

## Strategic management of bitou bush (*Chrysanthemoides monilifera* ssp. *rotundata* (L.) T.Norl.)

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**Summary** A project, funded under the NSW Biodiversity Strategy, has resulted in significant advances in the management of bitou bush in NSW. National and State management strategies for bitou bush have been prepared and a *threat abatement plan* to protect critical populations of threatened species is currently being finalised. Also, the distribution and abundance of bitou bush in coastal NSW has been mapped. This has shown that there is now approximately 36,700 ha of land infested with bitou bush and, since 1982, there has been a 36% increase in the length of coastline infested.

**Keywords** Bitou bush, mapping, strategy, biodiversity.

### INTRODUCTION

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

Invasion of native plant communities by *Chrysanthemoides monilifera* (bitou bush/boneseed) is listed as a key threatening process under the NSW *Threatened Species Conservation Act* 1995. In 1999, it was listed as a Weed of National Significance by the Commonwealth Government and in NSW, bitou bush/boneseed have been declared a noxious weed under the *Noxious Weeds Act* 1993.

Bitou bush has invaded and degraded the natural coastal vegetation to such an extent that rare and threatened species, endangered ecological communities and remote natural plant communities are affected: even widespread plant communities, such as coastal banksia forests, are significantly affected.

Bitou bush occurs on a variety of land tenures. State government agencies, corporations, local government and private landholders all have responsibilities for controlling bitou bush. Additionally, there is enormous community involvement in the management of bitou bush and this is reflected by the large number of Coastcare/Dunecare projects tackling this problem. A substantial research program, especially involving biological control, has also been undertaken.

In 1999 the NSW Government launched a major nature conservation initiative, the NSW Biodiversity Strategy (NSW National Parks and Wildlife Service 1999). One of the projects funded under this program was titled '*Strategic Management of Bitou Bush*'. The aim of this project was to develop and implement a strategy to reduce the impacts of bitou bush in coastal ecosystems in NSW. This paper describes some of the outcomes of this project and some related activities.

### OBJECTIVES AND METHODS

Because of the range of interests involved in the management of bitou bush, it was considered essential to obtain the views of key stakeholders in deciding on the scope of the project. An initial planning meeting held in Sydney in May 1999 identified key objectives for the project. The meeting was attended by representatives from the NPWS, other land management agencies, NSW Agriculture, research organisations and community groups.

The objectives of the project were:

- to map the distribution and abundance of bitou bush along the entire NSW coastline,
- to develop a strategy to identify key issues and priorities for action, and
- to establish sites to increase community awareness.

**Mapping** Information on the current distribution and abundance of bitou bush is essential to allow a full understanding of the nature and extent of the problem.

The distribution of bitou bush in NSW had previously been surveyed and mapped in 1981 and 1982. That survey found that bitou bush was present along 660 km of coastline which is approximately 60% of the entire coast (Love 1984 and Stanley *et al.* 1989).

Since 1982 there has been no statewide survey of the distribution of bitou bush although there have been a number of smaller projects mapping its distribution in individual parks and reserves, local government areas or other parts of the coastal landscape. These mapping projects have used a variety of survey methods and mapping classifications with some recording bitou bush as part of an overall weed infestation.

The initial step in the new mapping project was to develop uniform guidelines for data collection (e.g.

mapping scale, criteria to determine level of abundance). To achieve uniformity regional weeds committees and Coastcare representatives were consulted. NSW Agriculture had provided funding through the Regional Weeds Action Program to the North Coast Weeds Advisory Committee (NCWAC) and the South Coast and Southern Tablelands Noxious Plants Committee (SCSTNPC) for projects which included mapping bitou bush in their areas. Coastcare had provided funds for mapping of specific areas.

The standard methods adopted were those used by Williams and Gerrand (1999) based on interpretation of colour aerial photographs (1:10,000 or 1:8,000 scale) (LPI 1998–2000) obtained from the most recent coastal surveillance. Ground-truthing of these interpretations was also undertaken.

Four abundance levels were used: absent, light, medium and heavy. These four categories were sufficient to:

- reduce the complexity of the maps (important in reducing interpretation errors by the different people involved),
- provide adequate detail to allow effective control programs to be planned, and
- minimise the time required for deciding on the infestation level.

The categories correspond to the percentage of the total ground cover comprised of bitou bush at that site as outlined below:

<i>Absent</i>	0% cover – no plants located
<i>Light</i>	<10% cover – infrequently dispersed seedlings, small or large plants and small (isolated) clumps of bitou bush
<i>Medium</i>	10–40% cover – plants and small clumps readily located, generally uniformly dispersed throughout the site or occasional clumps of bitou bush
<i>Heavy</i>	>40% cover – continuous infestations throughout the site of numerous seedlings, young plants and established bitou bush plants.

Areas in which bitou bush control programs had recently been undertaken were difficult to classify. This posed a problem especially where infestations were dense prior to control. Such areas could be nearly 100% ground cover of bitou bush prior to spraying (classified as *Heavy* infestations), but six months after control could be less than 10% ground cover of bitou bush (classified as *Light* infestations). Subsequently, as bitou bush re-invades control areas, or as follow-up control programs are implemented, the level of ground cover is somewhere between these two extremes. For consistency, recently controlled areas were recorded at the original infestation level. The exception to this

rule was where control programs were secondary treatments: where this occurred the classification was based on the infestation level after the control had been implemented.

Draft maps of bitou bush infestations were produced on 1:25,000 topographic maps and circulated to local authorities to verify (ground-truthing). The amount of ground-truthing varied with location, the knowledge of the recorder, accessibility to the infestation and time constraints.

Where existing maps were available, the information was checked, revised where necessary and included in the state-wide database. All recorded infestations were then digitised by the GIS section of NPWS Coffs Harbour office. The digital mapping data is held at that location.

**NSW Bitou Bush Strategy** Effective techniques are available to manage bitou bush and numerous community groups are involved in control programs. Apart from some local plans e.g. Williams and Gerrand (1999) there was no overall strategy to prioritise issues or landforms/vegetation communities for action. The preparation of a state-wide strategy was seen as means of enabling a more coordinated and strategic approach for the control of bitou bush in NSW.

Bitou bush and boneseed were listed as Weeds of National Significance and this required the development of a national strategic plan. As NSW National Parks and Wildlife Service was appointed the lead agency to coordinate the preparation of the national strategic plan, the NSW Bitou Bush Strategy was developed concurrently with the National Strategic Plan for Bitou Bush and Boneseed (Agriculture and Resource Management Council of Australia and New Zealand *et al.* 2000).

To assist with the preparation of the National Strategic Plan, a planning meeting was held in Melbourne in December 1999. The meeting involved government, community and scientific representatives from all states and a national steering committee was formed (National Weeds Strategy Bitou Bush and Boneseed Steering Committee). A draft strategic plan was prepared during the meeting and this was circulated widely for public comment during March and May 2000. To enable all the issues to be identified and to allow ownership of and support for the plan, many stakeholders were involved in the public consultation process.

In NSW, the consultation process involved 30 public meetings and discussions with numerous individuals. Many of the meetings were held in conjunction with representatives from the North Coast (NCWAC) and South Coast (SCSTNPC) projects. Close

collaboration between the national, State and regional groups avoided duplication and enhanced feedback and linkages between all plans. Many of the meetings included inspections of local bitou bush infestations and discussions of local management issues. At each meeting, a presentation was given outlining the scope of the project and the current knowledge relating to the ecology and control of bitou bush. This was followed by a session where participants were asked to identify key issues, determine priorities, comment on the effectiveness of different control techniques and to suggest improvements to bitou bush management strategies. Over 1000 bitou bush *Best Practice Management Guides* (Vranjic 2000) were distributed at these meetings, or were circulated at a later date.

The information from the meetings and from individual discussions were used to refine the National Strategic Plan and were also used to produce a draft NSW Bitou Bush Strategy. The NSW Strategy was circulated for public comment during the early part of 2001.

**Demonstration sites** During the latter half of the 1990s the Cooperative Research Centre for Weed Management Systems conducted research to assist with the development of management systems for bitou bush. The publication of the *Best Practice Management Guide for Bitou Bush* (Vranjic 2000) was one the outcomes from this research. The management guide includes recommendations for the control of bitou bush in different landscapes/vegetation communities.

The third objective of the NSW project was to establish field sites to demonstrate best practice management and increase community awareness of bitou bush. These demonstration sites were used to "field test" the recommendations made in the *Best Practice Management Guide* and to increase community understanding of the impacts of bitou bush and various issues related to its control e.g. identification of biocontrol agents and their effects on bitou bush.

After lengthy consultations with local land managers and community groups three sites were selected:

- Munmorah State Recreation Area and the adjacent crown reserve at Budgewoi on the Central Coast of NSW.
- Sea Acres Nature Reserve near Port Macquarie on the Mid North Coast of NSW.
- Cudgen Nature Reserve near Cabarita on the Far North Coast of NSW.

Sites were not established on the South Coast because similar demonstration sites were being established by the SCTNPC.

## RESULTS

**Mapping** Mapping of bitou bush infestations was completed in June 2001. Information from eighty four 1:25,000 topographic (and other composite) maps was digitised and is stored on the NPWS GIS system. Both hard copy and digital files are being distributed to data providers (e.g. local councils, Coastcare groups, regional weed committees). The data is continually updated as new information becomes available.

As at December 2001, there is a total of 36,767 ha of coastal NSW infested with bitou bush. This includes 183 ha of land at risk of being invaded (see following discussion). The total area infested can be broken down as follows: 6797 ha classified as heavy; 9148 ha classified as medium; and 20,639 ha classified as light. Also, of the 902 km of coastline infested, 373 km is classified as heavy, 267 km as medium and 262 km as light.

**Strategy** The National Bitou Bush and Boneseed Strategic Plan was completed in December 2000. This plan and the NSW Bitou Bush Strategy were developed in parallel and have many shared objectives. Both plans were launched in August 2001 by the Director-General of NSW National Parks and Wildlife Service and the Chair of NSW Coastal Council.

The National Strategic Plan for Bitou Bush and Boneseed identifies priorities and provides direction at the national level and is also used to determine priorities for applications seeking funding through the National Weeds Program of the Natural Heritage Trust.

The goal of the NSW Bitou Bush Strategy is to reduce the impacts of bitou bush on NSW coastal ecosystems (NSW National Parks and Wildlife Service 2001). The Strategy recommends where resources should be directed in NSW to address the most critical issues. The focus is on improving control techniques, refining and adopting integrated management strategies and coordinating actions at the State, regional and local levels. Priority is given to enhancing community involvement by developing partnerships between stakeholders with specific recognition of the important role of volunteers. A high priority of the NSW Strategy is the preparation of a threat abatement plan to identify and protect critical populations of threatened species.

The NSW Bitou Bush Strategy aims to deliver three key outcomes.

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

*This will be achieved by:*

- identifying high-risk sites for invasion by bitou bush,

- developing and maintaining mechanisms for early detection and eradication.
2. Minimising the adverse impacts of bitou bush on biodiversity.  
*This will be achieved by:*
    - recording, assessing and prioritising existing infestations,
    - reducing the extent and impact of existing infestations,
    - involving the community in the preparation and implementation of management strategies at all levels,
    - refining and adopting best-management practices.
  3. Expanding the commitment to the management of bitou bush.  
*This will be achieved by:*
    - maintaining the effectiveness and relevance of the NSW Bitou Bush Strategy,
    - maintaining and expanding the resource base.

**Demonstration sites** Initial monitoring of sites occurred during autumn 2001 with treatments being applied during May 2001. At this stage it is too early to report on any information obtained.

DISCUSSION

**Mapping** Previous estimates of the area infested with bitou bush ranged from 50,500 ha (for NSW only) to 70,000 ha (estimate of the total area in Australia infested with bitou bush but 95% of this occurred in NSW) (Stanley *et al.* 1989, Toth *et al.* 1996 and Vranjic 2000). The lower estimate of the infested area was not derived from maps, but was based on inferences drawn from known infestation levels and an estimate of the total area of sand dunes in NSW. The higher estimate was derived by calculating the increase in bitou bush infestations in one area of the NSW coastline and multiplying this by the earlier estimate of the total area infested (John Toth pers. comm. 2001). Therefore, an accurate comparison cannot be made between these earlier estimates of areas/coastline infested with bitou bush and the more accurate figures determined from maps prepared from the current project.

This project used a conservative approach in mapping areas of bitou bush. Many areas which may potentially contain bitou bush or which only contain isolated plants were not included without confirmation from ground truthing or from local knowledge. Such situations most commonly occurred in forested areas inland from beach dune systems where low densities of bitou bush in the understorey could not be detected by aerial photo interpretation. Additionally, the

presence of bitou bush on roadsides was not used to make assumptions about infested areas away from roads, unless further information was available.

The change in the amount of bitou bush in NSW in the last 20 years was estimated by comparing the length of coastline infested. In 1982, Love (1984) estimated that bitou bush occurred on 660 km of coastline. This was approximately 60% of the total NSW coastline. The results of the current mapping project recorded bitou bush on 900 km of the coastline. This is 80% of the NSW coastline and a 36% increase since 1982 (Table 1).

Bitou bush is now the dominant species on over 400 km of coastline.

Between 1982 and 2001, there appears to have been a decrease in the length of the coastline with light infestation levels of bitou bush (335 km *cf.* 262 km). However, this is partially explained by the density of bitou bush in some of these areas increasing during the intervening 20 years to medium and high infestation levels. It was not possible to determine the affect of management on the change in infestation levels.

The results of this project provide a benchmark of the area/kilometres infested with bitou bush so that future rates of change can be accurately calculated. It will also allow the effectiveness of management strategies to be determined in the future.

Also, the GIS data will allow bitou bush infestations to be compared with overlays of the locations of threatened species and other natural resource information. This has been particularly useful in the preparation of the threat abatement plan which is currently underway.

**Strategy** There is now an overall framework for the management of bitou bush in NSW which is of direct relevance to all stakeholders. The NSW Bitou Bush

**Table 1.** Comparison of length of coastline infested with bitou bush in 1982 and 2001.

1982		2001	
Classification	Length (km)	Classification	Length (km)
Rare (190) <sup>^</sup>	na	–	–
Occasional (145) <sup>^</sup>	335	Light	262
Common	78	Medium	267
Very common	247	Heavy	373
Total	660	Total	902

<sup>^</sup> Figures in parentheses for *Rare* and *Occasional* classifications in 1982 have been summed to give a combined figure (335 km) to enable a comparison with the 2001 *Light* classification.

Strategy links with, and expands on key elements of the National Strategic Plan for the Management of Bitou Bush and Boneseed. The NSW Strategy reinforces objectives and actions already occurring in existing local and regional plans and also identifies additional actions to be included in plans yet to be prepared.

A sustainable reduction in bitou bush infestations requires actions to be implemented at the local level. Hence, strategic plans must be developed in consultation with all relevant stakeholders so that they have ownership of the plans and a commitment to the proposed actions. Also, local working groups should be established to oversee the implementation of these plans. Local ownership of the plans is needed to maintain the interest of community groups for the prolonged period (up to 10 years) required to achieve a sustainable reduction in bitou bush populations.

The strategy provides a framework to assist managers identify priorities for action. It will also assist funding bodies when assessing project applications. Actions for biodiversity conservation receive the highest priority. For example, *Prepare threat abatement plan* and *Coordinate and implement on ground works at sites of high conservation significance and lightly infested areas* are high priority actions. The former action is already being implemented and the ensuing threat abatement plan will identify the areas of high conservation significance. Hence, the linkages established during the development of the national and State strategies are already of benefit.

The community effort involved in the control of bitou bush equals or exceeds the resources that governments, at all levels, currently provide. Most of the successful control programs that have occurred have involved cooperative efforts between community groups and local land managers. Therefore, it is essential that the extensive community input directed towards the management of bitou bush continue to be supported. Training and providing resources for these groups, is essential for maintaining the commitment of existing community groups and encouraging more people to be involved.

A major issue which emerged during this project is the presence of other weeds which have the potential to invade after bitou bush has been controlled. Some of these species are more difficult to control than bitou bush e.g. glory lily (*Gloriosa superba*), asparagus ferns (*Asparagus* spp.), mirror bush (*Coprosma repens*) and ehrharta (*Ehrharta villosa*).

Continual improvement of management practices should lead to more effective bitou bush control in a variety of environments and with less risk of control programs impacting on non-target native species and/or allowing invasion by other weeds.

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