NSW

bitou bush strategy

NSW NATIONAL PARKS AND WILDLIFE SERVICE

Contents

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Foreword

Bitou bush is an example of an introduced pest species that has proliferated in Australia in the absence of its natural enemies. It is a very invasive species that threatens natural ecosystems and the recreational values of large sections of the NSW coast.

Bitou bush grows in a range of habitats and, without a more coordinated management approach, it is likely to become more abundant and spread into new areas.

The NSW Bitou Bush Strategy is an initiative funded under the NSW Biodiversity Strategy. It links with, and expands on, key elements of the National Strategy for Bitou Bush and Boneseed. The NSW Bitou Bush Strategy will provide a framework for the development of regional and local management plans to direct on-ground action.

A key component of the NSW Bitou Bush Strategy is community involvement in the preparation and implementation of management strategies at all levels. As part of this process, over 30 public meetings were held throughout coastal NSW to identify issues, priorities, impediments and improvements to the management of bitou bush. Many of these meetings were held in conjunction with the North Coast Weeds Advisory Committee and the South Coast and Southern Tablelands Noxious Plants Committee. In addition, many individuals have been consulted and all available literature has been reviewed.

The information gathered at these meetings was used to prepare a draft strategy which was circulated widely for public comment in February 2001. The draft has been revised to incorporate suggestions received through the public consultation process.

The NSW Bitou Bush Strategy will enable a more coordinated and strategic management approach to be adopted. It will achieve this through actions that will deliver three key outcomes:

- preventing the further introduction and spread of bitou bush;
- minimising the adverse impacts of bitou bush on biodiversity; and
- expanding the commitment to the management of bitou bush.

A key action identified in the NSW Bitou Bush Strategy is the preparation of a threat abatement plan. The threat abatement plan will identify the threatened species and endangered populations that are most at risk from bitou bush invasion, and the localities that will benefit most from control programs. It will also develop and refine site-specific management strategies to protect these communities.

I commend those involved in the preparation of the NSW Bitou Bush Strategy, and encourage all stakeholders to commit to the actions identified in the Strategy in order to improve the management of bitou bush in NSW.

Bob Debus
Minister for the Environment
June 2001

1 Executive Summary

Bitou bush (*Chrysanthemoides monilifera* ssp. *rotundata*) is a highly invasive introduced species that poses a major threat to coastal ecosystems. In NSW, bitou bush occurs from the far south coast to the Queensland border, with the heaviest concentrations on the north coast.

Invasion of native plant communities by bitou bush is listed as a key threatening process under the *Threatened Species Conservation Act* 1995. In 1999, it was listed as a weed of national significance by the Commonwealth Government and, in NSW, it has been declared under the *Noxious Weeds Act* 1993.

Bitou bush has invaded and degraded much of the natural coastal vegetation to such an extent that rare and threatened species, endangered ecological communities and remote natural plant communities are affected. Even widespread coastal plant communities, such as banksia woodlands, are significantly affected. A recent survey recorded it on 900 kilometres of the coastline (80 percent of the total length of the NSW coast) and it is the dominant plant on 400 kilometres. It is estimated that it infests 36,000 hectares on public and private lands.

Because of the scale of the problem, the need for repeated control and the limited resources available for management, a more strategic approach needs to be adopted. The NSW Bitou Bush Strategy outlines how this can be achieved by preventing further spread, developing priority areas for control, expanding and targeting resources, improving management strategies and maintaining and increasing community support.

Priority is given to increasing community involvement by developing partnerships between stakeholders, including an important role for volunteers. There are a number of examples of governments and communities working successfully together where they have access to a wider range of expertise and resources.

PRIMARY GOAL

The primary goal of the NSW Bitou Bush Strategy is to reduce the impacts of bitou bush on NSW coastal ecosystems.

OUTCOMES

The Strategy aims to deliver three key outcomes.

1. Preventing the further introduction and spread of bitou bush

This will be achieved by:

- identifying high-risk sites for invasion by bitou bush; and
- developing and maintaining mechanisms for early detection and eradication.

2. Minimising the adverse impacts of bitou bush on biodiversity

This will be achieved by:

- recording, assessing and prioritising existing infestations;
- reducing the extent and impact of existing infestations;
- involving the community in the preparation and implementation of management strategies at all levels; and
- refining and adopting best-management practices.

3. Expanding the commitment to the management of bitou bush

This will be achieved by:

- maintaining the effectiveness and relevance of the NSW Bitou Bush Strategy; and
- maintaining and expanding the resource base.

2 Weed Management Principles

The NSW Bitou Bush Strategy is based on the recognition and acceptance of the four principles in the National Weeds Strategy.

1. Weed management is an essential and integral part of the sustainable management of natural resources and the environment, and requires an integrated multi-disciplinary approach.
2. Prevention and early intervention are the most cost-effective techniques that can be deployed against weeds.
3. Successful weed management requires a coordinated national approach, which involves all levels of government in establishing appropriate legislative, educational and coordination frameworks in partnership with industry, landholders and community.
4. The primary responsibility for weed management rests with landholders/ land managers, but collective action is necessary where the problem transcends the capacity of the individual landholder/landmanager to address it adequately.

Bitou bush flower. Photo: J. Thomas

3 The Challenge

The challenge of reducing the impacts of bitou bush lies in the extent and nature of the problem, its weedy attributes and the resources required for management. At many sites, controlling bitou bush in isolation is inadequate and a broader landscape approach will be required to conserve biodiversity.

Bitou bush occurs along the whole of the NSW coastline (except near the Victorian border) in a wide range of dune and headland habitats. In many of these areas, it dominates the vegetation, having a major impact on rare or threatened species and endangered plant communities. Even common vegetation types, such as coastal banksia woodlands, are affected. Indications are that bitou bush is now spreading further into the understorey of forests and woodlands adjacent to the coastal strip. Recent mapping has recorded infestations up to 10 kilometres inland.

Bitou bush has invaded disturbed and undisturbed bushland because of its prolific seed production, readily dispersed fruit, long lived seed and short time to maturity. The spread of bitou bush was aided by over 20 years of deliberate planting for dune stabilisation.

A range of effective control techniques is available to manage bitou bush. Over the last few years, improvements have been made, especially with regard to integrated management practices. However, there is scope to improve existing controls, introduce new techniques and to develop site- or habitat-specific strategies.

The greatest difficulty is the large area infested and the rapid reinvasion of an area after initial attempts at control. A sustained control effort is required for up to 10 years and many people find it hard to maintain their initial enthusiasm over the long term. The need for resources over such a prolonged period is also a major limitation.

A problem that has emerged in the last few years is the increase in the number of other weeds that grow with bitou bush. Many of these are highly invasive and difficult to control. Successful biodiversity conservation will require each species to be controlled in a comprehensive program.

Nevertheless, many successful control programs are in place and the lessons learned from these provide hope for the future.

Heavy infestation of bitou bush in understorey of banksia woodland, Shelley Beach, Central Coast.
Photo: J. Thomas

4 Background

Some of the following information has been reproduced from the *Best Practice Management Guide for Bitou Bush* (Vranjic, 2000), published by the Cooperative Research Centre for Weed Management Systems.

4.1 BIOLOGY AND ECOLOGY

Bitou bush is a spreading woody shrub with succulent stems, often prostrate on the ground. Its dimensions are usually one to two metres tall and two to six metres wide. Bitou bush develops a creeping habit under shade and may smother canopies up to 10 metres in height. Leaves are three to eight centimetres long, bright green, succulent, oval in shape, with a tapering base and irregular toothed margins. The leaves and stems of juvenile plants are covered by a cottony down. Mature plants produce many bright yellow, daisy-like flowers, with 11 to 13 ray florets ('petals'). The fruits are green, becoming black when ripe and contain only a single seed. The seeds are egg-shaped, five to seven millimetres long, fleshy on the surface with an internal hard bone-like shell, which is dark brown to black when dry.

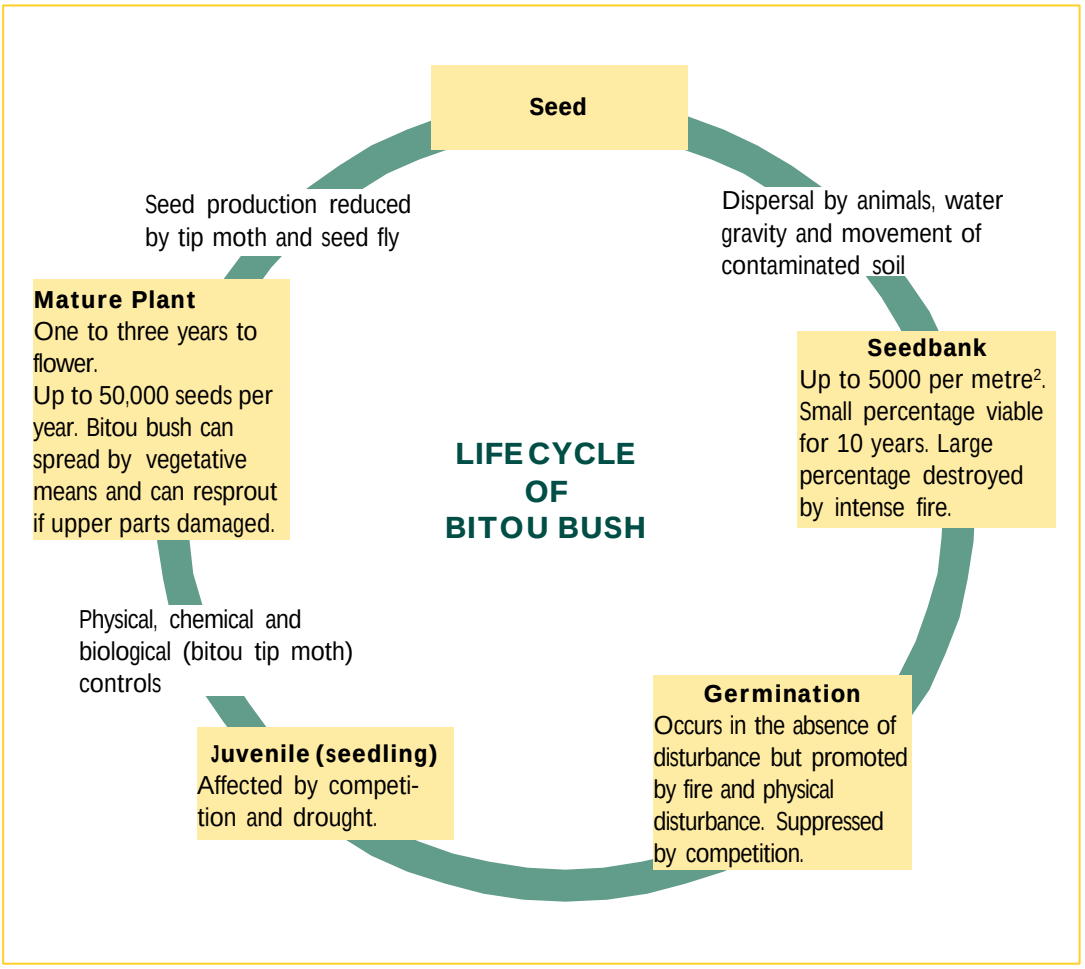
Bitou bush is similar in appearance to the closely related boneseed (*Chrysanthemoides monilifera* ssp. *monilifera*). The main differences between the two sub-species are outlined in the table below.

Bitou bush and boneseed can hybridise to produce fertile plants with characteristics that are shared or intermediate between the two sub-species.

A mature bitou bush plant can produce up to 50,000 seeds per plant per year. Prostrate stems enable vegetative reproduction to occur by sending roots from adventitious buds. Seeds can be spread over large distances by animals such as birds and foxes. Dispersal of seeds also occurs by wind, water, and vehicle movements, and movement of contaminated soil. In established infestations, soil seed banks can contain up to 5000 seeds per metre^2, with a small percentage of seeds remaining viable in the soil for up to 10 years, thereby providing a source for reinfestation. Disturbance, especially by fire, promotes seed germination, but germination still occurs in undisturbed situations.

Seed germination occurs throughout the year, although most seeds germinate during autumn. In southern NSW, bitou bush usually begins to flower two to three years after germinating. On the north coast, flowering has been recorded within 12 months of germinating. Bitou bush is capable of flowering year round, with a peak from April to June. Peak seed production generally occurs from June to September.

Character	Bitou bush	Boneseed
Habit	Spreading shrub, prostrate to semi-climbing, one to two metres tall by two to six metres wide (up to 10 metres)	Upright shrub, small tree one to two metres wide by half to three metres high (up to six metres)
Leaves	Obovate to broad elliptic, margins entire or variably toothed	Similar but generally narrower, margins with prominent teeth.
Flowers	All year round, mainly March to August, 11 to 13 ray florets (petals)	August to December, five to eight ray florets (petals)
Seeds	Egg-shaped ribbed seeds, dark when dry	Bone coloured, round, smooth seeds



Bitou bush can grow in a range of environments and it has invaded a variety of ecological communities. Bitou bush has a variable response to fire depending on the intensity. It is intolerant of waterlogged conditions and is slightly frost sensitive.

4.2 SPREAD AND DISTRIBUTION

Bitou bush originates from the coastal areas of South Africa.

The initial introduction of bitou bush is uncertain but the earliest records date from 1908 near Stockton. From 1946 to 1968, bitou bush was planted along the coast by the NSW Soil Conservation Service to reduce dune erosion and assist in post-mining rehabilitation. It was also planted on sand dunes near Menindee in western NSW where a small infestation still persists.

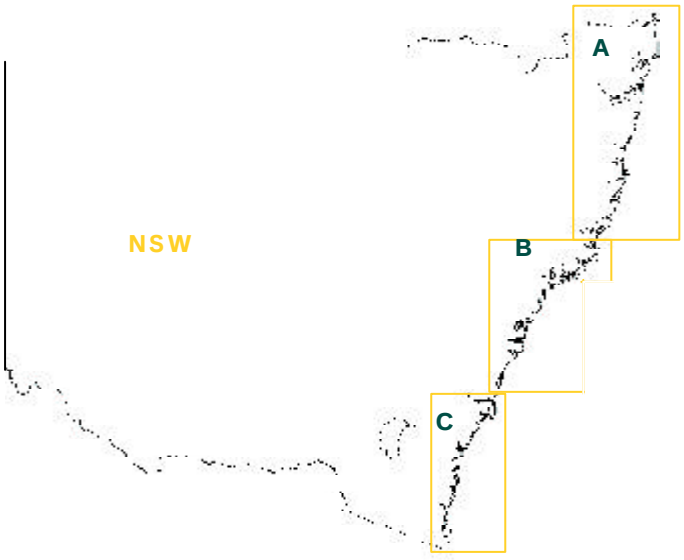
Bitou bush occurs over most of the NSW coastline (see maps on pages 9 and 10). Surveys in 1981 and 1982 found it on 660 kilometres of coastline or 60 percent of the total length of the NSW coast. Mapping of the entire coast during 2000 recorded it on over 80 percent of the coastline, with some areas, such as the Tweed coast, having over 95 percent infested. More than 36,000 hectares are now infested to varying degrees. There are 6,700 hectares of land with heavy infestation levels, 9,000 hectares of medium level and 20,100 hectares of light infestations.

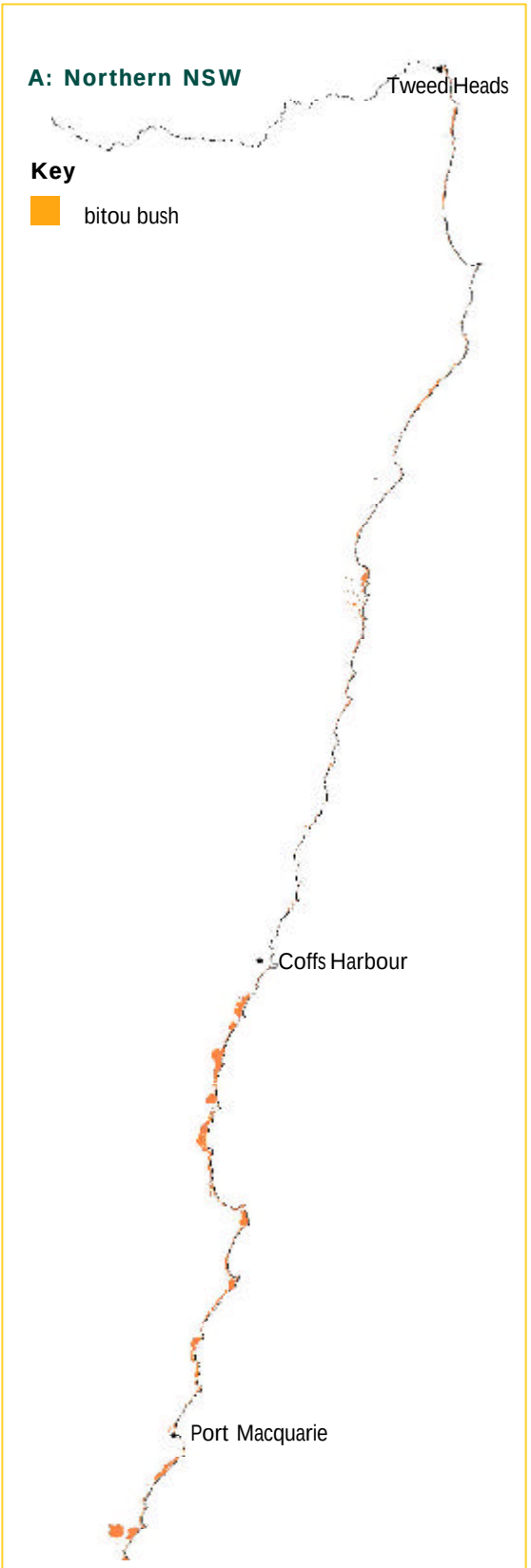
Isolated infestations occur in the Merimbula and Tathra areas on the far south coast of NSW. From the Moruya/ Batemans Bay area to the Shoalhaven

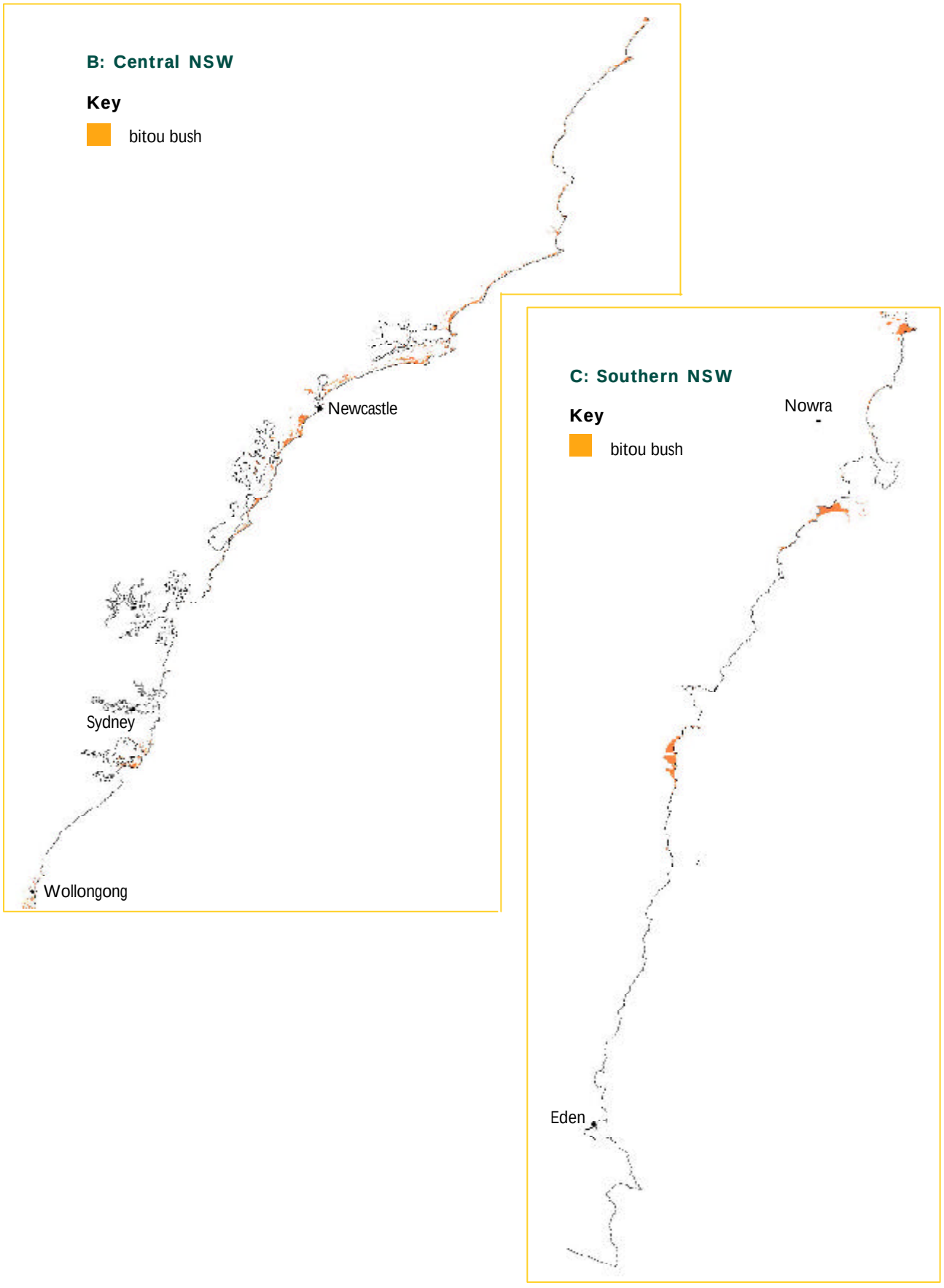
River, there are heavily infested sections, together with relatively large areas where bitou bush is much less abundant or absent. With a few significant exceptions, there is a continuous distribution of bitou bush from the Shoalhaven River to the Queensland border. Most of the north coast is heavily infested. In many areas north of Sydney, the only uninfested or lightly infested areas are where people are working on the problem or development has removed a suitable growing environment.

Bitou bush occurs mainly on publicly managed lands and lands used for utility purposes, such as easements or road and rail corridors. There are also significant infestations on industrial/commercial land in the Wollongong, Sydney and Newcastle areas as well as on freehold land.

Distribution of Bitou Bush in NSW






B: Central NSW
Key
bitou bush
Newcastle
Sydney
Wollongong
C: Southern NSW
Key
bitou bush
Nowra
Eden

4.3 BONESEED IN NSW

Boneseed (*Chrysanthemoides monilifera* ssp. *monilifera*) is a widespread weed in South Australia, Victoria and Tasmania. In NSW, boneseed occurs in the coastal area from the Hunter River southwards and is also found in south-western NSW (eg Dareton).

There are scattered infestations of boneseed on the central coast where it usually grows together with bitou bush in non-dunal areas. In the Sydney metropolitan area, occasional plants are found in bushland, with the heavier infestations found on clay soils along railway corridors. On the south coast, infestation levels vary, with both bitou/ boneseed infestations occurring in the coastal strip together with scattered light infestations on wasteland, utility corridors and bushland in the foothills of the escarpment.

Boneseed is a cause for concern in NSW because of its potential to spread (as evidenced by infestations in other states) and because of its ability to hybridise with bitou bush. Hybrid plants may differ in their response to control treatments, especially biological control that often targets only one of the sub-species. Additionally, selective herbicides developed for bitou bush are less effective on boneseed and hence, in mixed populations, the potential exists for boneseed to replace bitou bush.

4.4 IMPACTS

Both disturbed and undisturbed natural ecosystems are invaded. A variety of ecosystems are susceptible to invasion, often to the extent where bitou bush becomes the major component of the vegetation.

Ecosystems invaded include sand-dune heathlands and grasslands, headland heathlands and grasslands, various coastal woodlands, dry sclerophyll forests, wet sclerophyll forests, and littoral rainforests. Evidence indicates that bitou bush is now occurring regularly in the understorey of forests up to 10 kilometres inland. Bitou bush affects a number of threatened species and plant communities, particularly in the Sydney region, as outlined in the following table. Many other plant communities are at risk because of the invasive potential of bitou bush.

Threatened species	Endangered ecological communities	Other significant areas
Zieria prostata *Chamaesyce psammogeton* *Acacia terminalis* ssp. *terminalis* *Thesium australe* *Cynanchum elegans* *Pimelea spicata* *Syzygium paniculatum* *Diurus praecox* *Tethratheca juncea* *Melaleuca groveana* *Senna acclinis* *Acronychia littoralis*	Eastern Suburbs Banksia Scrub (Sydney) Kurnell Dune Forest (Sydney) Sutherland Shire Littoral Rainforest (Sydney)	World Heritage listed Iluka Nature Reserve. State Environment Protection Policy 26 littoral rainforest.

Invasion by bitou bush leads to a decline in floral diversity, as well as changes in the diversity of birds, native mammals and ground-dwelling insects. The structure and function of plant communities can also be radically changed. Stands of bitou bush may also harbour pest animals, such as foxes and introduced birds, which feed on and spread the seeds, or shelter under bitou bush canopies.

The economic impact of bitou bush is difficult to estimate with certainty. A recent study estimated that the expenditure on control programs alone was between one and two million dollars annually (Centre for International Economics 2000). This includes the cost of control by various land managers, the research effort and the large unpaid volunteer effort, especially through community groups, such as Dunecare.

Dieback of older infestations can lead to changes in dune shape and accelerated erosion. Dense infestations of bitou bush reduce the aesthetic appeal of natural areas, especially as older stands die back. Access to walking tracks and park visitor facilities may also be adversely affected.

Bitou bush can also affect cultural sites, including significant localised impacts on Aboriginal sites, either by preventing access to sites or stabilising sites subject to erosion. Physical removal of bitou bush can disturb middens.

In some areas, bitou bush has a beneficial role in dune stabilisation and, in the absence of other vegetation, it is a useful habitat for some native fauna.

4.5 RESEARCH AND MANAGEMENT

The adverse environmental impacts of bitou bush were recognised over 30 years ago when small-scale control programs were commenced, using physical methods and herbicides. At that time, control programs were limited because of the smaller scale of the problem and the lack of effective control options.

In contrast, a successful control program was implemented in south-east Queensland where, with its declaration as a noxious weed in 1981 and a relatively small area infested (700 hectares), a concerted effort commenced to eradicate bitou bush. After 10 years, the control program had successfully reduced bitou bush infestations to the extent that only a low-level maintenance program was required, which continues to the present day.

In 1983, an inter-departmental working group began the impetus for better management of bitou bush in NSW when they inspected bitou bush infestations on the north coast. A subsequent conference at Port Macquarie reviewed the impacts of bitou bush on conservation values, ecology of the species and examined control options. The conference resolved to strongly pursue avenues for biological control.

In the early 1980s, research commenced on developing suitable herbicide treatments. This led to the widespread use of glyphosate and, more recently, metsulfuron methyl. These herbicides are applied in winter at rates that are selective in most native plant communities. NSW Agriculture has developed a technique for applying these herbicides using helicopters. This involves the use of very low quantities of glyphosate (two litres per hectare, which is up to 80 percent less than that required for ground application) applied during winter. It is a very cost-effective control option that allows large areas to be treated rapidly. In most years, this has resulted in negligible damage to most native plant species.

The inadequacy of conventional control options in the early 1980s, coupled with the recognition of the magnitude of the problem, led to a nationally coordinated research program being initiated in 1986 to search for biological control agents.

This quickly led to the introduction and release of the bitou tip moth, *Comostolopsis germana*, near Port Macquarie in 1989.

The biological control program is nationally coordinated and involves funding from Australian and New Zealand Environment and Conservation Council agencies, including NSW National Parks and Wildlife Service (NPWS), and funding and research being provided by CSIRO, NSW Agriculture and the Victorian Department of Natural Resources and Environment. In recent years, the Cooperative Research Centre for Weed Management Systems has taken a leading role in the biological control program and has injected substantial additional funds.

As a result of this program, several insects have been released for biological control. Two of these, the bitou tip moth and the bitou seed fly (*Mesoclanis polana*), are substantially reducing seed production as well as reducing plant vigour.

In June 2000, a leaf rolling moth (*Tortricida*e), was released on bitou bush at Broadwater and Bundjalung national parks in northern NSW. Subsequently, releases have been made at other locations on the NSW coast. High hopes are held for this agent as it is the most damaging herbivore in its native habitat in South Africa and, at high densities, larvae are capable of decimating plants. Further research on a mite and a pathogen is continuing.

Removing bitou bush by hand is very effective for scattered plants or small infestations. Wildfires kill most mature plants, although a small proportion of plants can re-sprout. Fire kills some seeds but also stimulates germination of bitou bush and, more importantly, promotes the germination of native species. Strategic burning after spraying is therefore a useful method of control as it reduces the seed bank and allows easier access for follow-up control. Its effectiveness depends on the intensity of the fire that is determined in part by the fuel load and climatic conditions.

In 1989, the *Bitou Bush Control Handbook* summarised the current state of knowledge at that time. Recently, there has been a greater emphasis on integrated management strategies. Detailed information on control methods and integrated management packages are given in the *Best Practice Management Guide* (Vranjic, 2000) developed by the Cooperative Research Centre for Weed Management Systems and in other documents.

It is essential that site-specific management strategies are developed. These strategies should consider the management objectives of the area, infestation levels, physical characteristics of the site, the regenerative capacity of existing vegetation, presence of rare and threatened species, public use, the availability and suitability of individual controls and/or combination of controls. In particular, the impacts of controls on biodiversity should be considered. Control plans should be developed in consultation with relevant stakeholders.

4.6. SOCIO-ECONOMIC FACTORS

The greatest impediments to effective control are the magnitude of the problem and the limited resources that are available. The primary responsibility for controlling bitou bush rests with the individual landholder/manager. However, the listing of bitou bush as a weed of national significance recognises that, in many cases, its control is beyond the capacity of individual landholders/ managers.

In NSW, invasion of native plant communities by bitou bush has been listed as a key threatening process under the *Threatened Species Conservation Act* 1995. Under the NSW *Noxious Weeds Act* 1993, bitou bush is classified in the W3 category, which means it must be

prevented from spreading and the density of infestations should be reduced. Bitou bush is declared a noxious weed in all coastal local government areas and on Lord Howe Island, where it has a W2 classification.

The majority of infestations are on publicly managed lands and the control of bitou bush is only one of the many land management issues which agencies must address. In some areas, the problem is not recognised or it can appear to be so daunting that it receives a low priority. However, a number of successful programs have been implemented already. These programs share a number of common features, including:

- a variety of stakeholders working cooperatively, often with a formal plan that outlines priorities, roles and responsibilities. Successful plans are developed with full public consultation;
- a commitment from decisionmakers at all levels;
- persistence and continuity for long-term commitment;
- the presence of key individuals who coordinate and motivate participants; and
- the matching of the scale of work (including follow up) to the available resources.

Matching the scale of work to the available resources is particularly important as the lack of a long-term funding base restricts the expansion of programs and contributes to the failure of some programs. A large portion of the existing funding for on-ground works has come from programs such as Coastcare and there is no guarantee that these will continue. Additional sources of funding are required. For example, part of the environmental levy in the Coffs Harbour area is used for the control of bitou bush. Currently, there is limited business support for bitou bush programs but the potential exists to involve the growing coastal economy, particularly tourism and the service industries.

There is strong community interest in the management of bitou bush, with hundreds of volunteer groups contributing enormously to the control of bitou bush in NSW. Many of these groups and individuals have achieved a great deal, especially when supported by local control authorities or land managers. However, the magnitude of the problem, coupled with the limited number and mostly aging volunteers, and the requirement for a long-term commitment, can lead to disillusionment and the disbanding of local community groups. Additionally, many volunteers feel that they are being expected to undertake what they view as a government responsibility. It is important that volunteers receive appropriate recognition and support as their input is critical to the success of many programs, especially where the work is intensive and involves revegetation. As the majority of the population lives on the coast, there is considerable scope to increase the number of volunteers in control programs. There is also an opportunity to increase community awareness and support for bitou bush programs.

The different priorities and values of coastal communities can present problems. In particular, native vegetation restoration programs, in or near urban areas, can be affected by individuals seeking better views. Stronger law enforcement and other measures, such as artificial view screens, are required to deter destruction of native vegetation.

Right: Dune Care project at Budgewoi, involving bitou bush control, revegetation and dune stabilisation. Photo: J. Thomas

5 Links to Other Strategies

5.1 THE NATIONAL STRATEGY

The National Strategy for Bitou Bush and Boneseed provides the objectives, strategies and actions for the NSW Bitou Bush Strategy, which emphasises those areas that are of particular relevance to NSW.

The national strategy has three desired outcomes.

1. Preventing the further introduction and spread of bitou bush and boneseed

This is to be achieved by:

- identifying high-risk sites that may be invaded by bitou bush and boneseed;
- developing and maintaining mechanisms for early detection and eradication; and
- establishing an early detection system for other related taxa not present in Australia.

2. Minimising the adverse impacts of bitou bush and boneseed on biodiversity

This is to be achieved by:

- recording, assessing and prioritising existing infestations;
- reducing the extent and impact of existing infestations;
- refining and adopting best-management practices; and
- involving the community in the implementation of management strategies at all levels.

3. Maintaing the national commitment to the coordination and management of bitou bush and boneseed

This is to be achieved by:

- maintaining the effectiveness and relevance of the national strategy.

5.2 OTHER STRATEGIES

The NSW Bitou Bush Strategy is an initiative funded under the NSW Biodiversity Strategy. The Biodiversity Strategy provides a framework, and identifies a range of priority actions for the conservation of biodiversity throughout NSW. The NSW Bitou Bush Strategy is also linked to a range of other natural resource and weed management strategies (listed in Appendix 1).

The NSW Bitou Bush Strategy will provide a framework for the development of regional and local management plans. These plans will detail the specific actions required to coordinate and implement the control of bitou bush at the local level.

A key action identified in the NSW Bitou Bush Strategy is the preparation of a threat abatement plan. The threat abatement plan will identify the threatened species and endangered populations most at risk from bitou bush invasion, and the localities that will benefit most from its control. It will also develop and refine site-specific management strategies to protect these communities.

6 Strategic Plan

The Strategic Plan aims to deliver three desired outcomes.

6.1 PREVENTING SPREAD

Desired outcome

The further introduction and spread of bitou bush is prevented.

Background

Bitou bush is widely distributed along the NSW coastline. However there are significant areas within the existing range, especially on the south coast, which are not infested and there are large areas outside the current distribution, which are potentially at risk. Sites and plant communities that are most at risk need to be identified and a system for detecting, reporting, and eradicating new infestations needs to be established.

Land managers and weed control authorities have a responsibility for recording and mapping the spread of bitou bush (and boneseed). The control of new infestations must be a priority, particularly in high-risk areas. Uninfested dune and headland ecosystems adjacent to existing infestations are most at risk, with dry sclerophyll forests and woodlands within five to 25 kilometres of the coast also at risk. Currently, bitou bush is scattered, at generally low levels of infestation, in the understorey of a number of these forest areas. The edges of these areas, such as roadsides, often carry heavier infestations. Infestation levels rise with increased disturbance through events, such as repeated fire or clearing. It is unknown whether these mostly low infestation levels will stabilise or increase over time. Therefore, as a risk-minimisation strategy, it is wiser to control infestations in these areas while they are relatively easy to control.

Special attention should be given to national containment zones for bitou bush in northern and southern NSW. The northern containment zone is located immediately south of the Queensland border. It has been established to prevent reinvasion of Queensland. The current program on the northern side of the Tweed River should be extended south of the river. Addressing the complex array of issues relating to bitou bush management in this area will require the cooperation of all stakeholders. The southern containment zone is the area south of Tuross Heads on the Far South Coast. This area is the least infested region of the NSW coastline and a special effort should be made to protect this area by eradicating infestations. The existing control programs immediately north of the Moruya area should continue, as this will assist in preventing spread and reinfestation.

6.2 MINIMISING ADVERSE IMPACTS

Desired outcome

The adverse impacts of bitou bush on biodiversity are minimised.

Above: Tip moth on a bitou bush plant, Crowdy Bay National Park. Photo: J. Thomas

Right: Spraying of bitou bush encroaching on beach access, Crowdy Bay National Park. Photo: J. Thomas

Objective 6.1.1 Identify high-risk sites for invasion by bitou bush			
Strategy	**Action**	**Responsibility**	**Rank**
6.1.1.1 Risk assessment	Identify sites and plant communities most at risk from invasion and set priorities for monitoring	NPWS and Department of Land and Water Conservation in consultation with regional weed advisory committees, local weed control authorities and the community	1

Objective 6.1.2 Develop and maintain early detection and eradication mechanisms			
Strategy	**Action**	**Responsibility**	**Rank**
6.1.2.1 Establish a surveillance and reporting system	Assess existing weed reporting systems and adopt or modify and identify coordinator	NSW Noxious Weeds Advisory Committee to resolve in conjunction with NSW Agriculture and NPWS.	2
6.1.2.2 Prevent the establishment of new infestations	Monitor and record any new infestations, including boneseed.	NPWS, Department of Land and Water Conservation, NSW Agriculture, regional weed advisory committees and local weed control authorities	1
	Prioritise areas and undertake control actions in order of priority	NPWS, Department of Land and Water Conservation, regional weed advisory committees and local weed control authorities	1?
6.1.2.3 Establish containment zones	Establish and enforce containment zones in northern and southern NSW.	Regional weed advisory committees and local weed control authorities	2

Background

Recent mapping shows that infestations are widespread and have increased since 1982. Ongoing maintenance of the database is required to monitor changes in infestation levels and will provide a performance measure. Criteria will be established to assess and prioritise areas for control. The criteria will consider issues such as conservation significance, prevention of further spread, and the feasibility of control (eg plant community/ landscape, accessibility and resources required). These criteria will be established in the threat abatement plan.

To reduce the extent and impact of existing infestations, control programs must continue and be expanded in high-priority areas. At the current time, the broad priorities are to have control programs in:

- areas where rare and threatened species and/or significant plant communities are at risk;
- lightly infested areas where the natural vegetation is in good condition;
- in heavily infested areas where there is the greatest potential to restore remnant natural habitats;
- areas where local actions are having a significant lasting effect on reducing populations, with preference given to cooperative programs involving local communities; and
- containment zones.

It is also important to reduce the impact of dense and large-area infestations by using biological control and techniques, such as aerial spraying. While these controls on their own are inadequate for restoring ecosystems, they will help prevent reinfestation of higher-priority areas and may allow some natural regeneration to occur. Managers should avoid treating large heavily infested areas where other weeds may invade, or where continued commitment to the program is uncertain.

It is unlikely that there will ever be sufficient resources to treat all areas. Therefore, a strategic approach is required to allocate resources to priority areas. The north coast and south coast regional strategies and local government strategies are examples of this approach. Funding bodies give preference to actions that have been identified in strategic plans.

Strategic plans must be developed in consultation with all relevant stakeholders so that they have ownership and commitment to the proposed actions. Local working groups, comprising all stakeholders, should be established to oversee the implementation of these plans. Where appropriate, local control authorities should enforce control to assist with plan implementation.

The extensive community input that is currently directed towards the management of bitou bush must continue to be supported. The network of volunteer groups needs to be involved in the development and implementation of management plans. Educating and training all stakeholders in best-practice management will be important in making the best use of available resources. This is also essential for maintaining the commitment of existing community groups and encouraging more people to become involved.

A range of effective control techniques to manage bitou bush is available. The recent focus on integrated management (including revegetation where appropriate) will result in more effective control than any single technique used in isolation. Integrated management needs to be further refined, especially with regard to habitat and climatic variations. All practitioners have a responsibility to evaluate the controls they are using.

Particular regard should be given to balancing the effectiveness of control treatments and non-target impacts. In areas where the protection and restoration of biodiversity are the primary objective,

maintaining natural habitats and encouraging natural regeneration and succession should guide control options. Where natural regeneration is inadequate, revegetation with appropriate local species will be required.

A problem that has emerged in the last few years is the increase in the number of other weeds that grow with bitou bush. Many of these are highly invasive and difficult to control, such as asparagus ferns, lantana, glory lily, *Coprosma* and *Ehrarhta*. Successful biodiversity conservation will require each of these species to be controlled in a comprehensive program.

Bitou bush encroaching onto road reserve, Botany. Photo: J. Thomas

Objective 6.2.1 Record, assess and prioritise existing infestations

Strategy	Action	Responsibility	Rank
6.2.1.1 Maintain mapping database	Record changes in infestations and send to coordinator	NSW government agencies and local weed control authorities	2
	Ongoing maintenance and updating of data	NPWS in consultation with NSW Agriculture	3
6.2.1.2 Assess and prioritise areas for protection	Prepare threat abatement plan which will set criteria to determine priorities and prioritise areas for action	NPWS, in consultation with other agencies, regional weed advisory committees, local weed control authorities and local communities.	1

Objective 6.2.2 Reduce the extent and impact of existing infestations

Strategy	Action	Responsibility	Rank
6.2.2.1 Undertake control in high-priority areas	Coordinate and implement on-ground works at sites of high-conservation significance and in lightly infested areas	NSW government agencies, local weed control authorities, landholders and with community support	1
	Reduce populations in other bushland areas and continue with effective programs elsewhere	NSW government agencies, local weed control authorities, landholders and with community support	2
6.2.2.2 Reduce the impact of dense and large area infestations	Release and monitor biocontrol agents and implement other control options, such as aerial spraying, to reduce populations and contain their spread	CSIRO, NSW Agriculture, NPWS, Department of Land and Water Conservation and local weed control authorities with community support	2

Objective 6.2.3 Involve the community in the preparation and implementation of management strategies at all levels

Strategy	Action	Responsibility	Rank
6.2.3.1 Involve stakeholders in preparation of state, regional and local plans	Prepare threat abatement plan	NPWS in consultation with other stakeholders	1
	Establish regional and local groups where they do not currently exist to prepare and implement regional/local management plans	Regional weed advisory committees and local weed control authorities in consultation with all stakeholders	2
	Ensure control of bitou bush is included in coastal management plans	NSW government agencies, regional weed advisory committees and local weed control authorities	3
6.2.3.2 Train and involve all stakeholders in use of best-practice management	Develop and/or identify accredited training and deliver courses	NSW Agriculture, NSW TAFE, regional weed advisory committees and local weed control authorities	2
	Provide support for volunteers and expand the volunteer efforts	Regional weed advisory committees, local weed control authorities, NPWS, Department of Land and Water Conservation and community group facilitators	2
6.2.3.3 Improve communication and information exchange	Use existing networks to raise community awareness and information flow	NSW government agencies, regional weed advisory committees and local weed control authorities	3

Objective 6.2.4 Refine and adopt best-management practices

Strategy	Action	Responsibility	Rank
6.2.4.1 Evaluate new and existing herbicide applications	Evaluate effects on bitou bush	NSW Agriculture, all control practitioners and herbicide companies	2
	Evaluate effects on other weeds	NSW Agriculture, all control practitioners and herbicide companies	2
	Evaluate non-targets of herbicide impacts on: • native plants and animals • biotic and abiotic processes	NSW government agencies, local weed control authorities, Australian Museum and universities	2
	Evaluate effects on biocontrol agents	NSW Agriculture and CSIRO	3
6.2.4.2 Introduce, assess, and improve the effectiveness of biocontrol agents	Identify potential biocontrol agents and undertake host-specificity testing	Cooperative Research Centre for Weed Management Systems and member agencies	1
	Release and assess effectiveness of biocontrol agents	NSW Agriculture and CSIRO with support from other stakeholders	1
	Evaluate impacts of introduced biocontrol agents and interaction with other control options	NSW Agriculture with support from other stakeholders	2
6.2.4.3 Evaluate fire and physical control options	Evaluate the use of fire as a management technique	Cooperative Research Centre for Weed Management Systems, NPWS and local weed control authorities	2
	Evaluate the use of other control options (eg mechanical methods)	All control practitioners	3
6.2.4.4 Develop and implement site-specific integrated management strategies	Develop criteria to assess sites and identify most effective control options and priorities	Cooperative Research Centre for Weed Management Systems, NSW Agriculture, NPWS, Department of Land and Water Conservation, local weed control authorities with community involvement	1
	Evaluate current best-practice guidelines, and refine as required	Cooperative Research Centre for Weed Management Systems and member agencies, NSW government agencies, regional weed advisory committees and local weed control authorities with community involvement	2
	Develop revegetation guidelines for different habitats/vegetation communities	NSW government agencies, regional weed advisory committees, local weed control authorities, Coastcare with community involvement	3

6.3. IMPLEMENTATION

Desired outcome

The commitment to the management of bitou bush is expanded.

Background

The development, implementation and evaluation of management strategies for important weeds are requirements of the national and NSW weeds strategies. A framework has been identified for assessing progress with implementation of both state and national bitou bush strategies.

Many people have identified the need to raise awareness of the bitou bush threat in order to increase community and political support for control programs. As well, there is a need to increase the numbers of volunteers involved in bitou bush programs.

Successful implementation of this strategy will require additional resources. As infestations of bitou bush mainly occur on public lands, most funding, now and in the future, will have to be provided by governments. Much of this additional funding should be targeted to on-ground actions. In addition, all land managers and control authorities should apply for all available funding opportunities and resources, such as labour market programs. All stakeholders should explore new funding initiatives, including approaches to the private sector.

Objective 6.3.1 Maintain the effectiveness and relevance of the NSW Bitou Bush Strategy

Strategy	Action	Responsibility	Rank
6.3.1.1 Coordinate and monitor implementation of strategy	Report on progress made on actions in the strategy to NSW Noxious Weeds Advisory Committee and stakeholders	NPWS	1
	Report on progress made on national strategy actions to National Weeds Strategy Executive Committee	NPWS	2
6.3.1.2 Increase awareness of bitou bush and support for control programs	Maintain, develop and implement education and awareness programs aimed at all stakeholders	Coastcare, NPWS, NSW Agriculture, Department of Land and Water Conservation, regional weed advisory committees, local weed control authorities with community consultation	3
	Identify and implement strategies to increase the number of volunteers involved	NPWS, regional weed advisory committees, local weed control authorities and community group facilitators	2

Objective 6.3.2 Maintain and expand the resource base

Strategy	Action	Responsibility	Rank
6.3.2.1 Maintain existing commitments and seek additional sources of funding	Continue to fund control programs at current levels	All relevant stakeholders	1
	Promote the strategy and opportunies for funding	NSW Noxious Weeds Advisory Committee members, regional weed advisory committees, local weed control authorities and community group facilitators	2
	Cost actions listed in the strategy and seek additional resources where necessary	All stakeholders	2
	Cost implementation of the threat abatement plan and identify additional funds required	NPWS in consultation with all stakeholders.	2

Iluka Landcare volunteers and NPWS staff revegetating areas after bitou bush has been controlled in Bundjalung National Park. Photo: D. Carter

7 Monitoring and Evaluation

Damage caused by the tortrix moth on a bitou bush six months after release, Bundjalung National Park. Photo: J. Thomas

This strategic plan will be subject to a five-year review. The NPWS will monitor the implementation of the strategy.

PERFORMANCE INDICATORS

- The distribution map of bitou bush will be updated every five years and will include boneseed records.
- The national containment zones in northern and southern NSW are implemented.
- A threat abatement plan identifying priorities is prepared.
- Control programs continue and are expanded, with resources targeted to priority areas.
- Evaluation, refinement and promotion of best-practice management guidelines are established.
- Biological control agents continue to be released and information on their establishment and effectiveness is monitored and collated.
- Regional and local strategies identifying priority areas for control are prepared and implemented by relevant stakeholders.
- Area and abundance of infestations are reduced.
- All new light infestations in priority areas are treated within 12 months of detection.
- Workshops and training in best-practice management are conducted by relevant stakeholders.
- There is increased awareness of the social, environmental and economic impacts of bitou bush and boneseed at all levels, including the general community, private and public land managers, and relevant agencies.
- The community effort is maintained in proportion to the level needed to control infestations.

8 Stakeholder Roles

NSW government agencies, regional weed advisory committees, local control authorities, local government, community groups and individuals share responsibility for implementing the actions identified in Section 6. Some actions will be the responsibility of specific agencies or groups while, for other actions, collaboration is likely to be the most effective approach.

ALL PUBLIC AND PRIVATE LANDOWNERS AND MANAGERS

All public and private landowners and managers must comply with provisions of NSW *Noxious Weeds Act* 1993 and contribute towards and, where appropriate, implement actions as required in regional and local management plans.

COMMUNITY GROUPS

Community groups should:

- continue with and, if possible, expand control efforts;
- assist with the monitoring and mapping of the distribution of bitou bush in their area;
- contribute towards and, where appropriate, implement actions as required in regional and local management plans;
- assist with the preparation and implementation of the threat abatement plan; and
- refine and promote education and training programs on the impacts, ecology and best-practice management strategies, together with other appropriate agencies.

LOCAL CONTROL AUTHORITIES (LOCAL GOVERNMENT)

Local control authorities should:

- enforce the provisions of the NSW *Noxious Weeds Act* 1993, where appropriate;
- monitor and map the distribution of bitou bush, with government agencies;
- initiate regional and local management plans, involving other relevant stakeholders where required;
- develop and implement actions as required in regional and local management plans;
- assist with the preparation of the threat abatement plan and implement required actions;
- implement effective control programs on own land;
- refine and promote education and training programs on the impacts, ecology and best-practice management strategies of bitou bush, with other appropriate agencies; and
- provide assistance to volunteer community groups.

NSW NATIONAL PARKS AND WILDLIFE SERVICE

The NPWS will:

- monitor and map the distribution of bitou bush and regularly update the mapping database;
- contribute to the development of local and regional management plans for bitou bush;
- prepare and coordinate implementation of the NSW threat abatement plan in consultation with relevant stakeholders and seek financial assistance for priority actions identified in the threat abatement plan;
- implement effective control programs for bitou bush on NPWS managed lands;
- liaise with other stakeholders when implementing control programs on other lands;
- support research on the ecology and control of bitou bush and boneseed;
- refine and promote education and training programs on the impacts, ecology and best-practice management strategies of bitou bush, with other appropriate agencies;

- provide a coordinating role for strategy implementation; and
- provide assistance to volunteer community groups.

DEPARTMENT OF LAND AND WATER CONSERVATION

The Department of Land and Water Conservation will:

- assist with the monitoring and mapping of the distribution of bitou bush;
- contribute to the development of local and regional management plans for bitou bush;
- assist with the preparation of the threat abatement plan and implement required actions;
- implement effective control programs on own land; and
- provide assistance to volunteer community groups.

NSW AGRICULTURE

NSW Agriculture will:

- continue the biological control program in NSW;
- oversee the administration of the NSW *Noxious Weeds Act* 1993; and
- continue allocating funds from the Noxious Weeds Grant Scheme.

OTHER NSW GOVERNMENT AGENCIES/CORPORATIONS

Other NSW government agencies will:

- contribute towards and, where appropriate, implement actions as required in regional and local management plans; and
- implement effective control programs on own land.

NSW NOXIOUS WEEDS ADVISORY COMMITTEE

The NSW Noxious Weeds Advisory Committee will:

- assess existing weed surveillance and reporting systems;
- continue allocating funds from the NSW Government's Noxious Weeds Grant Scheme;
- provide feedback on progress with the implementation of actions; and
- provide feedback on drafts of the NSW threat abatement plan.

COASTCARE

Coastcare will:

- continue to provide financial support and technical advice for programs involving bitou bush control; and
- provide assistance to volunteer community groups through their facilitators.

RESEARCH ORGANISATIONS

Research organisations, such as CSIRO, Cooperative Research Centre for Weed Management Systems and universities, will:

- have a continuing role in research on impacts, ecology and control of bitou bush; and
- refine and promote education and training programs on the impacts, ecology and best-practice management strategies of bitou bush, with other appropriate agencies.

COMMONWEALTH GOVERNMENT

The Commonwealth Government will:

- provide financial assistance for actions consistent with the National Strategy for Bitou Bush and Boneseed;
- contribute towards and, where appropriate, implement actions as required in regional and local management plans; and
- implement effective control programs on own land.

9 Additional Reading

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Appendix: Links to Other Strategies

The NSW Bitou Bush Strategy is linked to a range of other strategies at national, state, regional and local levels. These include other weed management strategies, catchment and vegetation management plans and environmental planning instruments.

Scope Scale	Natural resource management	Weed/pest management
National	National Strategy for the Conservation of Australia's Biological Diversity National Strategy for Ecologically Sustainable Development	National Weeds Strategy Bitou Bush and Boneseed Strategic Plan (see below)
State	NSW Biodiversity Strategy NSW Draft Native Vegetation Conservation Strategy NSW Coastal Policy	NSW Weed Strategy
Regional/Catchment	Regional vegetation management plans Regional environment plans Coastal management plans	Regional bitou bush strategies (north coast, south coast, Sydney north) Regional weed action plans
Local	Park and reserve management plans Coastal management plans	Local bitou bush strategies (local weed authorities, councils) Local site plans