

SOUTH COAST REGIONAL BITOU BUSH STRATEGY

2002



The community working together to control the spread and reduce the negative impacts of bitou bush along the south coast of New South Wales.



Arnhem Environmental Impact Assessors
in conjunction with the
Steering Committee for the South Coast Bitou Bush Project

South Coast Regional Bitou Bush Strategy

The Vision

The community working together to control the spread and reduce the negative impacts of Bitou Bush along the South Coast of New South Wales.

Executive Summary

Bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata* (DC.) Norlindh) is a South African plant that has become a serious environmental weed on NSW coastal dune ecosystems since its accidental introduction in 1908. It has no natural enemies in Australia and produces some 50,000 drupaceous seeds per plant per annum which are attractive to birds and foxes. Presently about 36,000 ha and 900 km of coastline are occupied by bitou bush and it is the dominant plant along 400 km. It is estimated that by the year 2010 90% of the 1100km coast (mostly in natural ecosystems) could be infested with bitou bush.

Bitou bush is declared noxious in all coastal local councils NSW and Queensland, in 1999 it was listed as a Weed of National Significance under the *National Weeds Strategy*. Invasion of native plant communities by bitou bush was listed as a Key Threatening Process to Biodiversity under the *NSW Threatened Species Conservation Act, 1995*. Bitou bush poses a major threat to biodiversity and ecological stability throughout the coastal zone of SE Australia. Infestations are increasing and, in many cases, this increase is beyond the capacity of the individual landholder to control it. The cost of bitou bush to the community, in not only dollar terms but in loss of amenity and environmental sanctity, have yet to be measured but must be considered highly significant.

There are a number of different treatment techniques available to manage bitou bush and numerous groups are involved in control programs. However, many of these programs have previously been undertaken in an *ad hoc* manner. This strategy, together with recently completed state and national strategies prioritise key actions that are required to achieve our vision. Effective management will require coordinated action, backed by a

commitment from all stakeholders, to support and take part in management activities. It thus requires linkages between National, State and Regional Policies, Plans and Strategies and Local Action Plans and, possibly most importantly, a backing by the community.

This Strategy aims to raise public awareness and understanding of the bitou bush problem through encouraging involvement in the development and implementation of Local bitou bush Action Plans within a regional framework that will allow for the improved co-operation and co-ordination of the various groups and activities involved in bitou bush control. The community will be consulted in a series of regional workshops with the aim of identifying key issues, priorities for action and consolidating the mapping information network.

Management of bitou bush must be seen as a core responsibility of the land manager with a commitment to future management. In the development of a Regional Strategy stakeholder responsibilities will be identified and their obligations detailed so as to ensure sustainable long-term management of bitou bush (based on current or realistically predicted resourcing levels). The role of constituent Local Control Authorities will be to act in a managing position to ensure continuation of Local and Regional Management Plans.

The Strategy is closely linked to the NSW bitou bush strategy and National bitou bush and boneseed strategic plan, with particular emphasis on those areas of most relevance to the South Coast. It involves an extensive education/extension program that will communicate the results of bitou bush research and foster the adoption of appropriate management strategies (linked with the National Weeds Strategy and the forthcoming Threat Abatement Plan).

Goals and Objectives

The Strategy has three Goals, each with a number of subordinate Objectives. These are summarised below.

Goal 1: *Prevent the further introduction and spread of bitou bush*

- Objective 1.1.** Identify high risk sites for invasion by bitou bush.
- Objective 1.2.** Develop and maintain early detection and eradication mechanisms.

Goal 2: *Minimise the adverse impacts of bitou bush on biodiversity*

- Objective 2.1.** Record, assess and prioritise existing infestations.
- Objective 2.2.** Reduce the extent and impact of existing infestations.
- Objective 2.3.** Involve the community in the preparation and implementation of management strategies at all levels.
- Objective 2.4.** Adopt best management practices.

Goal 3: *Expand the commitment to the management of bitou bush*

- Objective 3.1.** Maintain the effectiveness and relevance of the South Coast Regional Bitou Bush Strategy
- Objective 3.2.** Maintain and expand the resource base

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South Coast Regional Bitou Bush Strategy

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1 The Challenge

Infestations of bitou bush are increasing and, in many cases, this increase is beyond the capacity of the individual landholder to control. The cost of bitou bush to the community, in not only dollar terms but in loss of amenity and environmental sanctity, have yet to be measured, but must be considered highly significant.

Recent mapping has produced a conservation estimate of 36,000 ha and 900 km of coastline are occupied by bitou bush and it is estimated that approximately two thirds of the coastal vegetation could be dominated by bitou bush by the year 2010 and that 90% of the 1100km NSW coastline (mostly in natural ecosystems) could be infested with bitou bush.

There are a number of different treatment techniques available to manage bitou bush and numerous groups are involved in control programs. However, many of these programs have previously been undertaken in an *ad hoc* manner. In recent years there has been an improvement in the planning and coordination of some programs, and this seeds to be expanded to encompass the whole area.

An effective strategy must achieve sustainable long-term management of bitou bush, based on current or realistically predicted resourcing levels. Furthermore, management of bitou bush must be seen as a core responsibility of the land manager with a commitment to future management.

2 Process Followed

An integrated strategy sets out to capture all knowledge about the problem and develop solutions. It must, above all, gain acceptance of a clear inspirational vision or outcome about the project which is realistic and credible.

Current knowledge about the biology of bitou bush and technical issues surrounding its control has been provided by research undertaken by NSW Agriculture, CSIRO, CRC for Weed Management Systems and NPWS. The CRC for Weed Management Systems has produced the Best Practice Management Guide for Environmental Weeds, No. 3, Bitou Bush (February, 2000).

Stakeholder involvement and ongoing commitment to managing bitou bush on the south coast of NSW has been encouraged through structured stakeholder workshops and the development of networking linkages. The purpose of stakeholder workshops has been to scope out the overall project structure with particular emphasis on how the various aspects of bitou bush management do, and/or should, interact, resulting in the drafting of an influence diagram, or 'mud map', of the problem. A regional strategy and for bitou bush has been developed based on the outcomes of these workshops and takes into account priorities in the National and State bitou bush strategies.

Information on bitou bush distribution and abundance along the NSW coastline has been coordinated Statewide by NPWS and NSW Agriculture in conjunction with local government councils, Dunecare, Coastcare and Landcare groups. An information sharing network has been established following a series of regional community workshops. This network will be used to inform community groups of ongoing activities to control bitou bush and to gather information for updating mapping of bitou bush.

It is proposed to establish a Task Force in order to oversight and assist in the ongoing implementation of the regional strategy and management plan for bitou bush on the South Coast of New South Wales.

Role for the Task Force

- Oversee and monitor the ongoing implementation of the regional strategy and management plans;
- Undertake a periodic review of the management plan and modify as required;
- Implement a public awareness campaign with view to increasing community understanding about the bitou bush problem and ways to combat it;
- Provide coordination for the activities of the various Local Weed Control Authorities in respect of bitou bush; and
- Provide a body through which to make funding submissions at the regional level.

This Strategy is supported by NSW Agriculture, CRC for Weed Management Systems, NSW National Parks and Wildlife Service, Coastcare, Environment Australia, Lower Shoalhaven Catchment Management and the Illawarra Catchment Management Committee. These organisations will provide strategic direction and co-ordination, and will ensure effective monitoring and evaluation is carried out.

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3 Background

3.1 Biology of the Weed

Bitou bush, *Chrysanthemoides monilifera*, ssp. *rotundata*, of South African origin, is a competitive environmental weed that has no natural enemies in Australia.

Ecosystems invaded: Bitou bush invades disturbed and undisturbed coastal ecosystems: sand dune (heathlands and grasslands), headland (heathlands and grasslands), coastal woodlands, coastal dry sclerophyll forests, and littoral rainforests.

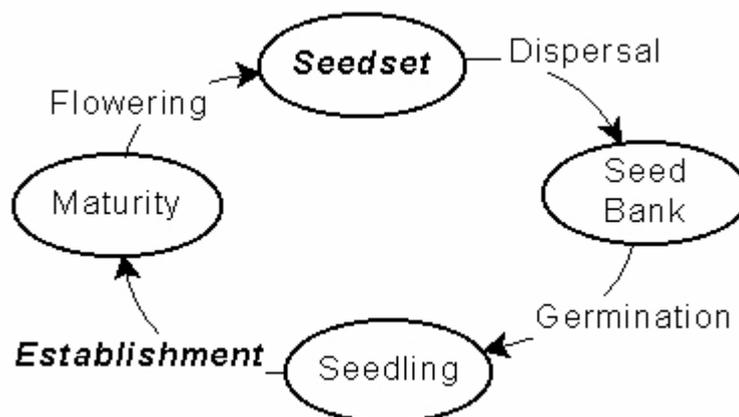
Lifeform: Adult bitou bush shrubs are about 1-2m high (or higher, up to 10m, scrambling up trees in woodlands or forests).

Description: The leaves are 3-8 cm long, bright green, succulent, oval, with irregular teeth along the edge and tapering at the base, young growth downy grey in appearance. Flowers are bright yellow, daisy like, with 11-13 'petals'. The fleshy fruit are green, becoming black when ripe and contain only 1 seed (egg-shaped, ribbed seeds 5-7 mm long).

Biology and Ecology: Peak flowering time is April to June and peak fruiting occurs from June to September. Seed production is prolific - up to 50,000 seeds per mature plant per year resulting in the build up of a massive soil seed bank. Most seeds last in the soil for 2-4 years, but a significant proportion can remain dormant in soil up to 7 years or more. The fleshy green fruit turn black when ripe and are eaten by birds (especially starlings) and foxes which can disperse the seeds several kilometres into uninfested areas. Germination is promoted by fire, soil disturbance or after ingestion by birds and mammals.

The weed is a vigorous competitor with native flora and tolerant of a range of growing conditions and disturbances. Bitou bush will hybridise with boneseed to produce fertile plants with intermediate characteristics. An Australian fungus *Sclerotinia sclerotiorum* is known to attack bitou bush causing shoot rot. There is a low incidence of fungi beneficial to plant growth forming associations on the roots.

Figure 1 Life Cycle of Bitou Bush



The highlighted (**bold**) phases in the life cycle indicate critical points where intervention to break the cycle at these stages can significantly disrupt the population dynamics of this species. The prevention of seedset (and secondarily, prevention of establishment of seedlings) is crucial in preventing bitou bush domination of invaded plant communities.

3.2 History of Spread

Bitou bush was first recorded in Australia from Stockton near Newcastle in 1908 (an accidental introduction in ships ballast). From 1946 until 1968, it was recommended for sand dune stabilisation by the Soil Conservation Service and planted in northern NSW to stabilise sand dunes after mining, and in southern NSW it was planted to stabilise blowouts.

The capacity of bitou bush to invade native vegetation had been recognised by the early 1970's and its recommendation for coastal planting was withdrawn. However, by 1976, bitou bush was naturalised along much of the NSW coast, due to its prolific seed production, long-lived soil seed banks and wide dispersal of the fleshy drupes by birds and other vectors such as foxes. Aerial surveys of the NSW coastline conducted by the NSW NPWS in 1981 and 1982 indicated that bitou bush occurs along 645 km of the NSW coast (60% of the total length). The range of bitou bush has expanded since and mapping during 2000 now finds it on 900 km of coastline. It has been predicted that it could spread to occupy over 90% of the NSW coastline by 2010 and would dominate the native vegetation along two thirds of the coastal fringe.

Climatic data from South Africa and Australia, used to determine the bioclimatic potential spread of bitou bush, indicates that most of the coastal zones of Victoria, NSW and Queensland, up to Mosman (north of Cairns) could be infested (Howden, 1984). Coastal plant communities from Bundaberg south to the Hunter River Valley are fairly uniform with little variation in composition. These communities have been invaded by bitou bush in NSW and there is no apparent reason why bitou bush would not degrade similar ecosystems in Queensland.

3.3 Summary of impacts

Bitou bush is largely an environmental weed infesting both disturbed and undisturbed natural areas. In agricultural areas it is easily controlled by stock grazing and cultivation. It is primarily restricted to coastal dune ecosystems with national parks, forests, coastal dune ecosystems, other recreational land (industrial/commercial land is also infested). Bitou bush currently infests coastal areas of southern Queensland, most of NSW and Lord Howe Island.

Bitou bush impacts can be both negative and positive. On the positive side, it provides short to medium term dune stabilisation and inhibits the growth of more problematic weeds. However, from both ecological and economic perspectives the negative impacts are significant, and point to the need for control.

Physiographic impacts: Destruction of mature bushes through mechanical means, herbicide spraying or natural senescence can result in sand dune blowout unless alternative species are established.

Ecosystem impacts: Bitou bush displaces the dominant plants in communities it invades and leads to a decline in floral biodiversity as well as changes in the diversity of birds, native mammals and ground-dwelling insects. Stands of Bitou Bush have been known to harbour pest animals, such as foxes and introduced birds, which feed on and disperse the seeds or shelter under the canopies.

Species impacts: Rare and endangered plant species such as *Pimelea spicata*, *Zieria prostrata*, *Cynanchum elegans* and *Thesium australe*, occurring in plant communities invaded by bitou bush, are particularly at risk due to the processes leading to a decline in floral diversity resulting from the aggressive competitiveness of bitou bush.

Economic impacts: The costs of large-scale management to date are high as they involve considerable amounts of labour from Dunecare, Coastcare and Landcare groups, aerial spraying with herbicides and establishing a biological program. Economic impacts may also occur because of losses to tourism. Dense bitou bush infestations can lead to loss of amenity and recreation by blocking access to beaches. It is thought that a reduction in biodiversity could impact adversely on tourism if people are selective about their destinations based on the integrity of the natural environment. However, there appears to be little hard evidence about this, and further research may be warranted.

3.4 Socioeconomic Factors affecting Management Decisions

The main socioeconomic factor that affects management decisions is the lack of a stable funding base.

Projects are generally run under grant funds which have to be applied for annually and it is difficult to plan ahead and disappointing to see works degrade if funding for follow-up is unavailable or not available at the time it would be most effective. The contribution made by volunteers in bitou bush management for follow-up work and rehabilitation of significant sites is high as they involve considerable amounts of time from individuals in Dunecare, Coastcare and Landcare groups. However the bulk of work that is required for

bitou bush control is beyond the capacity of volunteer care groups and needs to be undertaken by trained contractors or government staff.

Recognition of the importance of long-term management of bitou bush and the need for cooperation by government agencies and the community needs to go well beyond just those who are members of action groups such as Dunecare, or Landcare, etc. For instance, in some situations important follow-up aerial spraying of herbicide may not be able to be done in time because individual landholders may not agree to aerial spraying near their land. Maintenance of the momentum needed for continued commitment of individuals in groups and a broader community awareness will require the promotion of a structured program of community education of the economic and environmental impacts of bitou bush. Regional coordination of community groups is needed to foster cooperation between groups and sharing of information to help alleviate the symptoms of isolation and fragmentation suffered by many groups in the region.

3.5 History of Research and Management Including Regulation

The capacity of bitou bush to invade native vegetation had been recognised by the early 1970's and its recommendation for coastal planting was withdrawn. However, by 1976, bitou bush was naturalised along much of the NSW coast due to its prolific seed production, long-lived soil seed banks and wide dispersal of the fleshy drupes by birds and other vectors such as foxes.

Aerial surveys of the NSW coastline conducted by the NSW NPWS in 1981 and 1982 indicated that bitou bush occurs along 645 km of the NSW coast (60% of the total length). In November 1983 an interdepartmental working group visited the NSW North Coast to assess the impact of bitou bush in areas set aside for coastal conservation. By 1984 bitou bush control programs in NSW involved 21 local government authorities and 9 volunteer groups with an annual expenditure of \$200,000. Aware that bitou bush was a major threat to the conservation of natural areas along the entire east coast of Australia, a national forum was held in August 1984 to improve exchange of information and to develop co-operative and supportive strategies against this species. However, in NSW the range of bitou bush continued to expand (particularly in northern NSW) and it has been predicted that it could spread to occupy over 90% of the NSW coastline by 2010 and it could dominate the native vegetation along two thirds of the coastal fringe.

Traditionally, physical and chemical controls have been used to reduce infestations and limit spread of bitou bush. These methods have been used successfully to contain bitou bush at the extremes of its current distribution. Since 1983, in southern Queensland, heavy infestations from Inskip Point and South Stradbroke Island (700 ha) have been controlled and virtually eradicated with the use of Glyphosate herbicide by the staff of the Alan Fletcher Research Station, Department of Lands, Queensland. In the south of NSW (Bega Valley Shire) a localised heavy infestation of bitou bush in Tathra was brought under control by the continued efforts of a dedicated Landcare Group, formed in 1993 to carry out essential follow-up work after a large initial investment of an integrated control program started in 1990 by all three levels of government.

A biological control program against bitou bush was commenced in 1989 and six species of insects have been released with additional species under investigation. Two insects that attack bitou bush in South Africa have been released and established very well in Australia. These are the Bitou Tip Moth (*Comostolopsis germana*) which destroys the growing tips, and the Bitou Seed Fly (*Mesoclanis polana*) that destroys developing seeds. In 1992 studies on integrated control of bitou bush combining the use of biological control agents together with strategic herbicide applications were commenced. In 1997 the strategic use of fire, herbicide, biological control and clearing was trialed as a part of an integrated control-revegetation strategy for the management of bitou bush on coastal dunes. Regeneration of coastal areas (cleared of bitou bush) by local volunteer groups has also been an important component of bitou bush management.

Bitou bush was declared noxious in Queensland in 1981 and was recently declared noxious in all coastal councils of NSW under the *Noxious Weeds Act 1993* (category W3, meaning that the weed must be prevented from spreading and its numbers and distribution reduced). In 1999 invasion of plant communities by bitou bush was listed as a Key Threatening Process to Biodiversity under the *Threatened Species Conservation Act NSW, 1995*, and has also been listed as one of 20 Weeds of National Significance (WONS) under the *National Weeds Strategy*. By definition, the endorsement of a weed as a WONS requires national action to effectively manage the problem.

Under the *Quarantine Act 1908*, administered by AQIS and the *Wildlife Protection (Regulation of Exports and Imports) Act 1982*, the importation of bitou bush/boneseed (*Chrysanthemoides monilifera*) is prohibited because of its listing as a Weed of National Significance. It is essential to prevent new importations of any of the six sub-species of *Chrysanthemoides monilifera* into Australia. In 1994, the Standing Committee on Agriculture and Resource Management approved the release of a document entitled 'Operation of the Consultative Committee as a Component of Contingency Action Following the Introduction of Exotic Plant Insect Pests, Diseases and Weeds'. This document forms the basis of the contingency plan, including funding, appropriate for a response to an outbreak of a weed of national significance.

3.6 Control Methods (incorporating methods outlined in *Best Practice Management Guide For Environmental Weeds*, J. Vranjic, (2000)

There are a number of different treatment techniques available to manage bitou bush and numerous groups are involved in control programs. Bitou bush is being controlled by community care groups (Dunecare, Coastcare and Landcare), National Parks and Wildlife Service, Local Government, other Government Departments and private landholders. In small areas of high conservation value, labour intensive physical and chemical methods (eg pulling and cut stump painting) are used; moderate infestations have been treated with ground vehicle application of high volume herbicides; larger infestations have been treated by aerial spraying. NPWS are trialing combined spray-burn-spray treatments. Biological controls have also been incorporated into many control sites.

Mechanical treatment: Mature plants can be slashed, whilst seedlings can be hand-pulled to remove the entire root system. Plants are liable to resprout after slashing alone but applying herbicide to cut stems should prevent regrowth. Mechanical techniques are laborious and impractical for infestations that are extensive or in areas that are difficult to

access and may also cause soil disturbance and erosion problems, particularly when large roots are removed.

Herbicide information: When using chemicals always read the label and follow all instructions carefully. Consult a specialist for advice on registered chemicals in your particular State or Territory. Herbicide information is available at the National Registration Authority web site at www.affa.gov.au/nra/pubcris.html

Herbicides registered for bitou bush are applied in winter at low rates that effectively kill the weed, yet have minimal impacts on coastal vegetation. Herbicides can be applied from the air, from the ground or by a cut-and-paste method. Plants which are coated with dust or seaspray (eg. those close to tracks or the beach) could be less affected by herbicides. Glyphosate and metsulfuron have been the herbicides most widely and successfully used against bitou bush.

Biological control: Two insects that attack bitou bush in South Africa have been released and established very well in Australia. These are the Bitou Tip Moth (*Comostolopsis germana*) which destroys the growing tips, and the Bitou Seed Fly (*Mesoclanis polana*) that destroys developing seeds. Both agents are now distributed along most of the range of bitou bush and, together, are reducing seed production of bitou bush. Leaf-feeding beetles (*Chrysolina* and *Cassida* spp.) were also released but have either not established or are colonising only slowly. Research is continuing into other South African insects and fungi that attack bitou bush. In December 1999 approval was given for the release of Tortrix (Leaf Rolling Moth), the leaf defoliator for both boneseed and bitou bush, following host specificity testing at Keith Turnbull Research Institute and in South Africa.

Fire: The decision to use fire must be very carefully thought through. Permission of the land owners and a permit from the relevant State fire authority is required to authorise the use of fire. The use of fire for control of bitou bush should be undertaken by properly trained and equipped personnel. In particular, NPWS has tightened its requirements and all burning requires a burn plan and an REF if it is not part of an approved fire management plan.

An intense fire kills most mature plants although a small proportion of plants resprout. High intensity fire also kills bitou bush seeds in the litter and topsoil and stimulates germination of seeds from lower in the soil profile. Fire, therefore, can be useful in reducing the large numbers of bitou bush seeds present in the soil seed bank but much depends on the intensity of the fire which is determined in part by fuel load, season and fire history. Fire can cause additional problems such as increased erosion potential, increased traffic and access by humans and pest animals, and further invasion by weeds.

Grazing: Cattle eat bitou bush. This limits the spread of bitou bush onto grazed properties adjacent to heavily infested areas. Management of bitou bush through grazing, however, usually is not practised on public lands because of problems associated with stock such as browsing of desirable indigenous species, erosion from stock movement, fouling of areas by dung and the spread of other undesirable weed species.

Replacement Plants: Immediately after applying whatever control treatment is used a mix of appropriate native seeds should be sown to help fill the gaps made by the dead bitou bush before other weeds invade. It also makes it harder for the new crop of bitou bush seedlings to take over again. The indigenous plant species used to revegetate sites invaded by bitou bush depends on the composition of local flora present at each site or habitat. The existing indigenous vegetation at a site should be conserved as far as is practicable as these plants provide a natural seed-source.

If active revegetation is to be implemented, seeds or plants from locally occurring populations ideally should be used. Do not introduce native species that never were present at a locality as some native plants can become weeds in the wrong circumstances. Widespread coastal species that could be useful for revegetation include *Acacia sophorae*, *Banksia integrifolia*, *B. serrata*, *Lomandra longifolia*, *Spinifex sericeus* and *Themeda australis*. It is best to seek the advice of local flora and revegetation experts for suitable indigenous plants of local provenance for revegetation. Revegetation by sowing indigenous seed is best implemented in winter after applying the spray or burn so that emergent seedlings are not harmed by the weed control treatment. Trials are also being undertaken to assess the feasibility applying aerially sown seed simultaneously with the aerial application of herbicide.

Techniques targeted to disrupt bitou bush life-cycle:

- Strategic use of chemical and biological control can significantly reduce flowering and seed production by mature plants.
- Strategic burning after spraying is useful as it reduces the seedbank 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.
- Disruption of the dispersal phase could be aided in some areas by implementing control of foxes and starlings. Community co-operation is also sought to prevent vehicles transporting seeds on tyres. These measures would help prevent the spread of bitou bush into uninfested areas.

3.7 3.7 Integrated Management

Goal:

An integrated management strategy using a combination of treatment techniques is the best chance we have to significantly reduce bitou bush on our coastline, with rehabilitation of native vegetation threatened by bitou bush a high priority.

Objectives:

- Reduce or remove existing weeds (physical, herbicide, biocontrol or fire);
- Run down the amount of seeds in the soil (fire or soil disturbance);
- Rehabilitate and revegetate with appropriate native species to reduce opportunities for reinvasion by same or other weeds;

- Follow-up treatments with long-term monitoring of sites and try different treatments when necessary.

The nature of invasion by bitou bush means that these objectives must be long-term, as considerable time is required to properly apply some of the management techniques. A lack of appropriate follow-up will quickly lead to reinfestation of bitou bush. The following guidelines are some general strategies to manage bitou bush in particular ecosystems.

If the weed occurs in small isolated infestations, removal to prevent expansion is advisable. Larger infestations require planning to efficiently reduce the population to an acceptable level. That level will be determined by the management objectives of the area and the resources available to tackle the problem.

Principles:

- Prioritise areas to be managed depending on factors such as: conservation value and/or heritage significance (eg, the proximity of native vegetation remnants, threatened species or aboriginal middens); accessibility; and extent and density of infestation.

The highest priority is given to programs which aim to prevent the spread and undertake control in lightly infested areas.

- Target specific sections: It is impractical to aim for complete eradication of the weed. Instead, aim at minimising weed infestations to a level where it is easier and cheaper to manage. For instance: target specific sections of the weed population such as seedlings that have not yet reached flowering age in heavily disturbed sites, or only heavily flowering plants; concentrate control methods for bitou bush in the first year after fire (whether that fire be prescribed or wild).
- Adapt different combinations of techniques to suit each site.

Guidelines:

Isolated plants or small infestations: Ensure that you have correctly identified the plant before removal. Isolated plants can be physically removed, preferably before they have seeded, or treated with herbicide such as glyphosate applied by spot-spraying. As infestations become larger, a strategically staged approach for removal is advisable to ensure that treated areas are not reinfested.

Large and extensive infestations on coastal foredunes: A combination of biocontrol-spraying-mechanical removal may be most appropriate. Follow-up spraying may need to be undertaken regularly. Fire is not recommended because of the sensitive nature of this ecosystem to erosion. In areas with highly significant remnants a long-term strategy (incorporating bush regeneration techniques) is needed which will enhance the viability and extent of remnant native vegetation.

Large and extensive infestations in coastal heath, woodlands and grasslands on hind dunes: A multi-stage spray-burn-spray strategy incorporating biocontrol agents is recommended as a general strategy.

Firstly, introduce and establish the biocontrol agents. This is a time-consuming procedure but most sites now harbour at least one biocontrol agent. Secondly, spray large patches of bitou bush in winter with herbicide. This can be applied aerially or from the ground.

Leave some areas unsprayed to allow biocontrol agents to persist and subsequently disperse from.

Next, burn portions of sprayed patches. This should remove unsightly patches of dead bitou bush and stimulate the germination of both weed and certain indigenous species which are present in the soil (on the south coast of NSW an autumn fire is best).

Monitor sites for bitou bush, biocontrol agents and indigenous plants. In particular, determine the extent of re-emergence of bitou bush, impact of biocontrol agents on Bitou Bush seedlings and any regeneration of desirable indigenous plants.

Respray as necessary to control regrowth and bitou bush seedlings which have escaped damage by biocontrol agents. Again, leave some patches unsprayed to harbour biocontrol agents. The timing of the respray depends on the region but in general it is best to spray before seedlings start producing seeds but after they have grown sufficiently tall and self-thinned. The time for Bitou seedlings to reach maturity is at least a year on the south coast but as short as six months on the north coast of NSW.

The spray-burn-spray strategy should be applied within three successive years to account for the fact that stimulation of massive weed germination by fire will lead to a natural reduction in the numbers of emergent seedlings and allow time for biocontrol agents and indigenous plants to establish or have an impact. In all cases, it is important to remove immature plants of Bitou Bush before they reach flowering age, which is a minimum of six months to one year on burnt areas and 1-3 years on unburnt sites

Note that the full implications of a biocontrol-spray-burn-spray strategy to coastal grasslands have not yet been determined but many such ecosystems are known to be fire-adapted. In areas where a large proportion of the remnant vegetation is known to be fire-sensitive, fire should not be adopted.

Rainforests: Fire is not recommended because of the sensitive nature of rainforest plants to burning. A combination of biocontrol, spot-spraying and mechanical removal may be most appropriate for infestations within the forest. The numbers of new weed seedlings in rainforests may be low, due mainly to poor flowering of bitou bush under heavy shade and most seedlings probably will originate from external infestations. It is important, therefore, to give priority to managing healthy infestations of bitou bush surrounding rainforests.

3.8 Principles Underpinning the 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 approach which involves all levels of government in establishing appropriate legislative, educational and coordination frameworks in partnership with industry, landholders, water managers and the community.

4. The primary responsibility for weed management rests with the landholder or land and water manager, but collective action is necessary where the problem transcends the capacity of the landholder to address it adequately.

3.9 Regional Priorities

- Prevent the further introduction and spread of bitou bush.
- Give high priority to control in lightly infested areas.
- Reduce adverse impacts of bitou bush on biodiversity, aesthetic and recreational value of public lands.
- Support concerted control programs that result in shifting the southern containment line north.

3.10 Management Priorities for local action plans

Ease - Easy before hard

Condition - Good before poor

Trajectory - Improving before degrading areas

Rarity - Scarce before common

Priority Setting:

1. Conserve and enhance the good bits
2. Protect from threatening processes
3. Enhance areas with good recovery potential
4. Rehabilitate degraded areas

Many bush regenerators first manage the smallest weed infestations and gradually work towards larger infestations.

Smaller infestations in which much of the indigenous vegetation is intact have a greater potential for natural restoration.

Strategies will need to be modified to accommodate special requirements such as the management of endangered plant and animal species. For example, it is possible that bitou bush could provide shelter for certain indigenous fauna. In other cases, endangered indigenous plants may be particularly sensitive to management techniques.

4 Strategic Plan

Table 1 Regional Strategic Plan for Bitou Bush on the South Coast of NSW

Goal 1: <i>Prevent the further introduction and spread of bitou bush.</i>				
Objective 1.1: Identifying high risk sites for invasion by bitou bush.				
Management Strategy	Key Actions	Responsibility	Level	Priority
Risk assessment	Identify sites and plant communities most at risk from invasion and set priorities for monitoring	Task Force, LCAs and the community	Regional	1
Objective 1.2: Develop and maintain early detection and eradication mechanisms				
Management Strategy	Key Actions	Responsibility	Level	Priority
Prevent the establishment of new infestations	Monitor and record any new infestations, including boneseed.	Task Force and LCAs	Regional	1
	Prioritise areas and undertake control actions in order of priority	Task Force and LCAs	Regional/ Local	1
Establish containment zones	Establish and enforce southern containment zone.	Task Force and LCAs	Regional	1
Goal 2: <i>Minimise the adverse impacts of bitou bush on biodiversity.</i>				
Objective 2.1: Record, assess and prioritise existing infestations.				
Management Strategy	Key Actions	Responsibility	Level	Priority
Maintain mapping database	Monitor and update changes in infestations	Task Force and LCAs	Regional	2
Assess and prioritise areas for protection	Follow recommendations given in threat abatement plan which will set criteria to determine priorities and prioritise areas for action	Task Force, LCAs and community care groups	Regional/ Local	1

Objective 2.2: Reduce the extent and impact of existing infestations.				
Management Strategy	Key Actions	Responsibility	Level	Priority
Undertake control in high priority areas	Coordinate and implement on ground works at high priority site such as sites of high conservation significance and in lightly infested areas.	LCAs, NPWS, community care groups, Task Force, Land managers	Regional/ Local	1
Set priorities for allocation of funds	Determine criteria for funding priority setting such as: conservation and/or heritage significance; extent and density of infestation; accessibility.	Land managers LCAs, NPWS, community care groups, Task Force	Local	1
Reduce the impact of dense and large area infestations	Implement integrated management techniques such as release of biocontrol agents and aerial spraying, to reduce populations and contain the spread of bitou bush	Task Force, LCAs and community care groups	Regional/ Local	2
Objective 2.3: Involve the community in the preparation and implementation of management strategies at all levels.				
Management Strategy	Key Actions	Responsibility	Level	Priority
Involve stakeholders in preparation of regional and local plans	Develop of Regional Management Plan for bitou bush with input from stakeholders at workshops and through networking.	Completed as part of RWAP Program.	Regional	1
	Develop Local Action Plans through the organisation and facilitation of local meetings, workshops and field days to encourage community input.	LCAs, NPWS, community care groups, Task Force, Land managers	Local	2
As part of regional strategy, encourage local action.	Encourage private landholders to join a local control group, which will be cheaper for them overall (in terms of control costs and potential court costs).	Task Force, WO, LCAs	Regional/ Local	2
Ensure local action plans comply with legislative requirements.	Identify areas where an EIA is required	WO, NPWS, Task Force	Local	2
	Enforce requirements of Land Managers under the <i>NW Act 1993</i> if bitou bush remains untreated	WO	Local	3

Train and involve all stakeholders in use of best practice management	Develop and/or identify accredited training and deliver courses	NSW Ag, NSW TAFE, Task Force & LCAs		2
	Provide support for volunteers and expand the volunteer efforts	LCAs, NPWS, community care groups, Task Force, DLWC		2
Improve communication and information exchange	Identify relevant local communities with information gathered from contact register.	Task Force	Local	1
	Notify, by letter box drop, all relevant members of the community of their responsibilities and advise them the options available.	LCAs	Local	1
Use existing networks to raise community awareness and information flow	Regularly circulate news and updates on bitou bush management issues to those groups and individuals on the contact register.	Task Force, community care group	Regional & Local	3
Objective 2.4. Adopt best management practices.				
Management Strategy	Key Actions	Responsibility	Level	Priority
Develop and implement site-specific integrated management strategies	Develop criteria to assess sites & identify most effective control options and priorities	Weeds CRC, NSW Ag, NPWS, DLWC, LCAs & community care groups.	Local	1
	Evaluate current best practice guidelines, and refine as required	Weeds CRC, State agencies, Task Force & LCAs		2
	Develop revegetation guidelines for different habitats/vegetation communities	Weeds CRC, State agencies, Task Force & LCAs & community care groups		3
Promote the adoption of integrated approach based on Weed CRC 'Best Practice'.	Incorporate proforma action plans – based on good existing plans.	Care Groups and their coordinators	Local	2
	Provide resource kits outlining Best Practice.	Task Force	Local	2

Goal 3: <i>Expand the commitment to the management of bitou bush.</i>				
Objective 3.1: Maintain the effectiveness and relevance of the South Coast Regional Bitou Bush Strategy.				
Management Strategy	Key Actions	Responsibility	Level	Priority
Coordinate & monitor implementation of strategy	Report on progress with actions in the strategy to NWAC and stakeholders	Task Force	Regional	1
Increase the awareness of bitou bush and support for control programs	Media releases (press/radio), TV promotions and internet sites for coming events and inform public of achievements and success stories of work done by both community groups and government agencies.	Task Force, WO	Regional/ Local	1
	Hold field days throughout region;	WO, Task Force	Regional	2
Objective 3.2. Maintain and expand the resource base				
Management Strategy	Key Actions	Responsibility	Level	Priority
Maintain existing commitments and seek additional sources of funding	Provide information on funding sources through direct mailing of information to groups, and/or publishing information on the South Coast Bitou Bush website.	Task Force / Care Group coordinators	Local	1
Target tourist industry - likely to be negatively impacted by bitou bush	Promote use of tourism awards to encourage community groups involved in environmental improvement.	Local Govt/ industry	Local	2

4.1 Performance Indicators

- Reduction in distribution and infestation levels of bitou bush.
- The distribution map of bitou bush will be updated every 5 years and will include boneseed records
- The South Coast Regional Management Plan and Local Action Plans for bitou bush incorporating regional priorities set out in this strategy are implemented
- Control programs continue and expand with resources targeted to priority areas
- All new light infestations in priority areas are treated within 12 months of detection
- Increase in native fauna/flora biodiversity
- The national containment zone in southern NSW is implemented

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- Growth of a broad range of sustainable community action groups, and levels of community interest in demonstration sites, field days and workshops.
- 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

4.2 Relevance to Other Strategies

This strategy is closely linked to the NSW bitou bush strategy, with emphasis on those areas of particular relevance to the South Coast.

Table 2. Policy and strategy linkages

JURISDICTION	WEED STRATEGIES	RELATED STRATEGIES
National	National Weeds Strategy, Weeds of National Significance Bitou Bush/Boneseed Strategy.	Ecologically Sustainable Development, National Strategy for the Conservation of Australia's Biological Diversity, Water Quality, Intergovernment Agreement on the Environment, National Strategy for Resource Management.
Commonwealth	Policies, strategies, plans and controls applied to own land (Conservation and Military).	Decade of Landcare, Natural Heritage Trust, Forest Practices Agreements, World Heritage Areas, Ramsa sites.
State	NSW Weeds Strategy, NSW Bitou Bush Strategy	NSW Biodiversity Strategy, NSW Coastal Policy, NSW Vegetation Forum, NSW Forest Policy, NSW Wetland Management Policy, Total Catchment Management, Estuary Management Policy
Regional and local	Regional and Local Bitou Bush Control Plans or Strategies, Local Government Pest Management Plans, Rail, Road and Utility Corridor Management Plans,	State of the Environment Reports, Local Environment Plans, Plans of Management for Community Land, Local Approval Policies, Annual Management Plans, Landcare, Dunecare, Coastcare Plans.
Land/Property	Landholder Management Plans, Control Schedules.	Property Management Planning

5 Management Arrangement and Stakeholder Responsibilities

There are five generic groups of stakeholders as shown in Figure 2 (below)

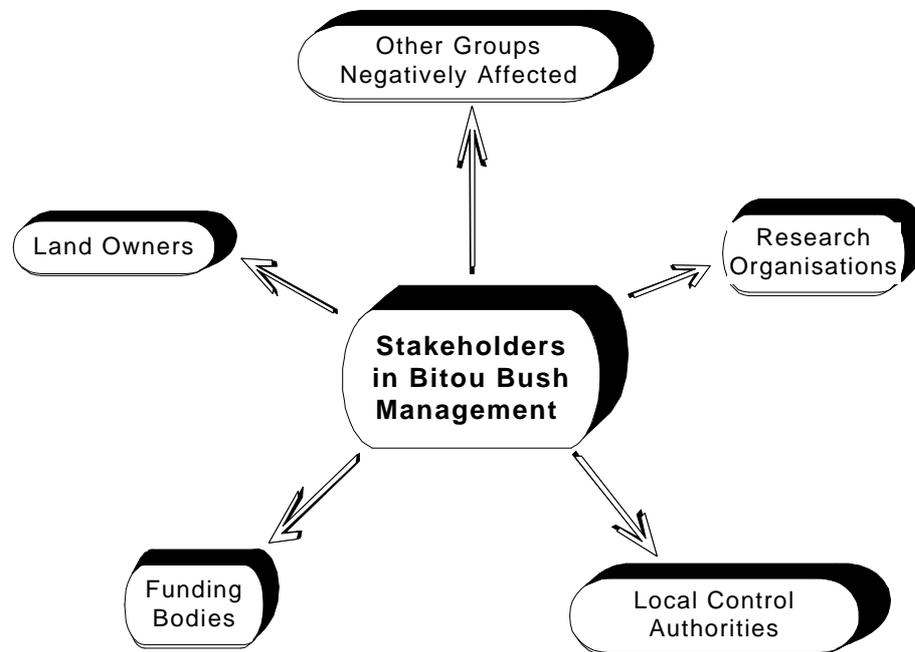


Figure 4: Major Bitou Bush Management Stakeholders

The major stakeholder group is that of land owners. As shown in Figure 3, there is both private and public land involved – the former comprising many individual, community and corporation owners, while a large number of government bodies also occupy land that is infested. Under the *NSW Noxious Weeds Act 1993*, it is the responsibility of the occupier of land to control any noxious plants growing thereon. However, experience of Weeds Officers and others, suggests that a negotiated approach, with elements of both ‘carrot and stick’, proves to be much more effective than just invoking the threat of fines if weeds are not controlled. As to the ‘carrot’, there are two federal incentives to assist in weed control – provisions for accelerated deductions for landcare works (including cost of chemicals), and a tax rebate for qualifying landcare expenditure – although these may only be available to land under primary production.

This suggests that any strategy ought to reflect the best way to engage in a coordinated way with the various stakeholders. Collective action is necessary where the problem transcends the capacity of the landowner to address it adequately. Clearly, bitou bush is widespread in terms of the land owners affected. This points to a need for carefully targeted strategies that are appropriate to the different interests concerned. For example, where land is owned by a corporation or other investor and held for future development, it is unlikely that an appeal to ‘community responsibility’ will have much impact on the (usually) absentee owners. Conversely, resident owners may well be more easily coopted into collective action through appeals to their sense of belonging to the community and ‘doing the right thing’.

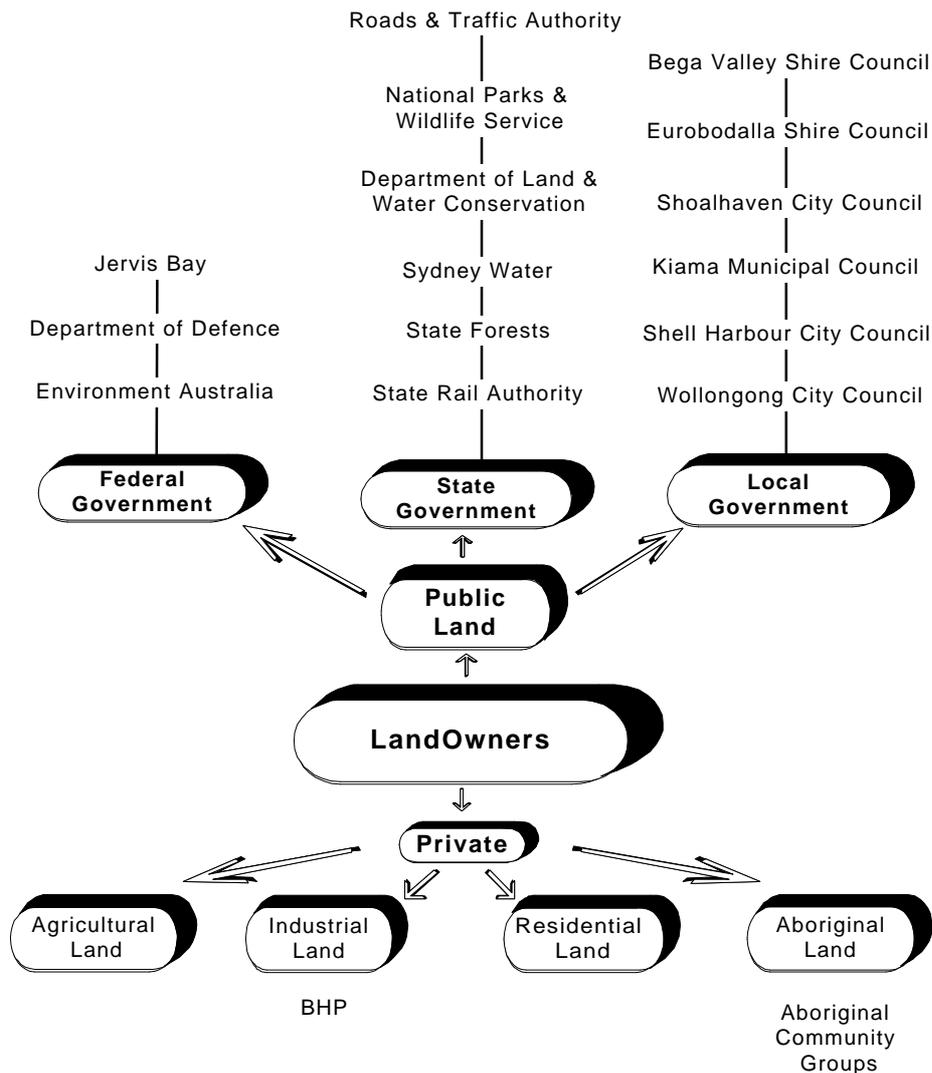


Figure 5: Major Land Owning Stakeholders

Another significant stakeholder group is the Local Control Authorities (LCA's) who have a responsibility under the Act to control noxious weeds on roadsides, RLPB land and council land. The LCA's for the South Coast region are Bega Valley Shire, Shoalhaven City, Eurobodalla Shire, and Illawarra District Noxious Weeds Authority. LCA's are responsible for the control of noxious weeds in their area. However, "... they do not exercise authority over other public authorities or other local control authorities. This authority is reserved to the Minister" (NSW Agriculture 1999). In practice, government agencies such as National Parks and Wildlife Service and State Rail are responsible to control weeds on land they control. Should they fail to do so, the LCA's can make representations at the Department Head and/or Ministerial level to address the matter.

6 Appendix 1: Regional Distribution of Bitou Bush in the South Coast of NSW - Resulting from SCBBP Mapping Workshops, Dec. 1999

Region -	Total km coastline	Density Category (as per Figure 2)	Coastline km	%	Area of infestation ha
Illawarra: (Wollongong, Shellharbour & Kiama)	100 km	Light	5	5%	1,385 ha
		Medium	45	45%	1,227 ha
		Heavy	36	36%	1,229 ha
		86	86%	3,841 ha	
Shoalhaven	147 km	Light	43	29%	1,042 ha
		Medium	27	19%	1,639 ha
		Heavy	22	15%	705 ha
		95	63%	3,386 ha	
Eurobodalla	146 km	Light	24	16%	1,722 ha
		Medium	20	14%	850 ha
		Heavy	3	2%	36 ha
		51	32%	2,608 ha	
Bega	208 km	Light	6	3%	536 ha
		Medium	0.5	>1%	13 ha
		Heavy	nil	nil	_____
		6.5	1%	549 ha	
Total:	601 km		231 km	38%	10,384 ha

NB: *Values represent estimates from hand drawn maps and will need revising when all GIS figures become available.

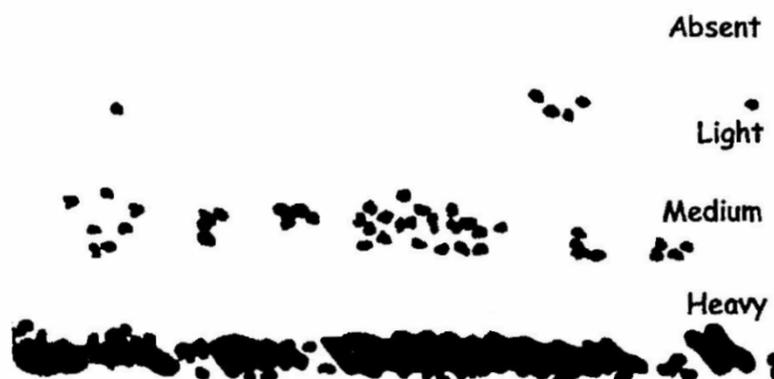


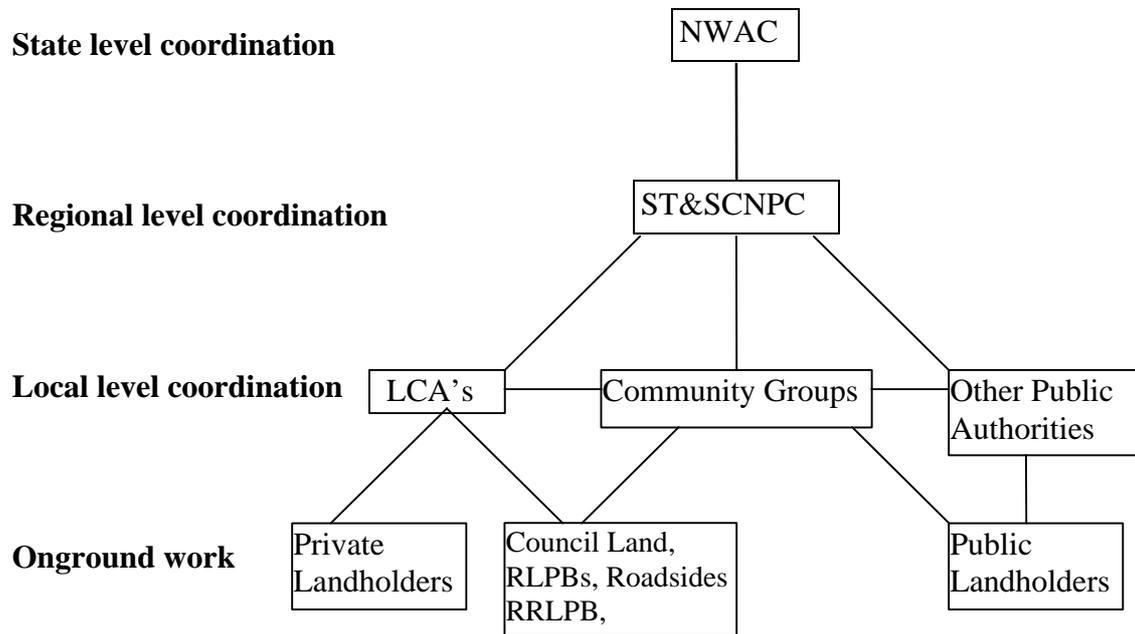
Figure 2 Density assessment diagram

(from Scanlon 2001)

7 Appendix 2 Roles and Responsibilities

Organisation	Roles and responsibilities	Work Undertaken	Funding Source
NWAC	Coordinate and Fund Regional Weed Action Programs (TASK FORCES)	Oversee NSW Weeds Strategy	NSW Ag
ST&SCNPC	Coordinate LCAs and other stakeholders in region	Oversee development of TASK FORCE	NSW Ag, TASK FORCE
LCA's	Participate in development of RMP & LAPs, Ongoing management of LAPs	Enforce NW Act 1993, control weeds on council land and roadsides in accordance with priorities and best practice guidelines recommended in the RMP and LAPs	Local Councils, Noxious Weeds grants, Task Force
Other Public Authorities	Participate in development & implementation of RMP and LAPs	Control weeds on own land in accordance with priorities and best practice guidelines recommended in the RMP and LAPs	NPWS, DLWC, SF, EA, Dept of Defence
Community Groups	Participate in development & implementation of RMP and LAPs	control light infestations, revegetate/rehabilitate on high profile public land in accordance with priorities and best practice guidelines recommended in the RMP and LAPs	NHT
Landholders	Participate in development & implementation of RMP and LAPs	Control weeds on own land in accordance with priorities and best practice guidelines recommended in the RMP and LAPs	Tax incentives, Rare rebates

8 Appendix 3 Management Structure



9 Appendix 4 Indicators of Success of Regional Strategy Plan for Bitou Bush Management Identified during Community Workshops 14 to 16 April 2000

1. Increase in native fauna/flora biodiversity
2. Use photographic records to track changes on a site specific basis
3. Volunteers' Hours Contributed eg, as noted in Landcare records
4. Formation of partnerships between volunteers groups and business/tourism and other groups and organisations
5. Area of bitou bush remaining (treated and untreated)
6. Survey perceptions of volunteers and government workers – positive or negative feelings about success
7. Number of grant applications
8. Number of successful grant applications
9. Bird diversity
10. Number of areas worked on
11. Media interest

NB: There is a difficulty in using short term indicators when aiming at long term outcomes – short term issues do not necessarily result in desired long term solutions. Short term indicators must be used cautiously because of this.

10 Appendix 5: Glossary

Actions	Specific tasks undertaken to achieve the strategies that contribute to the success of the overall project
API	Aerial Photograph Interpretation
ANZECCFM	Australia & New Zealand Environment & Conservation Council and Forestry Ministers
ARMCANZ	Agriculture & Resource Management Council of Australia & New Zealand
Challenge	The purpose of the project, including what it has been established to accomplish, weed impacts, key, management factors, and an outline of the potential distribution
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Research Organisation
DLWC	Department of Land and Water Conservation
EA	Environment Australia
EIA	Environmental Impact Assessment
EP & A Act 1979	Environment Protection & Assessment Act 1979
Goals	High level results to be achieved by the project
LAP	Local Action Plan
LCA	Local Control Authority
NHT	Natural Heritage Trust
NPWS	National Parks and Wildlife Service
NSW Ag	New South Wales Department of Agriculture
NW Act 1993	New South Wales Noxious Weeds Act 1993
NCWAC	North Coast Weeds Advisory Committee
NWAC	Noxious Weeds Advisory Council
Objectives	Targets or aims that the project must reach in order for it to achieve the goals. Converts goals into specific outcomes and concrete terms against which results can be measured

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Performance Indicators	A piece of important and useful information relating to the vision, expressed as an index, rate or other comparison with one or more criteria and monitored at regular intervals
Priority 1 - “what must be done”	Actions that must be undertaken in order to effectively manage the weed problem
Priority 2 - “what should be done”	Actions important for implementing the strategy by improving the efficiency or effectiveness of the overall strategy
Priority 3 - “what could be done”	Actions important for successful ongoing of the strategy - may have more flexibility regarding their timing and implementation
REF	Review of Environmental Effects
RLPB	Rural lands Protection Board
RMP	Regional Management Plan
ROTAP	Rare or Threatened Australian Plants
TASK FORCE	Regional Weeds Action Program
SF	Stare Forests
ST&SCNPC	Southern Tablelands and South Coast Noxious Plants Committee
Strategy	A plan of action or policy which will be completed in order to achieve the objective
TSC Act 1995	Threatened Species Conservation Act 1995
Vision	a short easily remembered, clear inspirational statement about the aim of the project that is realistic and credible
W3	the weed must be prevented from spreading and its numbers and distribution reduced (<i>NSW Noxious Weeds Act 1993</i>)
WO	Weeds Officer
WONS	Weeds of National Significance

11 Appendix 6: Reading Resources

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