

## **Eradication versus long-term surveillance and removal: contrasting approaches to *Chrysanthemoides monilifera* (L.) Norlindh management in Australia**

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**Summary** Outlier infestations of widespread weeds are likely candidates for eradication or long-term surveillance and removal. Eradication programs may take years to complete, but should have projected end dates. In contrast, surveillance and removal programs must continue indefinitely due to a high probability of reinvasion. This paper contrasts eradication versus long-term surveillance and removal programs in Australia for the widespread weeds boneseed and bitou bush (*Chrysanthemoides monilifera* subsp. *monilifera* (L.) Norlindh and subsp. *rotundata* (DC.) Norlindh, respectively). Although eradication programs are often high-profile and may be more likely to secure funding, surveillance and removal programs are also effective in minimising weed threat.

**Keywords** Eradication, long-term surveillance, bitou bush, boneseed.

### INTRODUCTION

Eradication is an effective means of preventing damage from invasive species, second only to preventing their establishment, and is considered more ethically acceptable and environmentally sound than extensive long-term control (Clout and Veitch 2002). Successful eradication of invasive species depends on several criteria, including: (i) a well-resourced plan, (ii) commitment from all stakeholders, (iii) good understanding of the target organism's biology, (iv) suitability of target organism to eradication, (v) availability of effective controls, (vi) ability to put entire target population at risk and (vii) ability to prevent re-invasion (Meyers *et al.* 2000). Although many plant invasions meet these criteria, eradication is rarely considered due in part to the large commitment required. Hence, few documented examples of successful plant eradications exist, even though eradication can provide significant environmental and economic benefits (Simberloff 2002).

Containment, rather than eradication, is commonly used to manage widespread weeds. However, strategic outlier populations of widespread weeds are often targeted for eradication (see Hester *et al.* 2004). Efforts to control outlier populations of widespread weeds are

not generally recognised as eradication programs in their own right, although they often meet the above eradication criteria. The most critical criterion for eradication of outlier populations is ability to prevent re-invasion, as widespread weeds are likely to have significant seed sources in nearby core infestations. If re-invasion probability is high, achieving eradication is not likely, but there may still be a valid economic and/or environmental benefit in continually eliminating all individuals (Simberloff 2002). Eradication when there is continued re-invasion can be considered 'long-term surveillance and removal', when there is no tolerance for the invasive plant to be present at any density. This contrasts with maintenance management, which allows for low densities of the plant to remain at tolerable levels (Simberloff 2002). Surveillance and removal programs are similar to eradication programs in that they require the same initial funding to remove all plants and both result in preventing significant weed infestations. However surveillance and removal programs differ in that they require ongoing commitment versus eradication programs, which have projected end dates and are, therefore, finite.

In Australia, the widespread weeds boneseed and bitou bush are listed together as a Weed of National Significance (WoNS). These weeds cause damaging environmental impacts over much of south-eastern Australia; however, a national strategy (ARMCANZ *et al.* 2000) is being implemented and national containment and management programs are in place (Cherry *et al.* 2008), with support from the Australian Government and all jurisdictions. In addition, several outlier populations of these weeds have been subjected to eradication. This paper contrasts the eradication program for boneseed in Western Australia (WA) with the long-term surveillance and removal program for bitou bush in Queensland (QLD) to illustrate the importance of both programs in managing widespread weeds.

**Boneseed eradication in WA** Boneseed damages thousands of hectares of native bushland in South Australia, Tasmania and Victoria. In WA, boneseed is limited to 35 small (i.e. majority <2 ha)

populations, but potential distribution predictions indicate that these populations could expand to impact several million hectares in the state's southwest. A program to eradicate boneseed from WA began in mid-2007, led by the WoNS Boneseed Program. All boneseed infestations in WA were documented and a WA eradication strategy was written with input from all land managers (Cherry 2006). The strategy sets a goal for eradication 10 years after initial removal of all mature boneseed plants. This is based on current knowledge of seed bank longevity; however, the strategy can change if new information becomes available.

A critical strategy component is an awareness raising program that encourages the public to report boneseed, as it is often found on residential properties. Boneseed was used minimally by home gardeners but is not known to have been in the commercial trade, so it is occasionally found in residential gardens, albeit to a limited extent. Boneseed is also found in a wide range of habitats from coastal dunes to dry, inland areas. This means that surveillance must occur across a variety of habitats and across public and private land. Therefore, the program must have widespread public support to succeed, hence the intensive awareness campaign. In addition, most people do not know what boneseed looks like, so training the public in identification is critical. The WA program involves numerous stakeholders, including private landholders, state and catchment agencies, Aboriginal groups, and local governments. Program success depends on continued coordination from the WoNS Boneseed Program and the WA Department of Agriculture and Food, as well as long-term commitment from a variety of land managers, enhanced public awareness and community willingness to remove boneseed on private property.

Program costs over the first two years will be relatively high due to the large cost of controlling all mature plants and intensive media campaigns. Early estimates for 2007 are approximately \$58,000. Significantly less investment will be needed in 2008, as most plants will be seedlings that can be quickly controlled. The majority of additional costs over the length of the program will be for awareness raising and surveillance. These costs are minimal in comparison to the cost of managing widespread boneseed infestations. In the 2006/07 financial year in South Australia, Tasmania and Victoria, management costs exceeded \$2m for an area of less than 200,000 ha. Given that the predicted distribution of boneseed in WA is over 37 million ha, the costs of management if boneseed were allowed to invade would far outweigh the relatively small eradication cost. Thus, eradication is a cost effective

and sound economic investment. This program is best described as an eradication program, as it meets eradication criteria, has a projected end date and there is little or no possibility of re-invasion.

#### **Bitou bush long-term surveillance and removal**

Bitou bush has invaded over 80% of the New South Wales (NSW) coastline and has potential to spread as far north as Bundaberg in QLD. A program began in 1981 to eradicate bitou bush from QLD. In the early stages of the program, all known mature bitou bush infestations (total infested area of >700 ha) were eliminated. Currently, all new bitou bush infestations are controlled annually and aerial surveys are conducted every three years. Surveillance is limited to the coastal fringe (preferred bitou bush habitat) and occurs mainly on public land. Bitou bush was intentionally planted to stabilise dunes after sand mining and has spread primarily in natural areas. Bitou bush is not generally found on residential land as it was not used as a garden ornamental, thus there is little need for private landowner participation or intense public awareness campaigns. This program is coordinated by one state agency (Biosecurity Queensland) and implemented by two additional state agencies, seven local governments and one private corporation; thus, it involves relatively few stakeholders compared to the WA eradication program. Success of the QLD program depends on continued state agency support and coordination.

Initial costs of the QLD program were high, as large numbers of mature plants required treatment, but at present only few new plants are discovered. The majority of costs are now for surveillance, as annual surveys must continue over the same initial area. The current annual program costs are approximately \$80,000. Given that the projected bitou bush distribution in QLD extends over 500 km of coastline, the relatively small investment in this program is economically sound. This compares favourably with the cost of managing bitou bush in NSW in 2006/07, which exceeded \$4.3m over approximately 1000 km of coastline. Thus, if bitou bush were allowed to invade to its maximum projected extent in QLD, and caused the same damage as in NSW, it could conceivably cost up to \$2m per year to manage. In light of this, \$80,000 in long-term surveillance and removal appears an excellent investment.

Although this began as an eradication program, it is now best described as a long-term surveillance and removal program. While it meets the majority of criteria, eradication is unlikely because dispersal agents (i.e. birds and water) continually facilitate re-invasion from NSW infestations. Therefore, the program must be maintained in perpetuity or until bitou bush

infestations in northern NSW are controlled. Regardless, this program still achieves the important goal of preventing large-scale bitou bush invasion in QLD and should continue to receive long term funding and support.

#### DISCUSSION

Undertaking eradication can be advantageous, since establishing a formal program may encourage resources to be dedicated specifically to control the target weed, as has occurred in these programs. Both programs provide similar benefits: environmentally, there is no negative impact from the weed; economically, the cost of continued control of large infestations of the weed is avoided. Initial stages of both programs were the most costly, as all mature plants had to be controlled. WA eradication costs will decrease over time as plants are eliminated and eventually only low-cost monitoring and surveillance will be needed. In contrast, the cost of the QLD long-term surveillance and removal program should remain fairly constant because surveys must continue over a large area and remote areas must be accessed to control new infestations. Both programs began as eradication campaigns; however, the bitou bush program is now regarded as long-term surveillance and removal due to constant re-invasion. This means that continued success of the long-term surveillance and removal program depends on perpetual funding, which is a key difference between this and eradication. Both programs need to be costed for eradication in the early stages, as all mature plants must be controlled; however the eradication program will only require funding for a limited time (time to eradication), while the long-term surveillance and removal program requires constant, albeit reduced funding in perpetuity (or until re-invasion is no longer likely).

The cost of any eradication program is dependent on many factors including biology of the target weed, its invasion history and many other criteria (Meyers *et al.* 2000). The boneseed eradication program involves costly media campaigns as it must engage residential landowners; however, the bitou bush program has a smaller target audience for awareness campaigns and thus media costs are less significant. Both programs are beneficial in that they raise public awareness of invasive plants and encourage public support for management actions (Simberloff 2003).

Both approaches can be economically and environmentally beneficial. Land managers should differentiate between the two approaches as it will help

ensure appropriate long-term resource allocation and support, especially from government agencies which are normally the primary investors. Eradication attempts should be encouraged where feasible and when the weed meets eradication criteria. However, as the bitou bush example illustrates, there is merit in attempting eradication initially and continuing the program as long-term surveillance and removal if eradication cannot be achieved. Either way, if the weed threat is minimised or eliminated, the end result is a success.

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