Western Australia Boneseed Eradication Strategy

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Western Australia Boneseed Eradication Strategy

Acronyms
DAFWA – Department of Agriculture and Food, Western Australia
DEC – Department of Environment and Conservation, Western Australia
LGA – Local Government Area
LCDC – Land Conservation District Committee
NRM – Natural Resource Management
WONS – Weeds of National Significance

Executive Summary

Boneseed, *Chrysanthemoides monilifera* subspecies *monilifera*, is one of Australia's worst weeds and is recognised as one of the twenty *Weeds of National Significance* (WONS). Boneseed infests large areas of South Australia, Tasmania and Victoria, where it severely impacts native plant communities and other environmental assets. In Western Australia, boneseed is currently found only in the southwest region of the State, and only in very small numbers. However, boneseed has potential to significantly expand its range, and also to become more abundant within its current range in Western Australia.

National coordination of boneseed management in Australia occurs as part of the WONS Program. A National Coordinator and National Management Group oversee the implementation of the Boneseed National Strategic Plan. The National Plan lists "eradication of boneseed in lightly infested areas and areas of high conservation value" as a high priority. This is supported in Western Australia, where boneseed is listed as a P1/P2 declared plant, requiring that all infestations be eradicated.

Given the appropriate resources, it is possible to eradicate boneseed from Western Australia, as infestations are still small and localised. The implementation of a boneseed eradication strategy in Western Australia is feasible under current conditions, fulfils state and national goals, and will provide long-term protection to Western Australia's unique environmental assets.

This eradication strategy provides information on the biology and ecology of boneseed, outlines the current and potential extent of boneseed in Western Australia, summarises legislation and related management strategies that support eradication of boneseed, provides information to land managers regarding resources, planning and implementation measures available for boneseed control, and outlines a plan to raise public awareness of boneseed in Western Australia. Boneseed seeds may remain viable in the soil for over 10 years and therefore commitment to eradication may be required for 10–15 years after the last reproductive individual is extirpated (or until no viable seed remains).

The purpose of this Western Australian Boneseed Eradication Strategy is to:

- Encourage and facilitate an increase in awareness of boneseed in Western Australia.
- Encourage and facilitate control and eradication of boneseed in Western Australia.
- Provide support to regional and local efforts to control and eradicate boneseed in a strategic and integrated manner that fulfils national boneseed priority actions and is commensurate with the National Boneseed WONS Strategy.

1. Introduction and purpose of this eradication strategy

Boneseed, *Chrysanthemoides monilifera* subspecies *monilifera*, is a South African plant that was imported to Australia for ornamental purposes and has since invaded a wide range of vegetation types across southern Australia. Based on its invasiveness, impacts on biodiversity, and potential for spread, boneseed is regarded as one of Australia's worst weeds. Boneseed and the closely related bitou bush (*C. monilifera* ssp. *rotundata*) are together recognised as one of the twenty *Weeds of National Significance* (WONS). Boneseed currently infests large areas of South Australia, Tasmania and Victoria (Figure 1), where it causes damage to native plant communities and other environmental assets. Boneseed is prohibited from import to Australia and is a declared weed in all States and Territories.

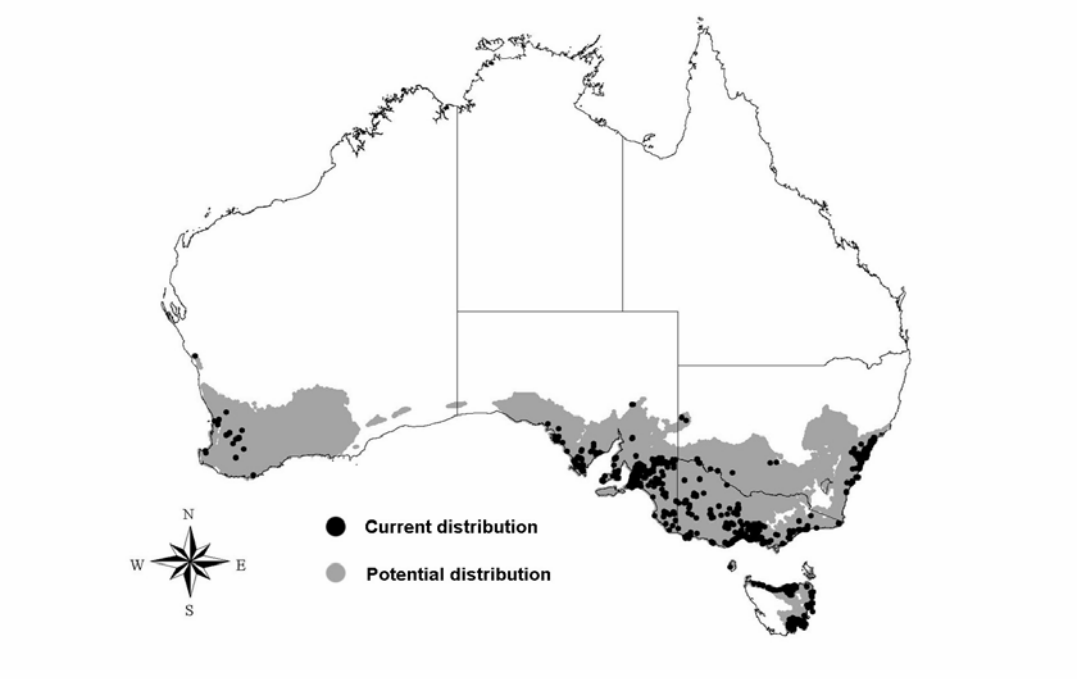

Figure 1. Current and potential distribution of boneseed in Australia, June 2006.

National coordination of boneseed management in Australia occurs as part of the WONS Program. A National Coordinator and National Management Group oversee the implementation of the Boneseed National Strategic Plan (ARMCANZ *et al.* 2000). A priority in the Plan is to "coordinate and implement on ground works to eradicate boneseed from lightly infested areas and areas of high conservation value." The establishment of eradication zones is also a high priority in the Boneseed National Priority Action Framework [available on www.weeds.org.au/WoNS/bitoubush]. In Western Australia, boneseed is listed as a P1/P2 declared plant, requiring that all infestations be eradicated.

Currently, boneseed is present only in the southwestern regions of Western Australia, and only in very small numbers. As of January 2010, there were 42 discrete sites in WA where boneseed has been found, six of which are presumed extirpated (Appendix A). The majority of these sites are less than 1 ha and contain fewer than 10 plants, while the largest infestations are confined to areas of less than 10 hectares. The total control area is estimated at approx. 70 ha and total search area is estimated at approx. 800 ha (Appendix A).

Given the appropriate resources, it is possible to eradicate boneseed from Western Australia. Thus, the implementation of an eradication strategy for boneseed in Western Australia is feasible under current conditions, fulfils state and national goals and will provide long-term protection to Western Australia's unique environmental assets.

The purpose of this Western Australian Boneseed Eradication Strategy is to:

- Encourage and facilitate an increase in awareness of boneseed in WA.
- Encourage and facilitate control and eradication of boneseed in WA.
- Provide support to regional and local efforts to control and eradicate boneseed in a strategic and integrated manner that fulfils national Boneseed priority actions and is commensurate with the National Boneseed WONS strategy.

2. Area covered by this eradication strategy

The State of Western Australia is covered by this eradication strategy. Known regions of boneseed infestation or potential infestation are in the metropolitan Perth area, in the Perth Hills as far north as Toodyay and as far east as Middle Swan, and south of Perth along the coast to Busselton and along the Albany Highway to Albany (Figure 3). This strategy focuses on the southern region of the state, as boneseed is less likely to invade central or northern regions due to climatic constraints.

3. Biology, ecology and impacts of boneseed

Two subspecies of *Chrysanthemoides monilifera* are present in Australia. *C. monilifera* subspecies *monilifera*, known as boneseed, is found mostly in temperate areas of New South Wales, South Australia, Tasmania, Victoria and Western Australia. *C. monilifera* subspecies *rotundata*, known as bitou bush, is found in coastal New South Wales, with occasional infestations occurring in southern Queensland and eastern Victoria.

The following information pertains to boneseed and has been taken from the Boneseed Management Manual (Brougham, *et al.* 2006). Please refer to the Manual for further information about boneseed [freely available on the Internet at www.weeds.org.au/WoNS/bitoubush.

Description

- Boneseed is an erect perennial shrub in the Asteraceae (daisy family) that grows to 3 m high. It has branched, upright, woody stems, and a shallow but extensive root system. Old trunks can be up to 20 cm in diameter.
- The fleshy leaves are 3–9 cm long, and alternate along the stems. They have an elongated oval-shape that tapers towards the base, with irregularly toothed edges towards the tip. New growth is covered with white downy hairs that are shed as the leaves mature.
- The yellow, daisy flowers are 2–3 cm in diameter with 4–8 'petals' (ray florets), and are clustered at the ends of branches.
- The round, fleshy fruits turn from green to black when mature. Beneath the fleshy tissue, the inner fruit (containing a single seed, or achene) is hard, smooth and round, 6–7 mm in diameter, and bone-coloured when dry – hence the name *boneseed*.

Figure 2.
Boneseed flowers, fruits and leaves.

Flowering and pollination: Boneseed plants do not normally flower until they are at least 18 months old. However, some plants may flower in their first year, particularly in burnt areas or in areas with high soil moisture and nutrient content. Plants growing in poor conditions may not flower until they are up to three years old.

Boneseed flowers are compound inflorescences made up of many small flowers called florets. The tiny disc florets make up the centre, and the large ray florets on the outer edge form the petal-like structures. Each fertile ray floret can develop into a fruit. Flowers develop from late winter to spring.

Seed production: Each inflorescence produces 4–8 fruit (one per ray floret or 'petal'). The fleshy tissue of the fruit dries and flakes off with age, revealing a single, bone-coloured seed pod (which contains the seed, or achene). A single plant can produce up to 50,000 seeds per year, of which approximately 60 percent are viable. Seeds are shed in summer in most regions, extending into autumn in Tasmania due to the later flowering period.

Seed dispersal: Boneseed does not reproduce vegetatively and so relies on its massive seed production for reproduction and spread. The fleshy fruits are attractive to a wide range of animals that spread the seeds, including foxes, rabbits, emus and a number of other bird species. The smooth round seeds also disperse from the parent plant by rolling down slopes, and the hard seed coat allows seeds to remain viable when transported via either fresh or salt water. Humans spread boneseed by dumping garden waste and soil, and by transporting seeds on machinery.

Seedbank longevity: Boneseed seeds can remain dormant in the soil if the seed coat remains intact. While the exact longevity of seeds is unknown, research has shown that around 13 percent of seeds can remain viable after three years, and some seeds appear to remain viable for over 10 years. Research is currently underway to determine seed persistence in the soil.

Germination: The hard seed coat surrounding the achene typically develops two or three cracks after exposure to the elements. Boneseed seeds can germinate any time of the year if the seed coat is cracked and there is sufficient soil moisture. Boneseed germination is not known to be limited by light or temperature.

Ecology

Boneseed prefers winter rainfall regions, where it is found in a wide range of vegetation communities including coastal dunes, estuarine areas, dry and wet sclerophyll forest, heath, woodland and mallee.

Boneseed occurs on a range of soil types, but does not tolerate waterlogged soils. Most infestations are therefore in low to medium rainfall areas, or on free-draining soils in areas with higher rainfall. Favouring sandy or medium-textured soils and tolerating saline conditions, boneseed thrives in coastal regions.

Boneseed can grow in a range of conditions. Seedlings can tolerate shade and mature plants will grow in moderate shade to full sun. Boneseed grows throughout the year if moisture is sufficient, but growth is most rapid after autumn rains and in spring. Prolonged droughts and frosts inhibit boneseed growth. While the longevity of boneseed plants is unknown, plants may live for 30 years or more.

Seedlings grow rapidly and will establish in the absence of disturbance, even in shade or infertile soil. Fire and physical soil disturbance can trigger mass germination events. The resulting increase in plant density can cause scattered populations to become dense infestations in a very short time.

Impacts

Boneseed has a number of traits that make it a successful invader of native bushland. Its vigorous growth is aided by the absence of natural enemies in Australia. Each plant produces large quantities of seed that is readily dispersed long distances by animals such as foxes, emus and other birds, allowing boneseed infestations to establish in undisturbed vegetation. Once established, its rapid regeneration and ability to spread quickly after disturbance, such as fire or clearing, allows it to outcompete and displace native species. Boneseed can alter habitat and replace the food plants of native fauna, and restrict access to parks, trails or beaches.

Boneseed endangers many threatened plant species and communities in southeastern Australia. Examples include brittle greenhood orchids in the You Yangs (south-west of Melbourne), the *Eucalyptus microcarpa* and *E. porosa* grassy woodlands in South Australia, the *E. ovata, E. viminalis* and *E. globulus* communities in Tasmania, and Eastern Suburbs Banksia Scrub in Sydney.

Boneseed does not seriously impact agriculture, as small plants are readily grazed. However once large plants establish they can impede access to grazing land and must be removed, as large plants are not typically grazed.

4. Boneseed distribution in Western Australia

Boneseed is present in small numbers in the southwest regions of Western Australia (Figure 3). As of January 2010, there were 42 discrete sites in Western Australia where boneseed has been found (Table 1). A detailed summary of those sites can be found in Appendix A. The number of sites may increase as heightened awareness of boneseed causes new infestations to be identified.

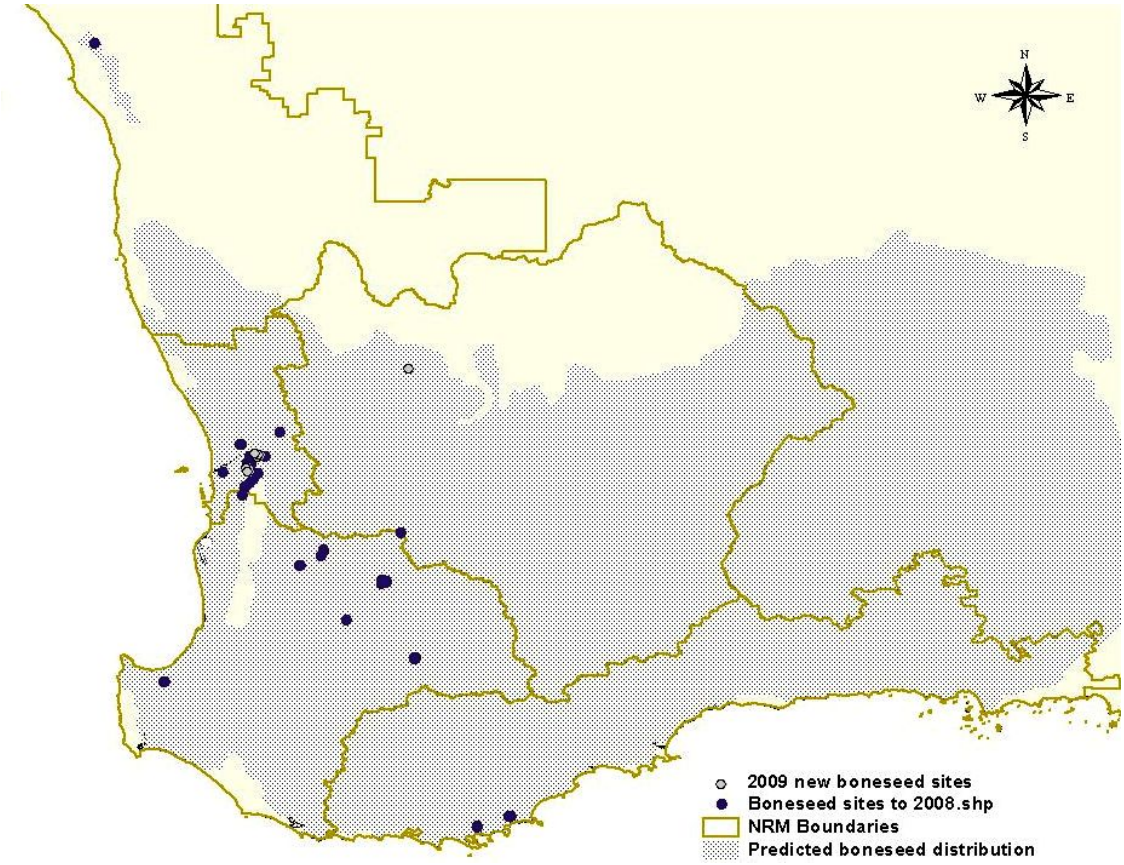

Figure 3. Current and potential distribution of boneseed in Western Australia as of January 2010 (see Table 1 for site information).

Significant populations (boneseed present in an area of ≥ 5 ha) of boneseed occur at Armadale, Perth Hills, Henley Brook, Wandering, Woodanilling, Narrogin and Many Peaks. Small infestations occur in the Perth Hills (Kalamunda and Mundaring Shires), Roleystone, Pickering Brook, Boddington, Dardadine, Albany and Busselton. In the past, boneseed specimens were collected from sites in Applecross (Perth), Nabawa, Toodyay, Byford, Tutanning and Wyalkatchem; in recent investigations these plants could not be found and these populations are presumed extirpated. These sites will be included in the eradication program, however, because follow-up monitoring must occur to ensure there is no seed production or germination, and awareness activities are crucial to revealing new infestations.

Table 1. Western Australia boneseed sites as of January 2010

See master spreadsheet (Appendix A) for additional information.

Site #	Closest town	Location	control area (ha) (2009)	approx. search area (ha)
1	Nabawa	No site data. PERTH herbarium specimen #416428	0	113.9
2	Toodyay	Perth-Toodyay road, near Toodyay, WA. "growing on roadside" PERTH specimen # 554014; Parking pull-in just before bend - plants found on opposite side of road.	0	88.5
3	Henley Brook	Aboriginal land in Saunders St. Upper Swan (Henley Brook) and 2 adjacent private properties on Rookwood and Roberts Rds.	6	12.9
4	Darlington	Infestation extends approx 1km from intersection Ryecroft and Leithdale Rds. In vacant lot on corner and in residential properties on Leithdale Rd, Ryecroft Rd, Lukin Rd, Alpike Rd and Hillcrest Rd. Also in Helena College property.	2	26.7
5	Sawyers Valley	Forrest Street, Sawyers Valley on residential property and on both sides of adjacent Shire road verge (ca. #90 Forrest St) ca. 20 m North of intersection w/Railway Tce West.	0.1	12.3
6	Kalamunda	Kalamunda Tip, WA	0	0.0
7	Kalamunda	Four residential properties on Heath Road (40-50 block) and one on East Terrace (0-10 block). Plants growing in front yards.	0.1	1.7
8	Kalamunda	End of Moran Rd, in residential yard & verge adj bushland and end of Brine Road in reserve edge Darling Range Reg Park.	0.1	4.5
9	Gooseberry Hill	Several (6) adjacent residential properties: Gooseberry Hill Rd and Landor Rd (20-50 block)	0.25	6.2
10	Gooseberry Hill	Noel Rd and Railway Road (100 block) on 3 residential blocks.	0.1	1.5
11	Kalamunda	Several (6) adj. residential properties: Mundaring Weir Rd (60 block), Roach Rd. (1-10 blk), Croxton Rd (50-60 Blk) and adj council reserve on Roach Rd.	0.2	6.1
12	Applecross Perth	Darnell Avenue (11-21 block), Mount Pleasant, Perth WA	0	0.1
13	Roleystone	Peet Rd. reserve bounded by Peet, High & Contour Rds.; also further further s along Peet Rd at int. w/Beales Rd (2-10 blk) & in res. properties on Mackie Rd (40 blk) & Brookton Hwy. (500 blk)	1	16.1
14	Roleystone	Springdale recycle depot: One plant inside tip fence, 1 plant ca. 100m from tip gate in S road verge. Several plants in bushland to the south of the tip (w of orchard).	0.2	4.6
15	Pickering Brook	Multiple plants 500m along both sides of Carinyah Rd and in Reserve N of sawmill and adj. golf course. Also in residential yard on Merrivale Rd (101-131 blk).	0.5	5.3
16	Bedfordale Hill	Neerigin Brook Reserve; Cnr Bedfordale Hill Rd & Albany Hwy in reserve & adj. residential properties. Along W side of Albany Hwy from Cnr Bed. Hill Rd. north to edge of truck arrestor bed & in adj residential properties. Also roundabout at B. Hill Rd & Jade St., also properties on S side of Bed. Hill Rd and on other side of Albany Hwy (180 block) in several residential yards.	5	9.3

Site #	Closest town	Location	control area (ha) (2009)	approx. search area (ha)
17	Byford	Byford - herbarium record only - does not contain location.	0	33.8
18	Pingelly	"Tutanning Reserve, 17 miles SE of Pingelly" - from herbarium record.	0	10.0
19	Wandering	Wandering township in several res. yards (White & Dorsett Sts), and school / road reserve along w side N Bannister -Wandering Rd. Throughout old mill site and in adj, reserve to N and water board reserve to West.	10	61.9
20	Wandering	S Wandering townshiop around tip: both sides Moramocking Rd and road to tip. Plants scattered in reserves w/in 500m of center of tip and towards cemetary.	10	71.6
21	Wandering	Small LGA road reserve on W side of Moramocking Rd. approx 6km SW of town and 500m N of O'Connell Rd.	0.5	6.4
22	Boddington	Ex-railway reserve E of bridge across river, NE cnr Crossman Rd and Bannister - Marradong Rd; on edge Hotham River.	0.3	3.5
23	Narrogin	Foxes Lair Reserve, W of town. N of Arboretum at back of housing toward Floreat St (E of track to Narrakine Rd).	0.5	13.7
24	Narrogin	NE area: 4 res. properties (Tuohy, Doney Sts and cnr Kipling/Grey St) and coucil land end of cul-de-ac near reserve (Tuohy St) across from residential homes.	1	8.8
25	Narrogin	Pioneer Drive. Road leading into CBH (Cooperative Bulk Handling) off roundabout. Numerous plants in creek area from roundabout to CBH gate	0.5	1.6
26	Narrogin	SE area: Narrogin High School: Bushland around south side of school and dump site near school (off Harrismith Rd); also 1 res. Property on Williams St.	3	13.9
27	Narrogin	SW area: E and W sides of Earl St. South (along fenceline adj. to council reserve on edge of ditch. And in depot land across St). Also in yard at Pitt St and Fairway St and along fence at Auto repair on Felspar St.	0.25	4.0
28	Narrogin	NW area: Disturbed bushland to the N and W of Narrogin tip (former tip area and along dirt track running SW from White Rd) . Large infestation West of White Rd across from tip entrance. Also on S verge of Fleay Rd approx 1.3 km E of int. with White Rd or 300m W of int. with Wandering -Narrogin Rd; and on W verge of Wandering - Narrogin Rd on first curve out of town towards Wandering.	10	45.9
29	Dardadine	Dardadine Rd S. 1-200m NW of int with Strickland Rd. along 100m of SW road verge. Also historic school grounds on E side Dardadine Rd - from small track N of int with Strickland Rd to edge of paddock fenceline to the SW.	1	16.8
30	Woodanilling	East side of Great Southern Hwy midway between Haddleton Rd and Robinson Rd in road verge along fenceline.	0.1	0.3
31	Woodanilling	Woodanilling townsite; house next to primary school across from #17 Carlton St.	0.1	21.8
32	Woodanilling	E side Shenton Rd. ca. 500m S of int. of Shenton and Robinson E Rds; plants scattered 100m along road verge between road and on both sides of water pipe.	0.5	5.8

Site #	Closest town	Location	control area (ha) (2009)	approx. search area (ha)
33	Woodanilling	Woodanilling tip reserve off Orchard Rd. Dirt track 200m east of tip entrance (S. side of Orchard Rd); approx. 150m south on dirt track – plants are present along both sides of dirt track and infestation extends to edge of adj. agricultural land to E and edge of tip to W. Also in adj. council reserve N of tip b/t Orchard and Robinson Rd West. approx. 200m west of int. of Great S. Hwy and Robinson Rd	5	25.8
34	Busselton	Chugg Road; on road verge approx 500 m west of int. with Jalbarragup Rd. Infestation approx 150m along both roadsides and 300m along creek (between two paddocks) that runs north from road.	0.2	3.6
35	Albany	Opposite #60 Francis St in road verge near native bushland. One plant growing under large Eucalypt.	0.1	0.0
36	Albany	In vacant lot (ca. 10 mature plants) on NW corner of The Esplanade and Rae Rd and in 'hedge' next to ditch along verge on S. edge of Rae Rd. (ca. 25-40 plants)	0.2	0.5
37	Many Peaks	Waychinicup Road; on road verge from approx 1.7 km from int. with Homestead Rd. Large infestation extending approx 2km along both sides of road in remnant bush. Also in native bushland on two private properties N side of road and in swamp area to N,	5	25.6
38	Wyalkatchem	Historical information indicates plants found at tip/reserve area and around school area in Wyalkatchem town.	0	110.5
39	Greenmount	Cnr Camfield & Pitterson Rds and on 2 adjacent res. properties. Also in bushland on Mount Street laneway Cnr Ferguson Rd and in bushland Opposite #5 Tower Hill Court (N and W of #5)	0.5	4.1
40	Parkerville	On three residential properties: 600-800 blk of Brooking Rd (E side of Rd 2 adjacent properites at intersection w/Hwy) and 2000 blk of Seabourne St	0.1	7.8
41	Hovea	John Forrest National Park, Falls Rd. On edge of Park and residential property	5	19.5
42	Lesmurdie	In bushland around Falls Primary School (Falls Rd) and on one residential property on Gilchrist Rd. (20-30 Block) planted in yard.	0.5	3.4
		grey shading = site presumed extirpated	*69.9*	*830.4*

Boneseed has the potential to significantly expand its range, and also to become more abundant within its current range in Western Australia. Climate-based analysis using the BIOCLIM modelling process predicts that the potential distribution of boneseed can extend throughout the SW regions and north of Perth (see Figure 3, shaded area).

The earliest specimen of boneseed from Western Australia dates from Armadale in 1948, indicating that boneseed has been present in the state for over 50 years. It is not known if boneseed has spread from this first known location or if all other infestations represent new introductions (nascent foci). As boneseed was often used as a garden plant, it is likely that many infestations have occurred independently, spreading from various residential plantings. Regardless of its method of spread in Western Australia, boneseed is still only present in a small number of sites relative to its potential distribution.

It is probable that boneseed in Western Australia is currently in a lag phase [the time between the introduction of a species into a new environment until it naturalises. Invader abundance is very low for some time (the lag phase), followed by a period of exponential growth]. It is also possible that the fauna in regions of Western Australia where boneseed is found is not contributing significantly to the spread of boneseed. Any change to the current situation could mean that boneseed spreads faster and causes increased damage. It is in the best interest of land managers to eradicate boneseed at this early stage: costs will be low relative to the large-scale control operations that will be necessary if boneseed spreads further. Because boneseed is declared a P1/P2 pest plant, there is also a legal requirement to control boneseed under the *Agriculture and Related Resources Protection Act* 1976.

5. Legislation

The *Agriculture and Related Resources Protection Act* 1976 (the *Act*) outlines legislative requirements for dealing with weeds or pest plants. A Declared Plant is a weed that has been "Declared" under the *Act*. If a plant is declared, all landholders are obliged to control that plant on their properties. Declarations specify a category, or categories, for each plant according to control strategies or objectives, which the Agriculture Protection Board believe are appropriate in a particular place. The landholder, as either the owner or the lessee, of the affected property is the responsible party for carrying out control work of Declared Plants.

Boneseed is a category P1/P2 declared plant in all of Western Australia.

P1 - (Prevention) indicates a plant that can not be introduced or spread. Most declared plants fall under this category.

P2 - (Eradication) indicates a potentially serious weed that is not widely established. P2 plants must be eradicated by the landholder.

From the *Act*:
Category P1 in respect of an area if the introduction into and movement within that area of those plants should, in the opinion of the Protection Board, be prohibited. Category P2 in respect of an area if those plants should, in the opinion of the Protection Board, be eradicated in that area.

The *Biosecurity and Agriculture Management Act 2007* (*BAM Act*) was enacted in October 2007. The main purposes of the *BAM Act* are to prevent new animal and plant pests (weeds and vermin) and diseases from entering Western Australia, to manage the impact and limit the spread of those already present in the State, and to safely manage the use of agriculture and veterinary chemicals and ensure agricultural products are not contaminated with chemical residues. Sections of the *BAM Act* are anticipated to be in place early in the 2010-11 financial year. Refer to the Department of Agriculture and Food website for more information - http://www.agric.wa.gov.au/content/pw/bamb_info.htm

6. Links to broader strategies and management plans

The control of boneseed and other weeds is a priority for conservation programs on national, state and regional levels.

National

The *Australian Weeds Strategy* (Natural Resource Management Ministerial Council, 2006) [which replaced the *National Weed Strategy* (ARMCANZ *et al.* 1997)]

encourages the development of weed strategies for managing priority weeds such as WONS, and has a key goal of preventing new weed problems, including minimising the spread of weeds to new areas.

The WONS boneseed program supports coordinated management of boneseed across Australia. Eradication of boneseed in WA is considered a top priority for the WONS boneseed program.

- The *National Boneseed Strategic Plan* (ARMCANZ *et al.* 2000) calls for action to "coordinate and implement on ground works to eradicate boneseed from lightly infested areas and areas of high conservation value."
- The National Boneseed Priority Action Framework lists the establishment of boneseed eradication zones as a highest priority.

Western Australia

The State Weed Plan or *A Weed Plan for Western Australia* (State Weed Plan Steering Group, 2001) supports state wide weed management actions. The goal of the Plan is to achieve coordinated, collaborative and effective weed management throughout Western Australia. The Plan recognises that "effective weed management requires a long-term commitment from managers of both private and public land, as well as a coordinated approach involving all relevant stakeholders," and that "Western Australia is participating in the national coordinated action against WONS." Key actions from the plan that pertain to this eradication strategy include:

- Coordinate weed management planning, implementation and monitoring across all land.
- Increase public awareness to gain community acceptance of the significance of weeds and their responsibilities for weed management.
- Encourage cooperative local and regional programs based on assessed priorities.

The WA Department of Environment and Conservation (DEC) reserve and park management plans support weed control in DEC lands across the state. DEC state wide initiatives also encourage management of priority weeds.

- The *draft Biodiversity Conservation Strategy* draft (DEC, 2006) identifies environmental weeds as a cause of biodiversity loss in WA and lists actions to implement the State's Environmental Weed Strategy and develop and implement an environmental weed action plan.
- The *Environmental Weed Strategy for Western Australia* (Department of Conservation and Land Management, 1999) identifies 1350 environmental weed species in WA. Eradication of boneseed complements state initiatives against weeds identified in the Environmental Weed Strategy such as the DEC program "Saving Our Species," which targets 40 environmental weeds with the goal of eradicating entire weed populations at a local scale.

NRM Regions

Five of the six Natural Resource Management (NRM) Regions in Western Australia are affected by boneseed: Avon, Northern Agricultural, Perth, South West and South Coast. Regional NRM strategies identify weed management actions that are supported by this Strategy.

The *Avon Natural Resource Management Strategy* (Avon Catchment Council, 2005) states that the identification, containment and, where possible, eradication of 100% of national, state and regional priority plant pest species is an ongoing activity and where possible, plant pests should be managed according to their declaration

category. The priority for investment in coordinated community action for plant and animal pest control is high. Management Action Targets related to weeds include:

- An extension program has provided an outline of the state and national strategic planning for plant and animal pests to increase understanding to 100% of LGA's, Land Conservation District Committee (LCDCs) and catchment groups within the region by 2005. Support the distribution of threat assessment information from state and national governments to local groups.
- A regional policy, planning and information framework will be developed by 2007 to ensure that regional responses are coordinated with state and national pest and disease strategies. Facilitation of the development of coordinated management plans between all land users at the local community level for implementation of BMP.
- By 2008, 80% of land managers have knowledge of the impacts and management of priority plant pest species. Awareness campaign for land managers targeting the identification of priority plant pest species.

The *Northern Agricultural Regional Natural Resource Management Strategy* (Northern Agricultural Catchments Council, 2005) lists pest plants as a major threatening process for terrestrial biodiversity. The resource condition targets commit to a "reduction in the density and distribution of significant environmental weed species affecting high value biodiversity assets by 2020". The strategy contains the following management action targets:

- All projects with a biodiversity focus to incorporate effective weed control as part of on ground works by 2006.
- A structure established with representation of relevant stakeholders that effectively coordinates control of weeds over the entire Northern Agricultural Region by 2005-06.
- Guidelines on best practice environmental weed management developed by 2006.

The *Swan Region Strategy for Natural Resource Management* (Swan Catchment Council, 2004) contains actions related to this boneseed eradication strategy, including:

- Develop management responses to ensure no new introduction of potential pest plants.
- Regionally implement the *State Weed Plan* and *Environmental Weed Strategy for Western Australia*.
- Facilitate, coordinate and support community and stakeholder involvement in mitigation and remediation activities.
- Promote wider regional community, land manager and Local Government education and awareness and training programs on pest and disease management.

The *South West Regional Strategy for Natural Resource Management* (South West Catchments Council, 2005) lists weeds as a threat to biodiversity and contains the following related matters for target:

- Develop a system for prioritising environmental weeds and targeting them with effective control measures including post-control revegetation.
- Coordinate weed control on public and private land to contain or eliminate environmental weeds in high value remnant vegetation.
- Implement measures to prevent new introductions of environmental weeds, including early detection and timely response to new occurrences.
- Weed control including surveillance and monitoring systems to allow early detection of new invasive species.

The *South Coast Strategy for Natural Resource Management* (South Coast Regional Initiative Planning Team, 2005) lists pest plants and animals as a major threat and indicates the "reduction in extent and occurrence of ecologically invasive species by 2025" as a Resource Condition Target.

- Management programs for 100% of priority invasive species implemented by 2010. Establish coordinated regional weed management actions.
- Manage impacts of invasive or introduced organisms, particularly through implementation of programs such as the State Weed Plan.
- Protect coastal vegetation systems and ecological communities from invasive plants and pest species.

Local

Many local government agencies have developed strategies to deal with weeds in their area. In addition, community groups also have local site plans and strategies to deal with priority weeds at a site level. Groups such as the Environmental Weed Action Network have a large number of community members and will be essential participants in boneseed awareness campaigns. Boneseed also occurs on Aboriginal land in Western Australia and liaison with the Aboriginal community and NRM Indigenous Land Management Facilitators is also essential. Interaction with local government, Aboriginal and community groups in areas susceptible to boneseed will strengthen implementation of this Boneseed Eradication Strategy.

7. Resources

The purpose of this strategy is to facilitate eradication of boneseed in Western Australia, and there are many existing resources to assist stakeholders in reaching this goal. Stakeholders will benefit from utilising the existing support and knowledge base and working cooperatively to increase the body of available knowledge.

The National Boneseed Program can provide:

- best practice management information (boneseed management manuals and weed management guides)
- education and awareness materials (posters, fliers, banners, Weedeck cards etc)
- distribution maps and information
- stakeholder contacts (local, state and national) and networking opportunities
- information about potential funding and assistance with funding applications
- media and awareness raising opportunities
- liaison with regional, state and national weed management agencies

State agencies can provide:

- legislative authority and enforcement, where necessary (DAFWA)
- advice on boneseed control (eg. herbicide use information - DAFWA)
- site planning and management advice
- assistance with funding applications
- assistance with coordinating efforts on public and private land
- policy tools, such as the State Weed Plan (DAFWA)

NRM Regional Bodies can provide:

- management advice
- assistance in assigning responsibility for management and follow-up of infested sites
- potential funding or advice on funding sources

- assistance preparing funding applications
- links with community and NRM (landcare) officers
- liaison with state, regional and local bodies
- policy tools, such as Regional NRM Strategies

Indigenous Land Management Facilitators can provide:
- advice on funding sources
- assistance preparing funding applications
- management advice and assistance for management and follow-up of infested sites
- links with community and Aboriginal groups

Local government can provide:
- Boneseed control and advice on weed control
- Weed mapping tools and information
- Local knowledge, including history of boneseed invasion and control
- Potential funding source and advice on funding sources
- Assistance with funding applications
- Links with local community and Aboriginal groups (Landcare officers)
- Land tenure information
- Policy tools, such as council weed strategies

Community and Aboriginal Groups can provide:
- Local knowledge, including history of boneseed invasion and control
- Boneseed control
- Advice on managing other weeds in conjunction with boneseed and advice on native flora
- Links to the greater community to promote education and awareness

Councils should consider working with local community groups and private landowners to encourage control of boneseed on private land, and provide assistance when necessary, especially in cases where the landowner is unable to control boneseed on their own. Relatively small efforts now will prevent further movement of boneseed to public lands.

8. Planning

When implementing this eradication strategy, it is critical for land managers to plan for the people and resources required. This will allow land managers to seek any necessary additional resources or funding in the early stages of their plan, rather than waiting until the boneseed infestation is further developed and thus more difficult to control. The development of a site-specific eradication plan will allow managers to identify the need for additional resources.

A site-specific eradication plan should:
- ✓ contain a detailed map, including boneseed infestations and assets
- ✓ take account of the operating conditions on and around the site
- ✓ clearly allocate responsibilities
- ✓ make cooperative arrangements with neighbouring stakeholders also undertaking boneseed control
- ✓ identify resources needed (financial, operational and educational)
- ✓ identify links with other stakeholders who can assist with eradication
- ✓ identify available control methods and select appropriate methods for the site

- ✓ prioritise efforts
- ✓ include a timeline and budget
- ✓ identify associated risks and a means for abating those risks
- ✓ contain provisions for monitoring.

A good monitoring plan will not only assist land managers in assessing the effectiveness of their program, but will also assist in assessing effectiveness of the overall eradication strategy. Local and regional data can be collated and analysed to provide feedback on progress towards statewide eradication. Monitoring data can also be used to maintain the relevance of the strategy, as it will provide the ability to evaluate changes in the status of boneseed and update the strategy accordingly. Monitoring data sheets have been designed for this eradication program that prompt collection of specific information to successfully assess the program (see monitoring templates in Appendix B).

This strategy should be implemented as soon a possible to prevent further spread of boneseed. Several of the known infestations are single plants or garden plants, which can be removed immediately, however these sites will still require several years of follow-up to ensure that no new plants have sprouted and the seedbank is exhausted. Larger boneseed infestations will require the preparation of a detailed site plan, which should include a time-line for primary control and follow-up removal.

Boneseed seeds may remain viable for over 10 years and this should be considered when planning follow-up control. Participants in this eradication program should be aware that commitment and funds to implement the program will be needed for up to 10 – 15 years from the date of removal of all mature plants (or as long as viable seeds are present in the seedbank). Research is currently underway to determine boneseed seed persistence (longevity) in the soil however until further information is revealed, a finite end-date of this eradication program cannot be set. Long-term monitoring of all WA boneseed sites may also reveal information about seed persistence. This eradication strategy will be revised as new information comes to light.

Eradication programs are often more costly towards the final stages of the program. Costs per unit area may actually increase after initial control. New seedlings will be small and hard to find, thus labour costs will increase as time spent searching for plants increases. In addition, it is often difficult to maintain commitment in the later stages of eradication program when the weeds are not visible. If no plants are being seen to cause damage, priorities can change and funds directed away from the eradication program to other weeds. This risk can be reduced by ensuring effective communication between all stakeholders and implementing awareness campaigns.

9. Implementation: Measures to eradicate boneseed

Eradication is the most appropriate management objective for areas that have little or no boneseed, such as Western Australia. The ultimate management outcome is achieving and maintaining the total absence of boneseed in Western Australia. To do this land managers must:

- ⋆ Prevent all seed production in the infested area
- ⋆ Suppress and destroy new establishment (germination)
- ⋆ Search for and destroy all plants and propagules over the long-term.

Current quarantine restrictions in Western Australia (ie. P1/P2 status) should ensure that no new plants or propagules enter the State, thus preventing new immigration.

The technology for complete removal of boneseed is available, and information can be found in the *Boneseed Management Manual* (Brougham, *et al.* 2006). These materials are available on the Internet [www.weeds.org.au/WoNS/bitoubush] and from the National Boneseed Coordinator, DAFWA and DEC. Methods include:

- ✓ site planning
- ✓ manual removal (hand pulling, etc)
- ✓ herbicides
- ✓ burning
- ✓ timing (when to return, seed longevity, when to control, etc)
- ✓ revegetation
- ✓ monitoring

While several successful biological control agents exist for the closely-related bitou bush, there are currently no effective biocontrol agents for boneseed. Regardless, biological control is not a viable option for Western Australia, as boneseed infestations in the State are too small to sustain biocontrol agent populations. Eradication should be possible using chemical and physical control methods.

As mentioned above, this program will need to continue for up to 10-15 years after the last seed bearing plant is controlled. Because boneseed reproduces only by seed, eradication cannot be declared until all visible plants are controlled and no viable seeds remain. Therefore, a specific end-date for this program cannot be determined until further information is gained on seed longevity. This does not preclude eradication success however as this strategy can be adjusted as information develops.

10. Prevention and Early Detection measures

To ensure the success of this strategy, land managers should undertake prevention measures on land that is currently free of boneseed, especially when that land is suited to boneseed establishment, as is the case for most of southwest Western Australia. These prevention measures include:

- developing the ability to identify boneseed,
- reporting the occurrence of boneseed on nearby private or public land (especially on transport corridors) to DAFWA authorities, and
- undertaking control of boneseed outbreaks completely and without delay.

Early detection and awareness raising are also critical to the success of this eradication strategy. Because boneseed only occurs in a few sites in Western Australia, it is not well known nor is it readily recognised as a weed. The majority of boneseed infestations in Western Australia have been traced back to garden escapes, and boneseed plants are still being discovered in home gardens. Because awareness is low, homeowners do not recognise boneseed as a declared weed and allow it to remain in the garden, where it can easily be spread by fauna and in garden waste (several infestations in Western Australia are adjacent to tip sites).

Eradication efforts over large areas, such as this one, have a greater chance of success when all infestations are known and action to control infestations is rapid. Increasing awareness of boneseed will allow new infestations to be reported, and legislation is in place to allow swift control of newfound infestations. Boneseed was declared a P1/P2 plant in 2006 and since then efforts have increased to raise awareness in Western Australia. As part of this eradication strategy, an awareness program is proposed as outlined below.

Awareness raising plan for boneseed in Western Australia

[the person or agency responsible for each action is identified in brackets]

1. Create awareness flier and posters aimed at general audience that contain photos and identification information, summary of impacts and contacts to report boneseed. [National Coordinator]
2. Establish network of boneseed stakeholders (including community and Aboriginal groups, NRM regions, local and state government, and transport corridor stakeholders). [National Coordinator]
3. Distribute flier and other materials to all stakeholders through above network and encourage further distribution through their own and complementary networks [National Coordinator in conjunction with stakeholders]
4. Organise media coverage for boneseed (newspaper, community newsletters, radio and television) [National Coordinator and state/NRM agencies]
5. Provide information and establish website links from local council, regional NRM and other agency websites to the Boneseed WONS webpage, which contains updated information on boneseed identification and control [National Coordinator and council/NRM website managers]
6. Organise a "WA Boneseed Blitz" during the August/September boneseed flowering period each year [National Coordinator/DAFWA/relevant stakeholders]. The Blitz will be an intensive weeklong campaign designed to alert people to boneseed when it is at its most recognisable (ie. in full flower). The National Coordinator will work with state, regional and local stakeholders to organise community group events and media that will enable local groups to educate members of the general public about boneseed. The concentrated nature of the Blitz is designed to attract media attention and thus have far-reaching effects.

Increased awareness will allow efficient early detection of boneseed. As awareness increases, more boneseed is likely to be discovered. Land managers will be able to eradicate infestations early, when they are small and easy to control, and ensure any boneseed garden plants are removed before they spread to bushland.

11. Review of this boneseed eradication strategy

A review of this boneseed eradication strategy should be undertaken at least once every year during the first five years of implementation. It is important to review this strategy on an annual interval to ensure its ongoing relevance and update the strategy to include revised priorities, updated control methods and changing community needs and expectations. Most critically, future reviews should incorporate new information learned about boneseed seed longevity and strive to refine an appropriate end-date for this eradication program.

As a consequence of the annual review, new knowledge and experience can be fed back into the strategy to assist with improved planning. The review can also serve to identify gaps in the planning or implementation process that may impede the eradication of boneseed in WA. This can be achieved through surveys and discussions with stakeholders to assess the progress of their site-specific eradication programs. Once identified, these gaps can be addressed in the revised strategy.

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Appendix A (in separate Excel file)

File containing detailed information for each boneseed site in WA, including location, current status and monitoring information.

Appendix B

Monitoring data sheet templates.

1. Boneseed site monitoring
2. Boneseed control records
3. Boneseed program cost monitoring

Boneseed Site Monitoring Field Sheet – Western Australia Boneseed Eradication

Boneseed site number: ..... **Site name:** .....

Date: ..... **Observers:** .....

Person/agency responsible for monitoring:
Date of next monitoring:

Location of site:

Approx. patch size (ha): ❑<0.5 ❑0.5-1 ❑1–2 ❑>2–5 ❑>5–10 ❑>10–20 ❑>20–50 ❑>50–100 ❑>100

Mature boneseed plants # of plants _____ (try to estimate - can also provide cover class below)

Cover class (% of site): ❑0 ❑<10 ❑>10–25 ❑>25–50 ❑>50–75 ❑>75–100

Boneseed seedlings

❑ Number of seedlings in patch: ❑0 ❑1–10 ❑11–100 ❑101–200 ❑201–500 ❑501–1000 ❑>1000

or

❑ Density of seedlings per m^2 in patch: .....
(please try to provide approximate number as well)

Observations	**Comments**
❑ juvenile boneseed present	
❑ mature boneseed present	
❑ dead boneseed present	
❑ flowers present	
❑ fruits present	
❑ seeds on plants	
❑ seeds on ground	

Native plants

Native ground cover (%): ❑0 ❑<10 ❑>10–25 ❑>25–50 ❑>50–75 ❑>75–100

Native shrub cover (%): ❑0 ❑<10 ❑>10–25 ❑>25–50 ❑>50–75 ❑>75–100

Native tree cover (%): ❑0 ❑<10 ❑>10–25 ❑>25–50 ❑>50–75 ❑>75–100

Notes

Boneseed Control Record

Boneseed site number: ..... **Site name:** .....

Monitoring area: ..... Patch number: .....

Dates of control: ..... Species treated .....

Control techniques: ..... Observers: .....

Details of Herbicide (s): Other Control Methods Used:

Area treated (area must be marked on the map)

i) Area treated (m^2): .....

or

ii) Approx. area treated (m^2): ❑ <10 ❑>10–50 ❑>50–100 ❑>100–200 ❑>200–500 ❑>500–1000 ❑>1000–2000 ❑>2000–5000 ❑>5000–10 000

or

iii) Approx. area treated (ha): ❑1–2 ❑>2–5 ❑>5–10 ❑>10–20 ❑>20–50 ❑>50–100 ❑>100

Burn history of Site:

Time

Number of people involved in control: ..... Time spent controlling other weeds in this patch (hrs): .....

Time spent on boneseed control in this patch (hrs): ..... Total person hours spent on control in this patch: .....

Cost

Cost of materials used for control in this patch: $ ..... Cost of contractors used for control in this patch: $ .....

In-kind control work in this patch: $ ..... Total cost of control in this patch: $ .....

Notes

Boneseed Program Cost Monitoring

Boneseed site number: ..... **Site name:** .....

Monitoring area: ..... Patch numbers: .....

Dates of monitoring: .....

Time spent monitoring in field

Number of people: ..... Time spent (hrs): .....

$ spent on monitoring in the field

Total $: ..... Details: .....

Time spent in the office

Time spent (hrs)

i) preparing maps: .....

ii) completing data sheets: .....

iii) entering data into a computer: .....

iv) analysing results: .....

$ spent on monitoring in the office

Total $: ..... Details: .....

.....