

Section Five

Linking control with restoration



Terry Inkison, Great Lakes Council



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Follow-up control

Definitions

Bush regeneration

The practice of restoring bushland by focusing on re-instating and re-inforcing the system's ongoing natural regeneration processes (mainly via minimal impact control).

Control

The active treatment or management of weed species (to prevent or reduce their further impacts).

Natural regeneration

The germination of native plants from seeds or propagules without human intervention, leading to self-sustaining populations.

Rehabilitation

The returning of land to a pre-determined, stable condition which blends with the surrounding landscape, but not necessarily to its original form or land use, often requiring major works.

Resilience

The ability of the native vegetation to recover after disturbance events such as clearing, or long-term suppression (e.g. from weeds).

Restoration

The returning of degraded habitats to an approximation of the natural condition or an agreed condition.

Revegetation

The re-establishment of native vegetation through active human involvement (e.g. planting of tube-stock or direct seeding).

Control of bitou bush alone will rarely lead to achieving your goals and thus other management activities will be needed. These may include active restoration or accommodating natural regeneration. Information is presented in this section on restoration activities and the things to consider when choosing to implement them.

Control stages

There are three stages in achieving successful bitou bush control: stages 2 and 3 involve linking restoration with control.

1. **Primary weed control** – the initial removal of all weeds, for example, adults through to existing seedlings.
2. **Secondary treatment** (follow-up control) – intensive control of the seedlings that emerge after primary weed control, as well as any resprouting of existing plants. This part of the program could take several years.
3. **Maintenance weeding** (follow-up control) – the ongoing removal of all bitou bush seedlings that establish from the seed bank or from seeds spread into the area by birds or other sources, after primary and secondary control. The level of weeding required here is low, but the duration may be long.

Follow-up control (i.e. secondary treatment and maintenance weeding) is crucial because bitou bush seedlings can continue to germinate from the seed bank for many years. The extent of follow-up control required will decrease with time if all plants are treated annually. The rate of seed bank decline is dependent on the size of the seed bank and germination rate of seeds from that seed bank.

To achieve effective follow-up control you should:

- Inspect areas within six to 12 months of primary control. Remove all bitou bush seedlings by handweeding or foliar spraying before they flower and set seed. Also treat all regrowing plants or plants missed during the primary control.
- Inspect areas every 12 months (at least) for the next three years and remove new bitou bush seedlings by handweeding or foliar spraying before they flower and set seed.
- Maintain the area free of bitou bush plants by surveying regularly for new plants. Remove all plants detected. Pay close attention to areas where seeds might collect, such as under tree roosts and along fence lines where birds perch.



Terry Inkson, Great Lakes Council

Before primary weed control



Terry Inkson, Great Lakes Council

After primary weed control, under secondary treatment

- Monitor your progress in terms of number of plants treated, costs and time spent on control, time elapsed since primary control and date that plants were last treated.

 **Revisit the intended outcome/goal for your site regularly to gauge progress.**

Impact of bitou bush removal on plant succession

An understanding of native plant succession is also important following primary weed control. Some species are early successional species (e.g. the colonisers like wattles) and will germinate first and establish fast, even becoming dominant. Other species are later successional species and will germinate and

establish over time. Thus achieving a diverse community of native plant species may require a number of years following control.

Removing bitou bush as the dominant species in an ecosystem leaves a niche to be filled by the fastest, most easily established species (primary colonisers). Often the plant species that are most opportunistic in a disturbance situation (such as bitou bush removal) are other weed species.

Other weed species may be present in small numbers before bitou bush is treated or may invade after bitou bush is removed. Your management plan (see Section 2) must encompass the management of these other weed species. Some of these species may be more difficult to control than bitou bush; a list of weeds to look out for is on page 30 in Section 3. Your efforts in controlling bitou bush may be negated if another weed species becomes dominant and requires intensive control.

Weed dynamics after fire

A controlled burn at Illuka Bluff Nature Reserve on the Far North Coast of New South Wales was effective in controlling bitou bush, however the nature of the other weeds on the site changed after the fire. In the years following the burn and subsequent bitou bush control, a low native canopy developed in more protected locations from both plantings and natural revegetation. This allowed the establishment of bird/animal dispersed weeds such as *Lantana camara*, *Rivina humilis* and *Solanum seaforthianum*, which required ongoing management.

Nevertheless, growth of native species has been extensive on Illuka Bluff and the surrounding area, and the site has now been completely transformed to a thriving native plant community. This is an important example of how ongoing holistic management is essential to management of a site as a whole after bitou bush is contained.



Paul Downey

Bitou bush and lantana co-occurring on the North Coast of New South Wales

Restoring native vegetation

Returning degraded habitats to an approximation of the natural condition, or an agreed condition, may require active restoration (via revegetation) as well as relying on natural regeneration. Deciding on which process to undertake requires an understanding of the resilience of individual plant species and the vegetation community.

 **You may wish to wait and determine the level of natural regeneration at your site before beginning any revegetation activities.**

Natural regeneration

Natural regeneration is preferable to revegetation because:

- Locally present native plant species are adapted specifically to the site or environment. Such species are also known as 'local provenance' species,
- Local biodiversity is conserved,
- Natural regeneration is far more cost-effective than revegetation, and
- Natural regeneration may lead to greater establishment success than revegetation.

Also see the case study *Replacing bitou bush the natural way* on page 92.

Determining resilience across species

The level of resilience at your site will determine the need for revegetation. Resilience of native vegetation depends on the soil seed bank and propagule characteristics (e.g. some species store their seeds in cones or other structures) and the species' ability to re-establish – either directly on site (e.g. from the seed bank) or by spreading from nearby areas.

The composition of native species present at a site (above ground) is not always reflected in the composition of the soil seed bank (below ground) and vice versa. For example, propagules of some above ground species may not be present in the soil seed bank or may be present in low numbers. This is especially so for species that hold their seeds above ground (e.g. banksia seeds are stored in cones), and those that do not possess seed dormancy mechanisms. In long-invaded sites, native species seed may only be present below ground (in the soil seed bank). Therefore, the level and diversity of natural regeneration may not be what you expect.

Dispersal mechanisms are highly significant in assessing resilience. For example, in rainforest communities, the proportion of species which can be dispersed long distances (i.e. are wind or animal dispersed) is less than 50%, and as low as 20% in sclerophyll sites (Westoby *et al.* 1990).

Unless an adult plant exists within the immediate area, species with short distance dispersal vectors (e.g. ants or gravity) may never arrive at your site by natural means.

There are a range of management activities that can be used to promote the recruitment of native species from the seed bank. For example, burning piles of dead bitou bush may stimulate native seeds to germinate.

Below is a list of situations when natural regeneration should be used, in order of resilience potential of the site. Remember, resilience may be difficult to assess at a single point in time, so consider leaving a site to naturally regenerate if it is:

1. Newly invaded, hence still has a good level of resilience (e.g. there is a diverse native seed bank and many seeding adults are still present spanning a range of native plant species),
2. Recently invaded (i.e. <5 years) and still has a native seed bank and some seeding adults,
3. Invaded but has a viable native seed bank (apparent over time) and a few seeding adults, and
4. Long-invaded, with a decreasing seed bank and few seeding adults (reassess over time).

If natural regeneration is an option at your site then you should select control methods (primary through to maintenance) that either encourage native plants to regenerate from the existing seeds or soil seed bank, or disperse in from nearby areas.

Revegetation

Where a site has low resilience, restoration will require some kind of revegetation. It is important that you assess the site to determine



Stephen Booth

Native seedling growing up through mulched bitou bush canes

the level of resilience *before* planning any revegetation activities. Revegetation may also be required if key native species are missing from your site and are unlikely to return via natural recruitment or spread, or if there is an immediate risk of erosion following bitou bush removal (leaving the site to naturally regenerate without any revegetation activities in such instances is not advisable).

When developing a revegetation program, you will need to consider:

- What native plant species are you going to use? Consideration should be given to the rare (or cryptic) species, as they are seldom replaced during restoration programs.
- Where do you intend to plant them (i.e. their position at your site)?
- How many individuals of each are you going to use (the density of planting)?
- What is the likely survival rate, and does this influence the number you use?
- What revegetation methods will you use (e.g. direct seeding versus planting of seedlings)?
- Are the species locally occurring (e.g. local provenance)?
- What vegetation type or community are you trying to replace?
- How easily can you source the seeds or tube-stock seedlings?
- Are extra commitments needed (e.g. watering of planted tube-stock seedlings, or scarification of seed)?
- What is the cost?

“Weed control (by hand) provides probably the most ideal opportunity for workers to identify at close hand the emerging native seedlings amongst the weeds. We do this every three to six months after primary clearing and monitor the gradual emergence of native seedlings as the weeds are hand-culled.” – Lee Andresen, Angels Beach Landcare.



Steve McRae

Strip planting between protective barriers of bitou bush

When choosing native plant species to replant, it is preferable that you use locally indigenous species, preferably those propagated using material sourced from the local bushland (local provenance species) or a local nursery. If possible, include the rarer (more cryptic) species, as this will help to restore natural diversity. A permit may be required to collect seed from some species – see page 106 for further information.

For detailed information on revegetation see *Bush Regeneration: Recovering Australian Landscapes* by Robin Buchanan (1989).

Revegetating sand dunes

In sand dune environments, re-establishing native coastal vegetation should be both appropriate to the geographical area and position within the dune system, and able to sufficiently provide plant cover to protect fragile dunes against wind erosion. For details on revegetation succession see the *Coastal Dune Management Manual* (NSW DLWC 2001), or check the restoration resource information on page 70.

Ensure that you target revegetation activities in both the hind dune and foredune areas simultaneously to maximise restoration and promote dune stability. You may need to start with hardy pioneer plants such as beach birds eye (*Alectryon coriaceus*) or beach spinifex grass (*Spinifex sericeus*).

To ensure stability, such plantings can be done gradually by controlling small patches of

bitou bush and then waiting for the natives to establish before moving on to the next patch of bitou bush. Alternatively, if using manual control techniques in medium or low density bitou bush infestations, plantings can be undertaken before control activities start, with control occurring after native species have established.

Ensuring success of native seedlings

When using tube-stock seedlings you may need to undertake additional steps to ensure their survival. For example, protection such as tree guards may be necessary in areas where grazing or browsing pressure from native animals is high. Other activities may include watering seedlings until they establish in the field or using water crystals at the time of planting. Water crystals must be buried wet and below the plants, otherwise when they expand they may push the plants out of the ground. Alternatively, wide strips of torn up newspaper may be soaked in water and laid inside the holes before planting. Hydrolyzers may be used if there is a hydrophobic barrier in the soil.

Timing is important for successful revegetation for both direct seeding or tube-stock plantings. Try to schedule weed control activities in your weed management plan (see Section 2) to coincide with the best time to revegetate with native plant species, for example with respect to rainfall, season and the species ecology.



Jeff Thomas

Tree guards can help to protect tube-stock seedlings planted in the field

Direct seeding

Direct seeding is the act of broadly spreading seeds onto the ground either by hand or with a machine (including by air during aerial herbicide application), for the purpose of regeneration. Direct seeding is a useful technique when soil seed banks have been heavily depleted and large scale plantings are needed.

Direct seeding is expensive because of the large amount of effort required to collect seed. Many of the easy-to-collect species such as *Acacia longifolia* ssp. *sophorae* (coastal wattle) are likely to be readily present in the seed bank and easily germinable, and hence don't need to be direct seeded.

Native seeds can be collected on site or in the nearby area, or purchased from a supplier. If collecting seed you must ensure that you have a licence and appropriate permissions from landholders to collect such seed, regardless of how common or rare the species is. It is best to check with your local nursery or bushland officer for advice on which species to use, and when, where and how to collect their seeds. Use the resource information provided on page 70.

At your site, seeds from fruiting plants may be opportunistically sown by collecting and broadcasting them as you pass by. Consider brush matting (the laying of branches carrying ripe fruit on the ground) as another option. Check with your local council for any permit requirements.

Seeds may need to be treated (e.g. scarified) prior to direct seeding so that they can germinate readily. However, the time of direct seeding is important because treated seeds rely on rainfall within a few days for the results to be most effective. Therefore you should consider treating only half of the seeds to ensure some seed is available to respond to varied weather conditions. Pre-treatment can result in immediate germination, which can also help to avoid seed predation by ants or other animals.

Treatment of seeds may not be an option for all native plant species and you should



Stephen Booth

A banksia seedling germinated on site

seek advice from a botanist or horticulturist beforehand. It is also valuable to distribute seeds after herbicide application and bitou bush defoliation, when competition with adult bitou bush plants is limited.

 **Whether through natural regeneration or revegetation, bushland restoration is a long-term process that requires an extended commitment.**

Site rehabilitation

Rehabilitation activities are often a crucial component of any restoration program. They can determine the success or failure of the program. Thus, site rehabilitation needs to be considered during the planning stage of your weed control program (see Section 2). Rehabilitation activities include: erosion control, stabilising soils and reconstructing environments (e.g. reforming sand dunes). Rehabilitation activities also need to occur in combination with control and other restoration activities like revegetation.

Managing erosion and stabilising soils

Bitou bush often occurs in erosion prone areas such as on sea cliffs and sand dunes, where erosion can occur as a result of water or wind action. Water erosion in bitou bush infestations occurs from ocean forces (e.g. waves) or from run-off following rain. Managing ocean-driven erosion is very difficult and requires an understanding of such processes. It is best

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achieved in conjunction with revegetation activities. The *Coastal Dune Management Manual* may be helpful for this; also see the table on page 70 for other information sources.

Managing wind erosion in bitou bush infested areas can be achieved using shade cloth or hessian fences to reduce the loss of wind blown sand/soil from the site. On-ground control of erosion is best done using mulched plant material or hessian laid along the ground. Bitou bush mulch can also be used. Staged control and revegetation activities may also limit soil erosion.



Jeif Thomas

Shade cloth fence tapered at the end to minimise sand build up



Steve McRae

Hessian staked into the ground can help minimise water erosion



Terry Inkson, Great Lakes Council

Timber and shade cloth fences can reduce wind erosion

Using dead bitou bush to limit soil erosion

Hand made 'eco-logs' can be built out of hessian wrapped around dead bitou bush plants. These logs are then pegged in place to provide a flexible structure that controls erosion and promotes litter accumulation.



Weed biomass is placed onto a length of hessian



The hessian is wrapped around the weed biomass and tied with string to form a flexible log structure



The eco-logs are secured using wooden stakes and shaped into arcs to create a pooling effect which then overflows to the next pool



Recently made eco-logs in 2005



Eco-logs in 2007 which have begun to decompose and collect sediments and organic material

All photographs provided by Trees in Newcastle

Advantages of hand made eco-logs

- Makes use of dead bitou bush plants,
- Uses decomposable materials for erosion control,
- Collects sediment and debris which allow for plant growth,
- Cheaper than buying pre-made eco-logs,
- Light and easy to manage when positioning into place, and
- Useful for disposing of bitou bush as it can't be transported, according to weeds legislation in all states.

Disadvantages of hand made eco-logs

- Requires more time and effort than buying pre-made eco-logs, and
- Not recommended for use when there are seeds on the dead bitou bush plants.

Mulching

Mulching dead (sprayed or handweeded) bitou bush plants by hand-lopping or machinery and spreading the mulched material over the ground will help control surface erosion and retain soil moisture. Mulching the standing bitou bush biomass can also improve the aesthetics of the site and reduce the risk of accidental or deliberate fire events.



Reece Luxton, Clarence Valley Shire Council

Mulching reduces fire hazard

Plants can be cut into small pieces (about 30 cm long) and spread evenly over the ground. Alternatively, mechanical mulchers can be used where vehicle access to the site is possible (see Section 4). Be careful, however, not to lay the mulch too thickly as this may prevent native regeneration.

Mulching will not completely suppress bitou bush germination, therefore follow-up control is essential. Also, bitou bush foliage is able to produce allelopathic chemicals which may suppress germination of native species for up to three months or more after control or mulching.

 **Note: In low nutrient environments, mulching bitou bush on site will increase nutrient levels in the soil. This can have adverse impacts on native vegetation adapted to low nutrient soils (such as heath), by favouring weeds that thrive on high nutrient loads. Be careful where you use bitou bush as mulch, so you don't provide a competitive advantage to the weeds!**



Lachlan Sims

Hand cut bitou bush mulch on site

Lake Cathie Mechanical Mulching – a disposal method for cleared bitou bush

Lake Cathie Landcare group have been handweeding extensive amounts of bitou bush since early 2007. Burning dead plants was not permitted and mulching by hand or carting plants away was not an option.

The quantities of dead plants were so large that the piles were causing a fire hazard (from accidental or deliberate lighting). Also, the piles were numerous and presenting a safety risk to volunteers working on further weeding.

The solution came with the purchase of a chipper/mulcher (driven by the power-take-off of the group’s small tractor) which can be moved into almost any work area.

One issue the group considered prior to mulching was what would happen to the bitou bush seed on the plants when mulched.

Lake Cathie Landcare coordinator, Rob Tate, said, “The seeds were not really a problem because we had an opportunity to control the seed from the removed plants”. The Landcare group found that if the mulch is heaped for about fourteen days after being processed, the vegetation begins composting which decomposes the seed. The group now

uses the composted mulch spread in a thin layer to protect native species germinating from the seed bank or after direct seeding, or to protect planted tube-stock. Regrowth from any remaining bitou bush seeds is easily controlled.

The group has witnessed positive results over the past twelve months using this technique, with only minimal regrowth of bitou bush. On the other hand, regrowth of natives from the seed bank and new plantings has been very encouraging.



Jack Jones



Jack Jones

Control and restoration considerations for native species

Broad scale control of bitou bush monocultures may create flow-on effects and alter native ecosystems. For example, removing large areas of bitou bush can deplete food and shelter for native animals which may rely on it as a primary source of food or habitat. Research has found that bird species which consume bitou bush fruit were less abundant following herbicide treatment of bitou bush, that suggests that the dramatic reduction in the amount of bitou bush fruit available caused them to forage elsewhere. Make sure you consider the requirements of native fauna when planning bitou bush control and restoration activities.



Marrion Winkler

Working around the needs of resident fauna may mean balancing the need for bitou bush control with habitat protection

Reconstructing environments – restoration of dunes under bitou bush hummocks

Bitou bush can form hummocks in sand dunes (see Section 3). Removing bitou bush from these hummocks and restoring them to natural habitats is a difficult task that may require substantial rehabilitation and restoration effort.

Fencing off these areas from public access is a good starting point to limit further erosion from 4WD traffic or from people walking on the dunes. However, this will not stop wind erosion which maybe exacerbated by the wind being channelled between the hummocks. The *Coastal Dune Management Manual* (NSW DLWC 2001) is an excellent resource covering various aspects of restoration in dune environments including rehabilitation of eroded dunes (see resources table on page 70).

Planting, brush matting and/or direct seeding can be used to fill in the gaps between hummocks (see the case study *Staged removal of bitou bush to protect Aboriginal sites and conserve biodiversity on the Yaccaba Peninsula*, page 90), however removing the bitou bush hummocks entirely may be the desired goal.

The process of dune reshaping is one way to rehabilitate the dunes after severe erosion events in areas with bitou bush hummocks. Heavy machinery may be used to uproot and bury bitou bush plants deep under the sand, clearing and reshaping the sand dunes entirely and preparing the site for revegetation. *Dune reconstruction is only suitable where bitou bush is the only remaining vegetation cover and erosion on the foredunes has become so extreme that natural regeneration is no longer a possibility.*

It is not suitable to use heavy machinery where threatened species of fauna or flora are present, or where long-term maintenance of the area is uncertain. Long-term commitment to site rehabilitation and restoration after dune reshaping is essential.

Before embarking on such reconstruction activities ensure that you:

- Consider all other options carefully,
- Set long-term commitments in place from the outset,
- Consider the revegetation options,
- Check for threatened species and nesting shore birds sites. Assess if they are/can be protected accordingly during your activities,
- Secure appropriate approvals. For example, a development application may need to be prepared for the project and approved by your local council, and
- Form appropriate communication networks and consult all relevant stakeholders.



Paul Marynissen, Wyong Shire Council

Heavy machinery being used to resculpt sand dunes



Paul Marynissen, Wyong Shire Council

A windrow of uprooted bitou bush plants on the dune crest

Restoration resource information

Resource	Information available
Florabank www.florabank.org.au	<ul style="list-style-type: none"> Information and guidelines (for download) on all stages of preparation, seed collection, seed cleaning, handling, storage, and native plant propagation Extensive web links
Greening Australia www.greeningaustralia.org.au	<ul style="list-style-type: none"> <i>Bush Tracks</i>: a database of high value vegetation management publications <i>Online Native Vegetation Guides</i>: directories of research and resources for vegetation management Facts sheets, conference proceedings and practical information on restoration, seed processing, etc. Extensive web links
CSIRO – Conservation Genetics www.csiro.au/science/psx8.html	<ul style="list-style-type: none"> Information on provenance and species selection Information on managing remnants
Coastal Plant Regeneration (NSW) www.lhccrems.nsw.gov.au/CPR/CPR/homeset.htm	<ul style="list-style-type: none"> Plant lists for revegetation, based on location Uses/values of specific species Propagation information
Growing Native Plants www.anbg.gov.au/gnp	<ul style="list-style-type: none"> Propagation information on hundreds of native plants
Beach and dune management Coastal Dune Management Manual www.shop.nsw.gov.au www.epa.qld.gov.au Click on Environmental management > Coast and oceans	<ul style="list-style-type: none"> Detailed information on dunes and the coastal zone, planning for working on dunes, dune reconstruction and protection, weeds and revegetation Detailed information about the formation, function, management and vegetation of Queensland's coastal sand dunes
Native plant alternatives to bird-dispersed weeds www.weedscrc.org.au Click on Publications > Factsheets and Guidelines > gardening and biodiversity	<ul style="list-style-type: none"> Guidelines for replacing weeds with native plants to support fruit-eating birds Alternative to bird-dispersed weeds for Weeds of National Significance Alternative to bird-dispersed weeds in North-East New South Wales and South-East Queensland
Seed collection permits You may need to apply for a licence/permit from the state authority, for example: www.dse.vic.gov.au www.environment.nsw.gov.au www.epa.qld.gov.au	<ul style="list-style-type: none"> When collecting seed, first ask the landholder for permission (consult your local council authority or national park office if intending to collect on public land) Information on seed collection and situations in which you are required to apply for seed collection permits