WEEDS OF NATIONAL SIGNIFICANCE

BITOU BUSH AND BONESEED

(*Chrysanthemoides monilifera* ssp. *rotundata*)
(*Chrysanthemoides monilifera* ssp. *monilifera*)

Strategic Plan

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Supporting information about the National Weeds Strategy, Weeds of National Significance and progress to date may be found at www.weeds.org.au where links and downloads provide contact details for all species, their management committees and copies of the strategy.

This strategy was developed under the leadership of the National Parks & Wildlife Service, NSW with full cooperation of all the States, Territories and Commonwealth of Australia.

Comments and constructive criticism are welcomed as an aid to improving the process and future revisions of this strategy.

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CONTENTS

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Figure 1. Bitou Bush infestation at Iluka, northern New South Wales.
Photo: J. Thomas

EXECUTIVE SUMMARY

Bitou bush and boneseed (*Chrysanthemoides monilifera* ssp. *rotundata* and *C.monilifera* ssp. *monilifera*) are highly invasive environmental weeds which pose a major threat to natural ecosystems. Bitou bush is most prolific in coastal ecosystems in NSW while boneseed occurs over a wider area of southern Australia, especially in Victoria, South Australia, and parts of the Tasmanian east coast.

The extent of some infestations and the need for repeated control, can at times, appear overwhelming. However, successes in Queensland and some other areas, together with the availability of effective control options, and widespread community support, offers considerable hope for the future**.**

This strategic plan will allow the nature and extent of the problem to be defined and will enable resources to be targeted to the most critical issues, and to plant communities most at risk**.** The focus is on improving control techniques, refining and adopting integrated management strategies, and coordinating actions at the national, state, regional and local level. Priority is given to enhancing community involvement by developing partnerships between stakeholders, with specific recognition of the important role of volunteers. The Coastcare Program has many successful examples of governments and communities working successfully together.

Successful implementation of this strategy will require additional resources. As infestations of bitou bush and boneseed mainly occur on public lands, most funding, now and in the future, will have to be provided by governments. However, one of the actions of the strategic plan is to identify opportunities for private sector support.

The vision of the strategy is:

Working together to arrest the spread and minimise the impact of bitou bush and boneseed in natural ecosystems

The strategy aims to deliver three desired outcomes:

The further introduction and spread of bitou bush and boneseed is prevented

- Risk assessment
- Establish a surveillance and reporting system
- Prevent the establishment of new infestations
- Establish national containment zones where appropriate
- Establish an early detection system for other related taxa not present in Australia

The adverse impacts of bitou bush and boneseed on biodiversity are minimised

- Record and map distribution and abundance of bitou bush and boneseed
- Assess and prioritise areas for protection
- Undertake control in high priority areas
- Reduce the impact of dense and large area infestations
- Evaluate new and existing herbicide applications
- Introduce, assess and improve the effectiveness of biocontrol agents
- Evaluate fire and physical control options
- Develop and implement site-specific integrated management strategies
- Involve stakeholders in preparation of state, regional and local plans
- Train and involve all stakeholders in use of best practice management
- Establish communication and information exchange

The national commitment to the coordination and management of bitou bush and boneseed is maintained

- Coordinate implementation of strategy
- Monitor implementation of the strategic plan
- Increase the recognition and understanding of the impact of bitou bush and boneseed
- Expand the resource base.

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Figure 2 Boneseed infestation at You Yangs Regional Park.
Photo K Blood

THE CHALLENGE

Bitou bush (*Chrysanthemoides monilifera* ssp. *rotundata*) and boneseed (*Chrysanthemoides monilifera* ssp. *monilifera*) are listed as Weeds of National Significance because of their adverse impacts on biodiversity. The challenge is to reduce these impacts and prevent further spread.

Bitou bush is restricted to coastal ecosystems where it occurs almost continuously from south-eastern Queensland to Tathra on the South Coast of NSW. In one 80 km stretch near Grafton, bitou bush has been recorded on 90% of the coastline. Smaller, isolated infestations, occur on Lord Howe Island, near Melbourne, and near Menindee in western NSW. Boneseed prefers more southern latitudes and occurs over wide areas of Victoria (especially the Mornington Peninsula and You Yang Range) and South Australia (mainly in the Mt. Lofty Range), and parts of the Tasmanian east coast, the South Coast and Central Coast of NSW, and near Perth in Western Australia.

Without effective control programs, bitou bush and boneseed have the potential to become more abundant within their current range, and spread into new areas. The potential distribution includes spread into central and northern Queensland, and further expansion into uninfested areas of NSW, Victoria, Tasmania, South Australia and south-western Western Australia.

Bitou bush and boneseed pose a major threat to the conservation of biodiversity because they reduce the abundance and diversity of native species and adversely affect the structure and function of natural ecosystems. Already, a number of significant rare or threatened species, and threatened ecological communities, have been invaded, while many others are at risk. The World Heritage listed Iluka Nature Reserve in northern NSW is an example of a high quality conservation area threatened by bitou bush.

Bitou bush and boneseed proliferate because of their rapid growth, enormous seed production with long viability and ready dispersal mechanisms, lack of predators or pathogens, and because of their adaptability to different environments.

These characteristics have allowed bitou bush and boneseed to invade and proliferate in a range of vegetation communities: dune heath and grasslands, headlands with heath, grasses and shrubs, and a variety of woodlands and forests have all been invaded. In some areas only monocultures of bitou bush or boneseed remain.

Bitou bush and boneseed can be controlled by the use of herbicides (aerial and ground applications), fire, and by hand-pulling individual plants. However, because of large and persistent seed banks in the soil, long-term control requires these techniques to be applied repeatedly for several years. Several biological control agents have been released, and show considerable promise. Biological control may play a significant role in the future by reducing seed production and plant vigour. Successful control of bitou bush and boneseed will require an integrated management approach using a number of different control options: the final combination often being site-specific. Control programs must be undertaken in such a way that the process of natural regeneration and succession is sustainable, so that re-invasion does not occur, and to prevent infestations of bitou bush and boneseed from being replaced by other weeds such as bridal creeper (*Asparagus asparagoides*), glory lily (*Gloriosa superba*) and lantana (*Lantana camara*).

1 BACKGROUND

Some of the following information has been reproduced from the Weeds CRC Best Practice Management Guides for Bitou Bush (Vranjic, 1999) and Boneseed (Adair and Ainsworth, 1999).

1.1 Biology

Bitou bush is a spreading woody shrub with succulent stems, often prostrate on the ground. Shrub dimensions are typically 1-2 m tall and 2-6 m wide. Bitou bush develops a creeping habit under shade and may smother canopies up to 10 m in height. Leaves are 3-8 cm long, bright green, succulent, oval in shape with a tapering base and irregular toothed margins. The leaves and stems of juvenile plants are typically covered by a cottony down. Mature plants produce many bright yellow, daisy-like flowers, with 11-13 ray florets ("petals"). Fruits are green, becoming black when ripe and contain only a single seed. The seeds are egg-shaped, 5-7 mm long, fleshy on the surface with an internal hard bone-like shell which is dark brown to black when dry.

Boneseed is an upright shrub to small tree, generally 1-2 m wide and 0.5-3 m high, but occasionally to 6 m tall. Leaves are oval in shape with a tapering base and irregularly toothed margins. Plants produce many bright yellow, daisy-like flowers with 5-8 ray florets. The seeds are produced in a fleshy green fruit, which become dark brown to black when mature. The single seed in each fruit is bone-colored when dry (hence the name "boneseed"), hard, globular and 6-7 mm in diameter. The leaves and stems of juvenile plants are typically covered in cottony down.

Bitou bush and boneseed can hybridise to produce fertile plants with intermediate characteristics.

Sexual reproduction occurs in both sub-species with up to 50,000 seeds produced per plant. Bitou bush can also reproduce vegetatively by rooting from adventitious buds along prostrate stems. Seeds can be spread over large distances by animals such as birds and foxes. Dispersal also occurs by wind, water, and vehicle movements, and movement of contaminated soil. In established infestations, soil seed banks can contain 800-2500 seeds/m^2 (boneseed) and 2000-5000 seeds/m^2 (bitou bush). A small percentage of seeds remain viable in the soil for up to 10 years, thereby providing a source for reinfestation. Disturbance, especially fire, promotes seed germination, but germination still occurs in undisturbed situations.

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Figure 3.
Bitou bush and flower (inset).
Photo: J.Thomas

Figure 4. Boneseed plant and flower (inset)
Photo S Willsher

Seed germination of both bitou bush and boneseed can occur throughout the year though most seeds germinate during autumn. In southern NSW, bitou bush usually begins to flower 2-3 years after germinating. However, on the NSW north coast flowering has been recorded within 12 months of germinating. Boneseed plants start producing seeds about 2 years after germination. Bitou bush is capable of flowering year round, but the peak period is from April to June, with seed production occurring from June to September. September and October are the peak flowering months for boneseed, with seed production occurring from November through January.

Both subspecies can grow in a wide range of environments and have invaded a wide variety of ecological communities. Boneseed is fire sensitive while bitou bush is more variable in its response, depending on the intensity of the fire. Both weeds are intolerant of waterlogged conditions, and slightly frost sensitive. Boneseed is also affected by prolonged drought.

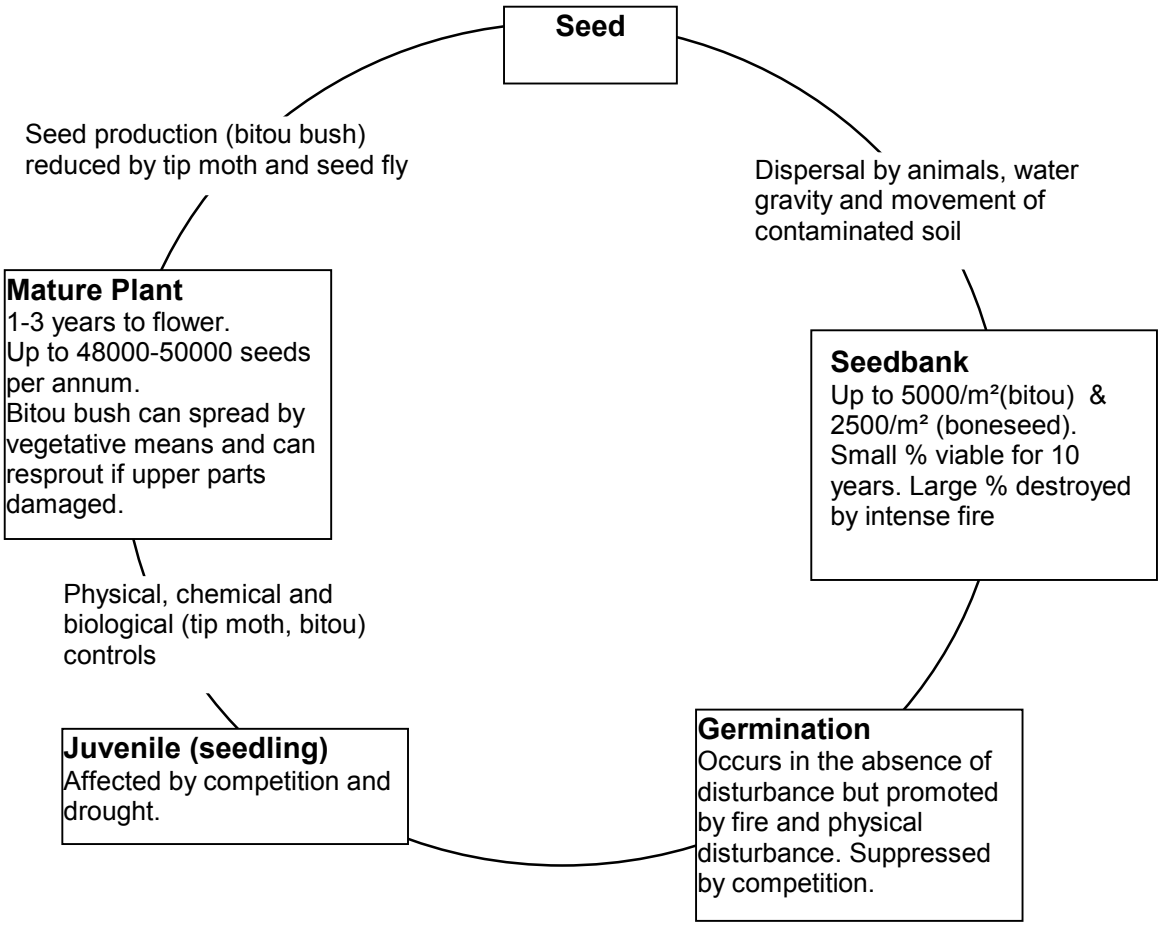

Figure 5. Life cycle of bitou bush and boneseed

1.2 History of Spread

Both bitou bush and boneseed originate from South Africa. Boneseed occurs near the south-western and south-eastern coast and in adjacent mountains, while bitou bush has a largely coastal distribution, which extends to more northern latitudes than boneseed.

Boneseed was first recorded as a garden plant in Sydney in 1852 and in Melbourne in 1858; by 1948 it was present in all southern states. Bushland infestations appear to have resulted from escape of garden plants.

The initial introduction of bitou bush is uncertain with the earliest records coming from near Newcastle in 1908. From 1946 to 1968 bitou bush was planted along the NSW 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.

In Queensland bitou bush was used for post mining rehabilitation in the late 1960s/ early 1970s on North and South Stradbroke Island and in the Wide Bay area. Other occurrences were recorded on the Gold, Sunshine and Fraser coasts.

Figure 6. Distribution of bitou bush (○) and boneseed (●).
(from Weiss, P.W., Adair, R.J. and Edwards, P.B. 1998).

(not included in this document due to file size)

Figure 7. Boneseed leaves and seeds (left) and bitou bush (right)
Photo: P.Weiss

1.3 Summary of impacts

Bitou bush and boneseed occur over a large part of southern Australia and have the potential to spread into uninfested areas. Over 70% of the NSW coastline have infestations of bitou bush with an estimated 70,000 ha infested. In one 80 km stretch near Grafton, bitou bush has been recorded on 90% of the coastline. Both disturbed and undisturbed natural ecosystems are invaded, often to the extent where bitou bush and boneseed become the dominant plants. The dense canopy that develops after invasion threatens local vegetation at all infested sites.

A variety of ecosystems are susceptible to invasion, including sand dune heathlands and grasslands, headland heathlands and grasslands, various coastal/non-coastal woodlands and dry sclerophyll forests, wet sclerophyll forests, littoral rainforests and mallee. There are a number of threatened species and plant communities affected by bitou bush and boneseed. The following table lists some of these. Many other plant communities are at risk because of the invasive potential of bitou bush and boneseed.

	Threatened species	**Threatened ecological communities**	**Other significant areas**
NSW	*Zieria prostata* *Chamaesyce psammogeton* *Acacia terminalis* ssp. *terminalis* *Thesium australe* *Cynanchum elegans* *Pimelea spicata*	Eastern Suburbs Banksia Scrub (Sydney) Kurnell Dune Forest (Sydney)	World Heritage Listed Iluka Nature Reserve. SEPP 26 Littoral Rainforest.
VICTORIA	Pterostylis truncata		*Eucalyptus viminalis* ssp. *pyoriana* vegetation association on Mornington Peninsula
TASMANIA	*Eryngium ovanum* *Thryptomene micrantha* *Pterostylis grandiflora* *Caladenia cordata* *Eucalyptus risdonii* Brunonia australis *Callitris oblonga* *Discaria pubescens* *Epacris exerta* *Prostanthera rotundifolia* *Velleia paradoxa* *Viola caleyana*		Grassy *Eucalyptus viminalis* forests. *E. risdonii* woodlands. Grassy *E.globulus* forest Shrubby *E. ovata* forest

Invasion 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.

It is difficult to estimate the economic impact of bitou bush and boneseed. However, there is considerable expenditure on control programs, especially those involving herbicides, and the national biological control program. There is also a large unpaid effort contributed by volunteers through Dunecare and Landcare groups.

Dieback of older infestations can lead to changes in dune shape and accelerated erosion. Dense infestations of bitou bush and boneseed 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.

Cultural effects include significant localised impacts on Aboriginal sites either from preventing access to sites or beneficially providing stabilisation of sites subject to erosion.

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.

1.4 History of research, management and control methods

The adverse environmental impacts of bitou bush and boneseed were recognised over 30 years ago. Small-scale control programs commenced using physical methods and herbicides. However, for many years the lack of suitable control measures meant that only limited control programs were undertaken.

The exception to this was in Queensland where, with early declaration of bitou bush as a noxious weed in 1981, and a relatively small area infested (700 ha), 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. This has continued to the present day, and now only spot spraying or hand removal of small isolated infestations is required. Western Australia has been able to maintain a similar effort with boneseed, and isolated infestations are eradicated as soon as they are detected.

In the early 1980s research commenced on developing suitable herbicide treatments. This has led to the widespread use of glyphosate, and more recently metsulfuron methyl herbicides. These herbicides are applied in winter at rates that are selective in most native plant communities. NSW Agriculture has adapted the use of herbicides to allow aerial application from helicopters. This involves the use of very low rates of glyphosate (80% 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, with negligible damage to most native species.

The inadequacy of control options in the 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 possible 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 a nationally coordinated program, which initially involved funding from ANZECC agencies, and funding and research being provided by CSIRO, the Victorian Department of Natural Resources and Environment and NSW Agriculture. In recent years the Weeds CRC 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 having a significant impact on seed production as well a reducing plant vigour.

Earlier this year, the bitou leaf rolling moth ("*Tortricidae*"), was released on boneseed (You Yangs National Park in Victoria), and on bitou bush (Broadwater and Bundjalung National Parks in NSW). High hopes are held for this agent as it is the most damaging herbivore in its native habitat in South Africa: at high densities larvae are capable of decimating plants. Further research on other agents is continuing.

Hand removal of plants is very effective for low densities of plants and where only small areas are infested. Wildfires, or fire used as a control measure kills most mature plants, although a small proportion of plants re-sprout. Fire also kills seeds and stimulates germination of bitou bush, boneseed, and more importantly native species. Strategic burning is therefore a useful technique to control plants and reduce the seedbank, but its effectiveness depends on the intensity of the fire which is determined in part by fuel load and climatic conditions.

Wherever possible an integrated management approach needs to be adopted. Such an approach may include two or more of the following control measures: release of biocontrol agents, aerial or ground application of herbicides, physical removal of

plants, or burning. As with most weed control programs in natural ecosystems, natural regeneration, or over-sowing with locally collected seed of native species, is an important part of the rehabilitation process.

Detailed information on control methods and integrated management packages are given in the Best Practice Management Guidelines developed by the Weeds CRC [see (7) Additional Reading].

(not included in this document due to file size)

Figure 8. Damage caused by the bitou tip moth, *Comostolopsis germana.*
Photo: J. Thomas.

1.5 Quarantine and legislative controls

Chrysanthemoides monilifera is not listed under quarantine legislation as a prohibited plant. It is essential that this occurs so that further introductions of bitou bush and boneseed and related taxa, are prevented. This includes any of the other 4 subspecies of *C.monilifera* which occur in South Africa but have not yet been introduced to Australia.

Under noxious plant legislation *Chrysanthemoides monilifera* is a declared species in Queensland, New South Wales, Victoria, South Australia and Western Australia. Under the *Rural Land Protection Act 1985* in Queensland *C.monilifera* is classified in the P2 category which means it must be destroyed throughout the state. In NSW, under the *Noxious Weeds Act 1993*, *C.monilifera* is classified in the W3 category, which means it, must be prevented from spreading and the density of infestations reduced. *C.monilifera* is declared in all relevant coastal local government areas, and on Lord Howe Island where it has a W2 classification. In Victoria, under the *Catchment and Land Protection Act 1994*, boneseed is a regionally prohibited plant in four regions and a regionally controlled plant in six regions. In South Australia under the *Animal and Plant Control Act 1986*, boneseed is a proclaimed plant for enforced control on private and Crown land and the sale and transport of plants and seeds is prohibited. In Western Australia, under the *Agricultural and Related Resources Protection Act 1976*, *C.monilifera* has a P5 classification which means it must be controlled on public land. Within Tasmania, it is intended to proceed with listing boneseed as a declared weed as soon as the *Weed Management Act 1999* is proclaimed.

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*.

1.6 Socio-economic factors affecting management decisions

Bitou bush and boneseed are predominantly, but not exclusively, weeds on land under public ownership and management. Hence, resources to manage these weeds are derived from government with limited opportunities to obtain industry funding to assist in control.

Most land managers and control authorities are faced with a variety of weeds that should be controlled and a range of other land management issues, which have to be addressed. Faced with limited resources, control of these weeds is often a lower priority and is either not attempted or inadequate efforts are made. A reassessment of land management priorities is required to increase the resources for management to the level required for the implementation of this strategy.

Fortunately, there is considerable community interest and awareness of the adverse impacts of bitou bush and boneseed, especially in coastal areas. This has manifested itself in the hundreds of volunteer coastal care and “friends of parks” groups being formed, who direct much of their energy towards removing bitou bush and boneseed. However, the sheer magnitude of the problem, coupled with the limited number of volunteers in most areas, and the requirement for a long-term commitment, can lead to disillusionment by volunteers and local community groups disbanding.

This must not occur, and there is considerable opportunity to harness the energy of local communities, but this will need “on-ground” support through facilitators and additional and continuing funding.

In some areas bitou bush and boneseed have a beneficial role in dune stabilisation, especially around Aboriginal sites. In the absence of significant other vegetation, bitou bush and boneseed provide useful habitat for some native fauna.

1.7 Principles underpinning the plan

This plan is based on the recognition and acceptance of the four principles of the National Weeds Strategy:

- 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.
- Prevention and early intervention are the most cost effective techniques that can be deployed against weeds.

- 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.
- 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.

1.8 Process followed

A national planning workshop was held in Melbourne in December 1999. Key stakeholders attended from Queensland, NSW, Victoria, Tasmania and South Australia, including the NWS project manager, representatives from state agencies, Coastcare, Dunecare and Landcare, as well as scientists from the Weeds CRC and herbaria.

A draft strategic plan was developed at the workshop. State coordinators consulted widely within their jurisdictions and provided feedback to the NPWS. For example in NSW over 30 public meetings were held along the coastline and a number of written submissions were received. The strategy was reviewed to address the issues raised during the consultation period, and the final version of the strategic plan was prepared and submitted to the NWSEC in August 2000.

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Figure 9. Bitou bush infestation (centre) and effect of aerial spraying (foreground). Green vegetation is undamaged coastal wattle (*Acacia sophorae)*. Photo: J. Thomas

1.9 Relevance to other strategies

This national 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 as outlined below.

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
State	Queensland Biodiversity and Natural Resource Management Strategy New South Wales Biodiversity Strategy Victoria's Biodiversity Strategy	Queensland, New South Wales Victorian, South Australia, Tasmanian, Western Australia Weed Strategies Environmental Weed Directions Plan for Victoria South Australian APCC boneseed policy
Regional/ Catchment	Regional Vegetation Management Plans Regional Environment Plans Regional Natural Resource Management Strategies Catchment Management Strategies	Regional/Catchment Weed Plans (NSW, Victoria and Tasmania) Regional Pest Management Strategies (Queensland) Parks and Wildlife Service District Weed Management Plans (NSW and Tasmania) Statutory Weed Management Plans (Tasmania)
Local	Park and Reserve Management Plans	Local Weed Plans (local weed authorities, councils) Local Government Pest Management Plans

2 STRATEGIC PLAN

VISION

Working together to arrest the spread and minimise the impact of bitou bush and boneseed in natural ecosystems.

2.1 Prevent spread

Desired outcome

The further introduction and spread of bitou bush and boneseed is prevented

Background

Bitou bush and boneseed are widely distributed along the south-eastern edge of the continent. However there are many areas within their existing ranges which are not infested and there are large areas outside the current distribution, which are potentially at risk. There is a need to identify sites and plant communities, which are most at risk, and to establish a system for detecting, reporting, and eradicating new infestations.

State agencies and weed control authorities each has a responsibility for recording and mapping the spread of bitou bush and boneseed. The control of new infestations must be a priority with emphasis on eradicating these in high risk areas.

Special attention should be given to national containment zones for bitou bush just south of the Queensland border, and on the Far South Coast of NSW between Merimbula and Narooma. This will assist in containing the spread of bitou bush outside its current range. Similar containment zones may need to be established for boneseed, but because of its wider and more scattered distribution, the location, need and effectiveness of containment zones for boneseed have yet to be determined.

The status of bitou bush and boneseed as noxious weeds in each State and Territory will be reviewed with a view to prohibiting their propagation, cultivation and distribution throughout Australia. An application will be made to AQIS to place *Chrysanthemoides monilifera* on the prohibited import list. This will prevent any further introductions of ssp. *rotundata* and ssp. *monilifera* into Australia, and will also prevent the introduction of four other subspecies, which do not yet occur in Australia. Extension materials will be prepared to illustrate and describe these four subspecies. Distribution and promotion of these materials will assist in the detection of any importations of these related taxa.

(not included in this document due to file size)

Figure 10. Dense infestations of bitou bush in northern New South Wales
Photo: J. Thomas

Objective 2.1.1. Identify high risk sites for invasion by bitou bush and boneseed			
Strategy	**Actions**	**Responsibility**	**Rank**
2.1.1.1 Risk assessment	Identify sites and plant communities most at risk from invasion and set priorities for monitoring	State agencies and Environment Australia, in consultation with local control authorities and the community	1
Objective 2.1.2. Develop and maintain early detection and eradication mechanisms			
Strategy	**Actions**	**Responsibility**	**Rank**
2.1.2.1 Establish a surveillance and reporting system	Assess existing weed reporting systems and adopt or modify	BBBS Committee and State agencies	1
2.1.2.2 Prevent the establishment of new infestations	Bitou bush and boneseed to be declared as "noxious" plants to prevent the propagation, cultivation and distribution in those jurisdictions where this does not already occur	State/Territory agencies	1
	Monitor and record any new infestations	State agencies, regional and local weed control authorities	1
	Prioritise areas and undertake control action in order of priority	State agencies, regional and local weed control authorities	1
2.1.2.3 Establish national containment zones where appropriate	Establish and enforce containment zones: in northern/southern NSW for bitou bush, and investigate the need for containment zones for boneseed	State agencies, regional and local weed control authorities	2
Objective 2.1.3. Establish an early detection system for other related taxa not present in Australia			
Strategy	**Actions**	**Responsibility**	**Rank**
2.1.3.1 Establish an early detection system for other related taxa not present in Australia	Apply to AQIS to include *C.monilfera* on the prohibited plants list	National coordinator	1
	Provide extension materials for state agencies to disseminate	National coordinator, BBBS Committee	3

2.2 Minimise adverse impacts

Desired outcome

The adverse impacts of bitou bush and boneseed on biodiversity are minimised

Background

This is the main thrust of the strategy. Infestations are widespread and occur in a variety of landscapes/vegetation types. However, in many regions the area and density of infestations have not been documented. Surveying, recording and mapping all infestations, using standard methodology, is a high priority. This will provide essential information on the extent and severity of the infestations, and the vegetation communities most affected. Summary reports need to be prepared at all levels: national, state, regional and local.

Concurrently, criteria will be established to assess and prioritise areas for control. The criteria will address issues such as conservation significance, prevention of further spread, and feasibility of control (e.g. plant community/landscape, accessibility and resources required).

The extent and impact of existing infestations must be reduced for biodiversity to be protected. This will involve eradicating bitou bush and boneseed from lightly infested areas and from sites of high conservation significance. Early intervention to control isolated infestations and/or lightly infested areas is essential, as established infestations take much longer to control and require significantly more resources. Aerial application of herbicides, or biological control, are the only options for large area infestations.

In recent years there has been an increase in the number and variety of control methods available: ground and aerial applications of herbicides, strategic burning, physical removal of plants, and several biological control agents. Each control option has advantages depending on the site conditions (e.g. vegetation and/or landscape infested). However, no single technique is likely to provide long-term control, and hence an integrated approach is required. New techniques need to be sought and evaluated, and the integrated managed packages, such as those developed by the Weeds CRC, need to be continually refined. It is particularly important to monitor the non-target impacts of particular control options. Each site needs to be assessed, as the final combination of techniques is likely to be site-specific. This is essential to obtain the most cost-effective result, minimise non-target impacts, and ensure that natural regeneration and succession is sustainable. Otherwise re-invasion will be rapid, and other weeds will replace bitou bush and boneseed.

Finally, management plans need to be developed at all levels (state, regional, local), so that a more strategic approach is taken. These must be developed in consultation with all relevant stakeholders so that there is ownership and commitment to the proposed course of action.

It is essential that the extensive community input that is currently directed towards the management of bitou bush and boneseed, is supported. The network of volunteer Dunecare, Bushcare and Landcare groups, need to be involved at all levels, in the development and implementation of management plans. Education and training of all stakeholders in best practice management will be important in making the best use of available resources. This is also essential to maintain the commitment of existing community groups, and to encourage more people to become involved.

Objective 2.2.1. Record, assess and prioritise existing infestations			
Strategy	**Actions**	**Responsibility**	**Rank**
2.2.1.1 Record and map distribution and abundance of bitou bush and boneseed	Identify guidelines for data collection	BBBS Committee, State agencies, national coordinator	1
	Collate existing information, identify gaps and undertake further work to produce distribution maps	State agencies, regional and local control authorities	1
	Ongoing maintenance and updating of data	State agencies, regional and local control authorities	2
2.2.1.2 Assess and prioritise areas for protection	Establish criteria to determine priorities with emphasis on conservation significance and feasibility of control	State agencies, regional and local control authorities with community consultation	1
	Prioritise areas	State agencies, regional and local control authorities with community consultation	1
Objective 2.2.2. Reduce the extent and impact of existing infestations			
Strategy	**Actions**	**Responsibility**	**Rank**
2.2.2.1 Undertake control in high priority areas	Coordinate and implement on ground works to eradicate bitou bush and boneseed from sites of high conservation significance and other lightly infested areas	State agencies, regional and local control authorities with community support	1
2.2.2.2 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	State agencies, regional and local control authorities with community support	2
Objective 2.2.3. Refine and adopt best management practices			
Strategy	**Actions**	**Responsibility**	**Rank**
2.2.3.1 Evaluate new and existing herbicide applications	Evaluate effects on target weeds	State agencies, regional and local control authorities, herbicide companies	1
	Evaluate effects on other weeds	State agencies, regional and local control authorities	2
	Evaluate effects on native plants	State agencies, regional and local control authorities	1
	Evaluate effects on biocontrol agents	Weeds CRC, State agencies, regional and local control authorities	2
	Evaluate effects on fauna	State agencies, Australian Museum, universities	3
2.2.3.2 Introduce assess, and improve the effectiveness of biocontrol agents	Identify potential biocontrol agents and undertake appropriate host specificity testing	Weeds CRC and member agencies	1
	Release and assess effectiveness of biocontrol agents	Weeds CRC and member agencies	1
	Evaluate impacts of introduced biocontrol agents and interaction with other control options	Weeds CRC and member agencies, regional and local control authorities	2
Strategy	**Actions**	**Responsibility**	**Rank**

2.2.3.3 Evaluate fire and physical control options	Evaluate the use of fire as a management technique	Weeds CRC and member agencies, State agencies, regional and local control authorities	2
	Evaluate the use of other control options e.g. mechanical methods	State agencies, regional and local control authorities	3
2.2.3.4 Develop and implement site-specific integrated management strategies	Develop criteria to assess sites, identify most effective control options and priorities	Weeds CRC and member agencies, State agencies, regional and local control authorities	1
	Evaluate current best practice guidelines, and refine as required	Weeds CRC and member agencies, State agencies, local weed authorities	1
	Develop re-vegetation guidelines for different habitats/vegetation communities	State agencies, regional and local control authorities with community support	2

Objective 2.2.4. Involve the community in the implementation of management strategies at all levels

Strategy	Actions	Responsibility	Rank
2.2.4.1 Involve stakeholders in preparation of state, regional and local plans	Prepare state-wide management strategies, or where appropriate threat abatement plans	State coordinators, with State agencies and other stakeholders	1
	Establish regional and local groups to prepare and implement regional/local management plans	State agencies, regional and local control authorities in consultation with all stakeholders	2
2.2.4.2 Train and involve all stakeholders in use of best practice management	Develop and/or identify accredited training and deliver courses	National coordinator, State agencies, regional and local control authorities	2
	Provide support for volunteers and expand the volunteer efforts	State agencies, regional and local control authorities	2
2.2.4.3 Establish communication and information exchange	Develop, promote and use information network	National coordinator and state coordinators using existing networks	3

2.3 Harness national commitment

Desired outcome

The national commitment to the coordination and management of bitou bush and boneseed is maintained.

Background

The development, implementation and evaluation of a national management strategy for bitou bush and boneseed is a requirement of their listing as weeds of national significance.

The planning process outlined in the National Weeds Strategy requires a number of actions:

- the involvement of all stakeholders in developing and implementing the plan;
- the integration of the plan with other existing, relevant land management programs at all levels;
- the suitability, availability, requirements for, and integration of all available tools for control and awareness;
- the utilisation of coordinated community action as the delivery mechanism for implementation wherever appropriate;

- the determination of an appropriate funding mechanism for the plan, including identification of the beneficiaries and their relative capacity to pay; and
- The establishment of performance objectives and methods for their evaluation.

The bitou bush and boneseed strategic plan addresses all these issues. It provides a framework for coordination of actions at the national, regional and local level so that resources are directed to address the most critical issues, and to plant communities where the benefits to biodiversity conservation will be greatest. Priority is given to enhancing community involvement by developing partnerships between stakeholders, with specific recognition of the important role of volunteers.

Successful implementation of this strategy will require additional resources. As infestations of bitou bush and boneseed mainly occur on public lands, most funding, now and in the future, will have to be provided by governments. One of the actions of the strategic plan is to identify opportunities for private sector support.

Objective 2.3.1. Maintain the effectiveness and relevance of the national strategy

Strategy	Actions	Responsibility	Rank
2.3.1.1 Coordinate implementation of strategy	Establish and maintain a bitou bush and boneseed steering committee and appoint a national coordinator	NWSEC, BBBS Committee, State agencies	1
2.3.1.2 Monitor implementation of the strategic plan	Report on progress with actions in strategy to NWSEC and stakeholders	National coordinator, BBBS Committee	2
2.3.1.3 Increase the recognition and understanding of the impact of bitou bush and boneseed	Develop and implement education and awareness programs aimed at all stakeholders	State agencies, regional and local weed control authorities with community consultation	2
2.3.1.4 Expand the resource base	Promote the strategy and opportunities for funding Identify new/additional sources of funding and human resources	NWSEC, National coordinator, BBBS Committee, State agencies All stakeholders	1 2

(not included in this document due to file size)

Figure 11. Community volunteers play an important role and they need ongoing support.
Photo: J. Thomas

3 MONITORING AND EVALUATION

This strategic plan will be subject to a 5 year review. The Bitou Bush and Boneseed Steering Committee overseeing bitou bush and boneseed will monitor the implementation of the strategy in cooperation with relevant Commonwealth and State/Territory agencies.

Performance indicators for the plan include the following:

- A bitou bush and boneseed steering committee is formed
- Bitou bush and boneseed are declared as noxious weeds/pest plants under relevant State/Territory legislation (where they are not already declared)
- *Chrysanthemoides monilifera* included on AQIS prohibited plants list
- A national coordinator is appointed
- A map of current distribution of bitou bush and boneseed is prepared: initially this will be the responsibility of each State/Territory with eventual preparation of national maps for each species
- National containment zones are established and maintained
- Publication, evaluation and refinement of best practice management guides for both bitou bush and boneseed
- Biological control agents continue to be released and information on their establishment and effectiveness monitored and collated
- Statewide and regional/local strategies identifying priority areas for control are prepared and distributed to relevant stakeholders; in NSW this will include the preparation of a threat abatement plan for bitou bush
- There is no increase in the total area infested by bitou bush and boneseed
- Effective control programs are implemented in priority conservation areas
- Workshops/training in “best practice” management are held in relevant States/Territories
- There is increased awareness at all levels, including the general community, private and public land managers, and relevant agencies of the social, environmental and economic impacts of bitou bush and boneseed
- The community effort is maintained in proportion to the level needed to control infestations.

(not included in this document due to file size)

Figure 12.
Volunteers and agency staff working together to revegetate an area after control.
Photo: J. Thomas

4 STAKEHOLDER ROLES AND RESPONSIBILITIES

Commonwealth and State/Territory agencies, regional and local weed control authorities, local government, community groups and individuals share responsibility for implementing the actions identified in Section 4. Some actions will be the responsibility of specific agencies/groups, while for other actions a collaborative approach is likely to be the most effective.

Private landholders

- Contribute towards, and where appropriate implement, actions as required in regional/local management plans.

Community groups

- Where appropriate monitor and map the distribution
- Contribute towards, and where appropriate implement, actions as required in regional/local management plans
- Where appropriate, contribute to the preparation and implementation of threat abatement plans where required under threatened species legislation
- With other appropriate agencies refine and promote education and training programs on the impacts, ecology and best practice management strategies.

Regional and local weed control authorities (local government)

- Where appropriate, enforce the provisions of relevant State/Territory noxious weed legislation
- With state agencies monitor and map the distribution
- Develop and implement actions as required in regional/local management plans
- Contribute to the preparation and implementation of threat abatement plans where required under threatened species legislation
- Implement effective control programs on own land
- With other appropriate agencies refine and promote education and training programs on the impacts, ecology and best practice management strategies.

State government agencies

- With appropriate agencies, introduce and enforce noxious weed legislation if this has not already occurred
- Monitor and map the distribution
- Coordinate and/or contribute to the development of local/regional management plans for bitou bush and boneseed
- Involve relevant stakeholders in the preparation and implementation of threat abatement plans where required under threatened species legislation
- Implement effective control programs on publicly managed lands
- Liaise with other stakeholders for implementation of programs on other lands
- Conduct research on the ecology and control of bitou bush and boneseed
- With other appropriate agencies refine and promote education and training programs on the impacts, ecology and best practice management strategies
- With Bitou Bush and Boneseed Steering Committee, coordinate actions required to implement and evaluate the national strategy.

Cooperative Research Centre for Weed Management Systems and universities

- CSIRO/Weeds CRC/universities have a continuing role in research on impacts, ecology and control
- With other appropriate agencies refine and promote education and training programs on the impacts, ecology and best practice management strategies
- With BBBS Committee, coordinate actions required to implement and evaluate the national strategy.

Federal government departments and corporations

- Ensure quarantine controls on entry of bitou bush and boneseed (AQIS)
- To ensure uptake by Departmental staff to restrict movement of weeds (agencies that manage land and travel on non-government land)
- To ensure bitou bush and boneseed control is undertaken on all federally managed lands (Defence, Environment Australia and other Commonwealth departments/ corporations that manage land)
- Oversee and manage federal funds including Natural Heritage Trust and National Weed Program (Environment Australia, Agriculture, Forestry and Fisheries – Australia).

Bitou Bush and Boneseed Steering Committee

- Coordinate implementation of actions identified in the Bitou Bush and Boneseed Strategic Plan
- Monitor and report to NWSEC on the implementation of the Strategic Plan.

(not included in this document due to file size)

Figure 13. Eastern Suburbs Banksia Scrub, a threatened plant community affected by bitou bush. La Perouse, Sydney. Photo P. Glass

5 ADDITIONAL READING

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6 GLOSSARY

APCC Animal and Plant Control Commission of South Australia

ANZECC Australian and New Zealand Environment and Conservation Council

AQIS Australian Quarantine and Inspection Service

DNRE Victorian Department o Natural Resources and Environment

BBBS National Weeds Strategy Bitou Bush and Boneseed Steering Committee

Local weed control authorities

Organisations with responsibilities for weed planning and control at the local level - generally local government councils

NHT Natural Heritage Trust

NPWS NSW National Parks and Wildlife Service

NWS National Weeds Strategy

NWSEC National Weeds Strategy Executive Committee

Regional weed control authorities

Organisations with responsibilities for weed planning and control at the regional or catchment scale e.g. catchment management boards, regional weeds advisory committees

State agencies

State government departments with responsibilities for conservation, natural resources, agriculture and pest management

Weeds CRC Cooperative Research Centre for Weed Management Systems