and invades coastal vegetation and mallee.

Similar native species

These native Australian shrubs with yellow pea-flowers could be mistaken for certain introduced brooms and may grow in similar habitats.

Golden spray or Australian native broom (*Viminaria juncea*) is a shrub 1–5 m tall. Its stems are not ridged, mature leaves are reduced to wiry petioles (stalks) 3–25 cm long. Flowers are yellow to orange, may have reddish markings, in a spray, up to 20 cm or more long. Pods are small with a wrinkled surface, containing 1 seed. Often grows in swampy areas. It occurs in NSW, Qld, SA, Tas., WA, Vic. (Resembles the weeds Scotch and Spanish brooms).
Photo: Jackie Miles and Max Campbell

Golden tip or clover bush (*Goodia lotifolia*) and western golden tip (*G. medicaginea*) are shrubs to 4 m or 1.5 m tall respectively. Young branchlets are not ridged. Leaves are clover-like with a long stalk and 3 egg-shaped leaflets. Flowers are borne in groups at the end of branches, stalked, yellow to orange with darker markings. Pods are irregularly oval to oblong, stalked with a narrow base, not hairy. One or both species occur in NSW, Qld, SA, Tas., Vic., WA. (Resembles the weed Montpellier broom).
Photo: Jackie Miles and Max Campbell

Giant wedge-pea (*Gompholobium latifolium*) is a shrub to 3 m tall, with narrow leaflets in threes on a short stalk. The yellow flowers are in groups of 1–3, borne at tips and along branches. Pods are ovoid to obloid, to 18 mm long, not hairy, containing numerous seeds. It occurs in NSW, Qld, Vic. (Its narrow leaves resemble those of flax-leaf broom. Other species of *Gompholobium* could also be mistaken for broom species).
Photo: Jackie Miles and Max Campbell

Large-leaf bush-pea (*Pultenaea daphnoides*) is a shrub, 1–3 m tall, stems not ridged, leaves not divided into leaflets, darker above than below, firm, variable but often wedge-shaped. Flowers are without stalks, in clusters of 6–15 at branch tips, yellow and red. Pods are flattened, 5–7 mm long, pubescent. It occurs in NSW, Qld, SA, Tas., Vic. (It commonly grows amongst the weedy shrubs of Montpellier and Scotch brooms).
Photo: Jackie Miles and Max Campbell

Dogwood (*Jacksonia scoparia*) is a shrub, up to 3 m tall, with silvery-grey stems and thick fissured bark and may be weeping in habit. Most leaves are usually reduced to scales. Flowers are yellow, in groups at or near the ends of branches. Pods are 6–12 mm long. It occurs in NSW, Qld. (Resembles the weeds Scotch and Spanish brooms).
Photo: Jackie Miles and Max Campbell

Potential distribution

Climate modelling has been undertaken at the national level for Scotch and Montpellier brooms. It indicates that there is potential for further spread of both these species in southern Australia and for Scotch broom into WA. Genetic studies of this species indicate that a diversity of genetic forms was introduced to Australia from its extensive native and introduced range and that further diversity is arising here. Modelling undertaken for most of the introduced brooms in Vic. indicates that they have potential to become more widespread.

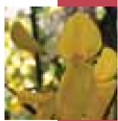
Growth cycle

Scotch broom plants first flower at 3–5 years old and may live for up to 27 years. Leaves are often deciduous, falling in dry or cold seasons, but the green stems enable continued photosynthesis. Flowering occurs mainly in spring and seeds ripen and shed in summer. They can germinate in the warmer months. A proportion of seed may become dormant and survive in the seedbank for 20 or more years. In Australia, recruitment of seedlings can occur under a mature Scotch broom canopy if there is adequate light, contributing to stand persistence.

Montpellier broom flowers when 2 years old and lives for 8–10 years. It produces new growth in winter to spring and flowers in late winter to spring. Pods ripen in summer and seeds mainly germinate in the autumn. In its native range, recruitment is episodic and native populations are eventually replaced by longer-lived species if not disturbed. However, Montpellier broom populations in Australia reproduce without disturbance and are persistent.

Many other brooms also have seed that germinates soon after shedding and some hard seed that is long-lived in the soil seedbank. Germination of this seed is promoted by soil disturbance, an increase in light levels, or fire.

	Species	Habit	Flowers and season	Leaves	Seed pods	Legislation and notes	Distribution
	Scotch or English broom (*Cytisus scoparius*) Photo: Matthew Baker, Tasmanian Herbarium	Shrub 1–4 m tall; young branches 5-angled	Yellow but some naturalised hybrids have red and yellow flowers, 15–25 mm long; single or in pairs Mainly late winter to summer	Simple or 3 leaflets on a stalk; sparse; deciduous when plants are stressed	Narrowly oblong, 25–70 mm long, hairy along the opening; up to 22 seeds	Declared in ACT, NSW, SA, Tas., Vic. Quarantine weed in WA AQIS not permitted	ACT, NSW, SA, Tas., Vic. Widespread in cool wet areas Origin: Macronesia, Europe
	Montpellier or Cape broom (*Genista monspessulana*) Photo: Jackie Miles and Max Campbell	Shrub 1–3 m tall; stems ribbed	Yellow, 8–13 mm long; usually in groups of 3–7 on short branches Late winter and spring, sometimes late summer and autumn	3 egg-shaped leaflets on a short stalk	Narrowly oblong, 15–30 mm long, densely hairy; 5–8 seeds	Declared in ACT, NSW, SA, Tas., Vic. AQIS not permitted	ACT, NSW, Qld, SA, Tas., Vic. WA Widespread in southeastern Australia Origin: Mediterranean, Georgia
	Flax-leaf broom (*Genista linifolia*) Photo: Jackie Miles and Max Campbell	Shrub 1–3 m tall; stems ribbed	Yellow, 10–15 mm long; in groups of 3–16 Mainly in spring	3 narrow leaflets, 10–25 mm long, 0.5–4.5 mm wide; margins rolled under	Narrowly oblong, 13–30 mm long, densely hairy; 2–6 seeds	Declared in ACT, NSW, Vic. AQIS not permitted	NSW, SA, Tas., Vic., WA Scattered locations Origin: Canary Islands, W. Mediterranean
	Spanish or weavers broom (*Spartium junceum*) Photo: Matthew Baker, Tasmanian Herbarium	Shrub to 3 m (rarely to 5 m) tall; stems not ribbed	Yellow, 20–30 mm long, scented; in sprays, 5–20 flowered Spring to early summer	Simple, 10–30 mm long, 2–5 mm wide; sparse, may shed when plants are stressed	Slender, 60–80 mm long, approx. 6 mm wide; becoming hairless; mostly with 10–15 seeds	Declared in ACT, NSW	ACT, #NSW, Qld, SA, Tas., #Vic. Localised, uncommon Origin: Azores, Mediterranean, Caucasus
	Spiny broom (*Calicotome spinosa*) Photo: Andrew Steed	Shrub to 3 m tall with rigid spines to 7.5 cm long; stems hairless	Yellow, 12–15 mm long; in clusters of 1–5 Early summer (Nov—Dec)	3 leaflets, 5–10 mm long, 2–5 mm wide; on a stalk up to 10 mm long	Oblong, 25–45 mm long; lower margin winged, almost hairless; 5–15 seeds	Declared in Vic. Quarantine weed in WA AQIS not permitted	Vic. Localised, uncommon Origin: Mediterranean



Species	Habit	Flowers and season	Leaves	Seed pods	Legislation and notes	Distribution
 Tree lucerne or tagasaste (*Chamaecytisus palmensis*) Photo: Jackie Miles and Max Campbell	Shrub or tree to 5 m tall; branches hairy	Cream to white, 15–20 mm long; in groups of 3–7 or more Winter and early spring	3 leaflets 10–45 mm long on a stalk	Linear—oblong, mostly 40–60 mm long, 8–12 mm wide; densely hairy, mainly with 4–10 seeds	Not declared Commonly planted for fodder	ACT, NSW, SA, Tas., Vic., WA. Widespread Origin: Canary Island
 White Spanish broom (*Cytisus multiflorus*) Photo: Yoshi Nomura	Shrub to 3 m tall; stems ribbed	White with a pink streak, approx. 10 mm long; 1–3 per leaf axil Spring	3 leaflets to 12 mm long, 4 mm wide on a stalk, and simple leaves	Linear—oblong, 15–30 mm long, 4–7 mm wide, appressed silky; mostly with 3–7 seeds	Declared in Tas. Alert List species Parent of horticultural hybrids including *C.* x *dallimorei*	Vic. Localised, uncommon Origin: SW Europe
 White weeping broom (*Retama raetam*) Photo: John Virtue, SA DWLBC	Shrub to 3 m tall, 'weeping' habit; hairy when young	White, 8–10 mm long, pinkish base, in clusters of 3–15 Mainly winter and spring	Simple, tiny, narrow, hairy; deciduous	Obovoid, 15 mm long, 10 mm wide with a short point or beak; 1–2 seeds; either not opening at maturity or opening late	Alert List species Bridal broom (*R. monosperma*) is similar and is invasive in California	SA, WA Localised Origin: Mediterranean, Middle East, Canary Islands

Where the state flora or census records a species as present but not truly naturalised.

Weed identification

Introduced brooms naturalised in Australia have pea-flowers of various sizes and colours (mainly yellow or white). The stems are generally green and in some species leaves drop early so they are usually leafless. Leaves may be simple, comprise leaflets in threes, or both types may be present. The hybrid brooms grown in gardens commonly have weedy species as one or both parents. Gorse (*Ulex europaeus*), a relative of brooms, is a Weed of National Significance.

The main features of the broom species naturalised in Australia are summarised in the table on the following page.

Other broom species not covered in the table:

Dallimore's Spanish broom (*Cytisus* x *dallimorei*) = *Cytisus scoparius* cv. '*andreanus*' x *Cytisus multiflorus* is a WA Quarantine Weed.

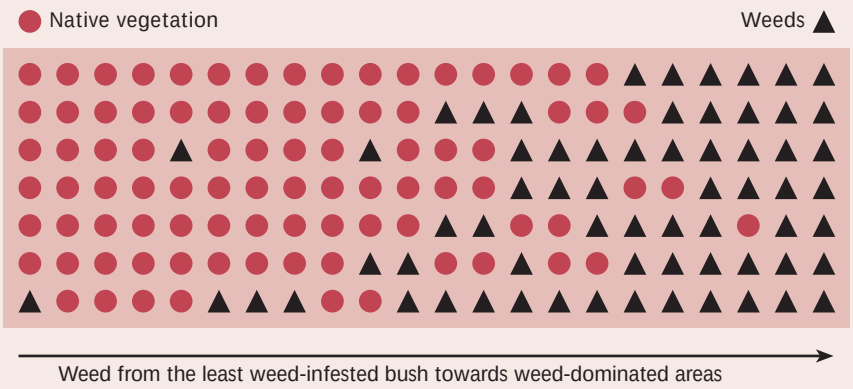
Madeira broom (*Genista stenopetala*) is naturalised but uncommon and localised in southeastern Australia. It is sometimes confused with *G.* x *spachiana* (naturalised in Vic.). It is a shrub to 6 m tall with terminal sprays of yellow flowers.

Dyers broom (*Genista tinctoria*) was recorded in Victoria but is probably not naturalised in Australia.

What to do about it

Strategies need to be developed at the regional level, to prevent brooms spreading and to reduce their impacts on biodiversity. In regions where one or more brooms are widespread, total eradication may not be a realistic goal. Sites of biodiversity significance need to be identified and accorded high priority for weed management. At the local or property scale a long-term management program targeting all brooms can reduce their harmful effects,

Strategic weeding in native vegetation



help contain spread and encourage native vegetation to recover. The capacity of a site to recover following broom removal is affected by the condition and type of native vegetation and also the age of the infestation.

Assist with biological control programs:

Community groups and schools can sometimes be involved in the raising, distribution and monitoring of biological control agents. For opportunities to assist in these efforts, departmental details are listed in the contact table.

Prevent brooms spreading:

Identify locations where broom occurs as isolated plants or sparse populations. Remove seedlings and treat isolated plants or clumps first and follow up. Keep uninfested areas free of broom and prevent additional weed species establishing in the region. Isolated plants are most easily detected when flowering, generally in spring. Accurate identification is essential as some native species may look similar to brooms.

Raise community awareness of weedy brooms. A number of the naturalised species are still available for sale, are not always labelled consistently and some cultivated forms have been known to spread. Provide information on alternative non-weedy plants, particularly local native species that are available for gardens.

Reduce established infestations:

A planned, strategic approach is essential to ensure that after treatment, broom is replaced by desirable plant cover rather than new broom seedlings, regrowth or other weeds. As well as the information presented in this guide on broom biology and control methods, a plan needs to be based on specific knowledge about the site—including the distribution of other major weeds.

Develop and implement a long-term weed management plan.

1. Investigate the site

- Identify all plant species: weeds including all brooms and native plants that need protecting.
- Map weed infestations: indicate weed density throughout the site, identify major sources of seed from which re-invasion can occur.
- Map native vegetation condition: assess its capacity for recovery after broom is removed and identify sites of high biodiversity value, such as rare flora.
- Values and risks: identify native fauna habitat values and high-risk sites for erosion potential and other factors.

2. Develop the site action plan

- Identify goals and priorities based on the site information.
- Define priority areas for control by overlaying maps of weed density, native vegetation, site values and risks.
- Plan to weed strategically:
  - protect the better quality native vegetation first and consider the needs of rare fauna and flora
  - work from isolated broom plants towards core infestations
  - control plants from upstream to downstream.
- The size of the area targeted at each stage should be manageable enough to follow up thoroughly. Seedlings and regrowth need to be removed before they replenish the seedbank.
- Include control of other weeds so that they do not establish where broom has been removed.
- Select the most suitable control method for each weed growth stage to avoid damage to native vegetation. Plan appropriate disposal of weed material.
- Prepare a weed management calendar to maximise the effectiveness of control activities including avoiding the breeding seasons of key native species.

3. Implement the action plan

- Remove broom from the least infested areas into the more infested areas. Minimise soil disturbance and ensure that activities do not spread the seed. Adapt to local seasonal conditions.
- Follow up broom regrowth each year in areas previously treated before moving further into the infestation.
- Coordinate control programs with neighbouring landholders to maximise effectiveness and reduce ongoing spread.

4. Monitor and evaluate outcomes and adapt the plan accordingly

Include monitoring of native plant regeneration. In weed management programs there is often a tendency to focus on the removal of weeds as

White weeping broom (*Retama raetam*) seedlings rapidly develop deep taproots and survive dry conditions.
Photo: D. Agnew, Northern and Yorke NRM Board

a goal, but at the site level the ultimate goal is restoration of native vegetation, or productive pastures for grazing properties.

Control methods

Brooms are difficult to manage in native vegetation because they form dense stands, have a high growth rate, produce a large seedbank and generally resprout from the base. Seed may germinate in large numbers after mechanical removal, hand pulling, herbicide treatment or fire. Once Scotch or Montpellier broom is well established in native vegetation, restoration through natural regeneration is difficult to achieve, particularly in older stands, where dense broom prevents replenishment of the native rootstock and seedbank.

The key to successful management of brooms is to integrate a range of treatments tailored to the situation, including biological control where available. Perseverance is required, with consistent effort over the long term to create conditions in which native plants regenerate and the broom seedbank declines. Methods that are effective on the major broom weeds are generally the starting point for trials on the less common species. Different methods may be appropriate for sparse broom plants amongst native vegetation, compared with dense, established infestations.

Biological control

Due to the major threat to native vegetation from Scotch broom in south eastern Australia, biological control agents have been introduced for this species. Several insects have become established in Australia but have not yet had a major impact on its infestations or its spread. More recently, research has commenced into biological control of Montpellier broom and potential agents have been identified. As these broom species are also major weeds in America and New Zealand, biological control research has involved international collaboration.

Fire

Burning is often seen as an effective first stage in controlling weeds such as broom as hot fire removes the above ground plants and destroys or stimulates germination of soil-stored seed. However, burning has other impacts. Native plants will have been affected and some broom plants may survive and resprout more rapidly.

Decisions about if and when to burn require careful consideration of a range of issues and consultation with fire authorities. Stands of broom should only be burnt as a component of a comprehensive long-term vegetation management plan. Native and weed species need to be managed when targeting regrowth of broom. Repeated fires at short intervals would have unpredictable impacts on natives. Fire, whether planned or unplanned, should be followed up with different treatments to selectively remove broom regenerating among natives.

Physical weed removal

Hand pulling can be an effective method for removing small or isolated broom plants within native vegetation. If a stand has been established for only a few years, remove plants before seeding, but for older stands that already have a broom seedbank this is less critical. Small to medium-sized plants can be hand pulled when the soil is moist, but the resulting disturbance of the soil and increased light will lead to germination of soil-stored seed in mature infestations. Hand weeding or other treatment will be necessary to continue the follow up work, while protecting native plants. Avoid removing plants carrying mature seed if possible, otherwise safe disposal is required. Weed material can be either bagged and removed, or heaped and carefully burnt on site, ensuring that no viable seed remains.

In accessible, broom-infested areas such as non-native pastures, mechanical equipment may be used to mulch non-seeding broom plants with minimum soil disturbance. The layer of broom mulch may suppress regrowth and seedlings temporarily, assisting with follow up work. Resources will be needed over the long term to re-establish vegetation through natural regeneration or planting.

Chemical control

Herbicide can be highly effective, providing it is carefully chosen and selectively applied to minimise regrowth and off-target damage. The main herbicide treatments for brooms are foliar spray, cut-stump, stem injection and basal bark application. All of these methods are only effective if the plants are actively growing at the time of application. While more labour intensive than foliar spray, stem treatments of

long-established plants are dependable and minimise off-target damage. Limited information is available on the most effective treatments for the less common brooms.

Foliar spray

For spraying to be effective, all weed foliage must be wetted and the equipment suited to the size of the plants. In native vegetation, careful spot spraying using hand-held equipment (handgun and hose or knapsack) would be required to avoid off-target damage. In this situation, foliar spraying is generally limited to small plants and regrowth under conditions when spray drift will not occur.

Foliar spray is most suitable where a carpet of broom seedlings appears after disturbance. Native plants need to be located and shielded from spray contact.

Cut-stump application

Suitable for all basal stem sizes

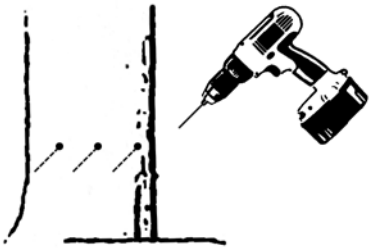
All stems are cut horizontally with secateurs, bush saw or a chainsaw no higher than 15 cm from the ground and the cut surface painted immediately (within 10 seconds) with herbicide, using a hand-held spray bottle or a brush. For large infestations, a team of two or more people need to work together. Use a dye in the mixture to show that stems have been treated.

Preliminary trials have indicated that cut-stump herbicide application is an effective treatment for mature plants of white weeping broom.

Stem injection

For basal stem diameter larger than 5 cm

Drill holes at approximately 5 cm intervals around the stem, angled downwards and sideways. Holes need only be as deep as the living wood just under the bark. Fill immediately with herbicide using a squirt bottle or plastic syringe.



Stem injection. Side view of trunk showing 45°-angled holes in sapwood.

Basal bark application

For basal stem diameter up to 5 cm

Bark of all stems needs to be sprayed or painted with suitable herbicide around the entire circumference to a height of at least 30 cm from ground level.

Registered herbicides for brooms

Various triclopyr products are registered for foliar spraying Scotch (English) broom or *Genista* spp. in spring to mid summer prior to pod formation. Foliar spot spray of Scotch broom is also included on the label for aquatic formulation of glyphosate. Triclopyr applied via basal bark or cut stump treatment is listed on labels for Tas. only. These herbicides are translocated and are not herbicide active in the soil. Glyphosate is not selective and can affect any type of plant and Triclopyr affects plants other than grasses. Other mixtures are also registered for particular brooms but soil-residual herbicides involve greater risk in native vegetation.

When using herbicides always read the label and follow instructions carefully. At least one member of a group should have formal training in the safe storage, handling, preparation and use of the chosen herbicides. Particular care should be taken near waterways because rainfall runoff will carry herbicides. Use special formulations for such environments where appropriate.

Alternative methods of applying glyphosate

Cut-stump application and stem injection of glyphosate for brooms are not included on registered labels. A 'Permit to allow minor use of an AGVET chemical product' may be issued to allow registered products to be used for a purpose or in a manner that is not included on the approved label. Permits that include stem treatment of brooms with glyphosate in some situations exist in Tas., WA, Qld, SA, NSW and the ACT. Refer to the Australian Pesticides and Veterinary Medicines Authority website to find the relevant permit for your state or territory and obtain advice on local conditions from the permit holder. Refer to the fact sheet 'Off label chemical use in Victoria' for sources of advice in that state.

Research is underway comparing chemicals and methods for controlling white weeping broom in SA with a view to applying for a minor use permit. Refer to contacts table for current information.

Where covered by a permit non-residual, systemic chemicals are often applied to individual weed plants in native vegetation by community groups, landholders and public land managers.

...case study

Controlling broom after major fires in the Victorian Alps

Scotch (or English) broom (*Cytisus scoparius*) has been present in the Victorian Alps for many decades and is actively invading native subalpine vegetation, where it is a major threat to biodiversity. Parks Victoria, manager of the Alpine National Park, has an ongoing strategy for containing broom and minimising its impacts with the following main aims:

- eradicate isolated broom populations
- progressively remove broom from catchment headwaters and other high value sites
- keep seed-bearing broom plants away from roads and tracks to minimise spread by vehicles and walkers.

Dense regeneration of Scotch broom (*Cytisus scoparius*) in competition with native understorey after the 2003 fires in the Victorian Alps.
Photo: Parks Victoria

After extensive wildfires in January 2003, broom germinated from the seedbank forming dense thickets, and where the fires were most intense the seedbank was diminished. The fires also destroyed populations of broom-feeding insects that had been introduced as potential biological control (biocontrol) agents.

Parks Victoria recognised that the area, density and impact of broom infestations in the region would greatly increase if these new thickets were allowed to produce seed. A major collaborative program was put in place to tackle the task of minimising this replenishment. Partners in the program, coordinated and led by Parks Victoria, include state government agencies, the catchment management authority, community recreational organisations, local government, private landholders and sponsors.

The program included:

- trials of the effectiveness, timing and cost efficiency of three herbicides sprayed at label rates including a glyphosate aquatic formulation
- monitoring to evaluate which plant species regenerate after weed removal
- applying control techniques more widely if they were successful in trials
- targeting isolated broom patches recorded using GPS
- reintroducing the biocontrol agent, the twig-mining moth (*Leucoptera spartifoliella*)
- community workshops and involvement of private landholders, landcare groups and schools.

This last point recognises that communication and consultation are vital to coordinate weed control across property boundaries and to ensure that biocontrol agent release sites are not inadvertently damaged by spraying or controlled fires. Monitoring outcomes and adapting the management program are also essential.

Early herbicide trial results found that commencing spraying in the autumn, 15 months after the fires, was more effective and less expensive than commencing the following spring, 21 months after the fires. This remained the case in 2005 and 2006, indicating the benefits of early commencement of treatment post-fire (2007 data are currently being analysed). It is possible that a commencement of spraying during the first spring, 9 months post-fire, may have resulted in even greater control effectiveness. There were differences in the impacts of treatments on broom stands, however none of the herbicides resulted in a total broom kill.

After 3 years there were changes to native vegetation across all sites, in both treated and control (untreated) plots. Herbaceous species were the most susceptible growth form, both to increasing broom density (in unsprayed plots) and to herbicide application, and their cover and richness decreased.

Perseverance with the trials and the collaborative program, informed by continued monitoring of the results (~10% of the costs) is needed to find effective ways to contain the spread of broom and minimise its impacts on biodiversity. The search for effective biocontrol agents continues and planning is advanced to introduce the broom gall mite (*Aceria genistae*) later in 2008.

Contacts

State / Territory	Department	Phone	Email	Website
ACT	Dept of Territory and Municipal Services	132281	N/A	www.tams.act.gov.au/live/environment
NSW	Dept of Primary Industries Dept of Environment and Climate Change	1800 680 244 131555	weeds@dpi.nsw.gov.au info@environment.nsw.gov.au	www.dpi.nsw.gov.au/weeds www.environment.nsw.gov.au
Qld	Dept of Primary Industries and Fisheries	132523	callweb@dpi.qld.gov.au	www.dpi.qld.gov.au
SA	Dept of Water, Land and Biodiversity Conservation	(08) 8303 9620	N/A	www.dwlbc.sa.gov.au
Tas.	Dept of Primary Industries and Water	1300 368 550	weedsenquiries@dpiw.tas.gov.au	www.dpiw.tas.gov.au
Vic.	Dept of Primary Industries Dept of Sustainability and Environment	136186	customer.service@dpi.vic.gov.au customer.service@dse.vic.gov.au	www.dpi.vic.gov.au www.dse.vic.gov.au
WA	Dept of Agriculture and Food	(08) 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au
Australia-wide	Australian Pesticides and Veterinary Medicines Authority (APVMA)	(02) 6210 4700	N/A	www.apvma.gov.au

Contact details for state and territory agencies with responsibility for weeds are listed above, along with the APVMA. The APVMA website hosts the PUBCRIS database which contains information on all herbicides that are registered for use on weeds in each Australian state and territory, including minor use permits.

Consult the natural resource management organisation for your region or local council to find local contacts on managing weeds for biodiversity, including community groups working on brooms.

Refer to the CRC for Australian Weed Management website (www.weedscrc.org.au) for weed management guides in this series, as well as guides for Weeds of National Significance and Alert List species. The Introductory Weed Management Manual (also available from this website) may assist in developing a plan tailored to your situation.

Legislation

Under national quarantine legislation a wide range of broom species and hybrids are permitted entry as seeds to Australia without prior weed risk assessment. Exceptions are *Cytisus scoparius*, *Genista monspessulana*, *G. linifolia* and *Calicotome spinosa*, all of which are declared weeds at a state or regional level.

In total, five species of broom are declared weeds in one or more states with the aim being to require control of species that have a major impact and to apply quarantine measures (see the table: Naturalised broom species in Australia). Introduction of Scotch broom and spiny broom to WA and white Spanish broom to Tas. are prohibited. White Spanish broom and Spanish broom are under consideration in the Victorian noxious weeds review. Invasion and establishment of Scotch broom is a key threatening process under the NSW *Threatened Species Conservation Act 1995*.

Where brooms are widespread weeds, legislation encourages involvement of all landholders in coordinated, long-term programs to reduce impacts and minimise spread into uninfested areas (see the table above for further details relevant to your location). However, declared brooms may still be available to gardeners. Broom control that could significantly damage native vegetation may be regulated by legislation.

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Map: Australia's Virtual Herbarium, (*Cytisus scoparius* and *Genista monspessulana*), via Royal Botanic Gardens Melbourne, Council of Heads of Australian Herbaria. www.rbg.vic.gov.au/cgi-bin/avhpublic/avh.cgi

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Montpellier broom (*Genista monspessulana*) invading regrowth eucalypt woodlands, Mt Lofty Ranges, SA.
Photo: Peter Martin

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Knowledge gaps

Little is known about the biology of the less common broom species and methods for their control. Few comparative studies have been undertaken on native vegetation invaded by broom that would assist in predicting the response of native plants as well as brooms to various management options. Such information is needed to enable the most appropriate actions to be planned for each site at all stages in a broom management program.

Strategic management of brooms

Quick reference guide

Scotch broom – *Cytisus scoparius* and other introduced brooms

Regional / local status of brooms	Not yet established	Small, isolated outbreaks	Widely established
Management goals	Prevent establishment	Eradicate	Contain infestations and mitigate threats
Strategies required	Practise weed hygiene Raise community awareness and capacity to recognise the weeds and the problem Monitor, detect and identify possible new infestations	Do not allow young stands to seed Treat manually or using herbicide with minimal disturbance Follow up Prevent re-establishment or invasion by other weeds and encourage natural regeneration of native vegetation	Native vegetation: Identify high priority biodiversity assets under threat from brooms Protect them through implementing long-term site management plans Public and private gardens: Replace any known weedy species Monitor specimens of other brooms and remove if seedlings found Roadsides and other corridors: Map infestations and practise weed hygiene to prevent spread along and from roadsides into native vegetation Pastures: Options may include mulching (not bulldozing) or strategic grazing to restore broom-infested pastures

Vegetation management or weed control?

Adopt a strategic, integrated, long-term approach to maximise restoration of native vegetation and minimise reinvasion by broom or other weeds.

Natural regeneration of native plants is the best form of revegetation, but in sites dominated by broom over many years, there may be no native plants or seed remaining. Where this is the case, establish a range of indigenous plants.

Adapt the control method to the situation

Brooms occur in a range of environmental conditions and land uses. Mulching, grazing or repeated use of fire may be appropriate in introduced pasture but would be unlikely to assist regeneration of native vegetation to replace broom.

Apply herbicides during periods of active growth

Herbicide should be applied when plants are leafy and actively growing, preferably before seeds mature. Avoid hot or wet conditions, or periods when plants are under stress, as specified on the herbicide label.

Consider disposal options

Cut broom should not be left on top of native vegetation. Cut stems bearing viable seeds should be collected and removed or heaped and carefully burnt, ensuring no viable seed remains.

Follow up

It is essential to monitor for regrowth from stumps after physical or chemical treatment and follow up thoroughly.

Prevent broom re-establishment

Once fruiting plants have been killed, the focus is on preventing re-establishment of stands and replenishment of the seedbank. A few germinating seeds can quickly produce a large infestation if neglected, so ongoing surveillance will be needed.

- Avoid large-scale disturbance that would create extensive areas of bare soil, such as too-frequent fire in native vegetation or overgrazing in pasture.
- Identify likely broom seed sources, dispersal agents and patterns of invasion.
- Monitor broom-free areas every 2 years at the start of the flowering season to detect and remove seedlings and young plants before they seed.

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