

Current status and management of boneseed in New Zealand

Keith Briden, New Zealand Department of Conservation, PO Box 13049, Christchurch 8141, New Zealand.

Summary

Boneseed, *Chrysanthemoides monilifera* subsp. *monilifera* (L.) T.Norl., was first recorded in New Zealand in 1870. After a relatively long lag phase, it was increasingly recognized as an invasive weed during the 1990s. Boneseed is now widespread on drier east coast sites of New Zealand and is a serious threat to coastal ecosystems. It is declared an 'unwanted organism' under the *New Zealand Biosecurity Act 1993* which means it is banned from promotion, sale, propagation and distribution. New Zealand has a strategic approach to weed control and uses surveillance and a weed-led approach to find and eradicate new infestations, and a site-led approach to manage high value sites where boneseed has become a widespread weed. A range of methods are used in New Zealand to control boneseed, including manual, herbicide, mechanical, and biological control. Boneseed is an ideal weed for control by community Weedbuster¹ groups.

Spread and distribution of boneseed in New Zealand

Boneseed was first recorded in Auckland in 1870 (Webb *et al.* 1988). It is a highly invasive plant originating from South Africa and is weedy in Australia, New Zealand, France and the USA (Weiss *et al.* 2008). It appears to have had a reasonably long lag phase. Records from the Auckland Museum Herbarium and the Allan Herbarium in Christchurch show a steady increase in abundance and distribution from the 1970s to present.

The New Zealand Department of Conservation (DoC) funding for all environmental weed species has increased steadily from NZ\$1 million in 1994 to NZ\$14 million in 2006. This increase in funding has

allowed more monitoring and control of weeds like boneseed, and this has resulted in an increased awareness of the impacts of boneseed and the need for its control. Local authorities have also increased the amount of funds spent on environmental weed control in recent years. Specific weed awareness programs such as Weedbusters have been enabled by the local and central government initiatives.

Boneseed is now distributed at many sites on the east coast of New Zealand from Northland in the North Island down to the Otago Peninsula in the South Island. Infestations occur on the west coast of the North Island near Wanganui and from Wellington to the Kapiti coast (Figure 1). Boneseed has been used as an ornamental garden plant and the worst infestations are found near the main population centres such as Auckland, Wellington and Christchurch. Lesser infestations are now common around some smaller coastal settlements. Boneseed has now spread to native coastal ecosystems and is a serious threat to conservation values. Ecosystems affected by boneseed include; dune systems, rocky coastlines, cliffs, estuaries, coastal shrublands, and offshore islands. Offshore islands are particularly important to New Zealand's conservation effort because many are pest free and contain threatened fauna and flora. The closely related bitou bush (*C. monilifera* subsp. *rotundata* (DC.) T.Norl) does not occur in New Zealand.

Legislation

The *New Zealand Biosecurity Act 1993* is the main statute governing biosecurity activities. The purpose of the Biosecurity Act is to enable 'the exclusion, eradication and effective management of pests and unwanted organisms'. Boneseed is classified as an unwanted organism under the Act. This means that it is illegal to sell, propagate, distribute or promote boneseed in New Zealand.

The *Hazardous Substances and New Organisms Act 1996* (HSNO Act) enables the New Zealand Environmental Risk Management Authority to make decisions on applications for all hazardous substances and new organisms, which includes new plants and herbicides being imported into New Zealand. As boneseed is already declared an unwanted organism, this prohibits the importation of the other five subspecies of *Chrysanthemoides monilifera* into New Zealand.

The HSNO Act also governs herbicide use and registration. It requires persons applying herbicides to be approved handlers if (1) they are commercial operators, (2) the herbicide is toxic to humans, or (3) the herbicide is toxic to the environment. For boneseed, suitable herbicides are registered that are not toxic to humans or the environment. Such herbicides can be used by land managers and volunteers, like Weedbusters groups, without the need for them to become approved handlers.

Registered herbicides in New Zealand do not often carry specific label information related to controlling specific environmental weeds. HSNO legislation allows off label use of herbicides when the weed targeted is not a food crop or the herbicide used does not find its way indirectly into food. This pragmatic approach allows a range of readily available herbicides to be used at various application rates to control boneseed in New Zealand.

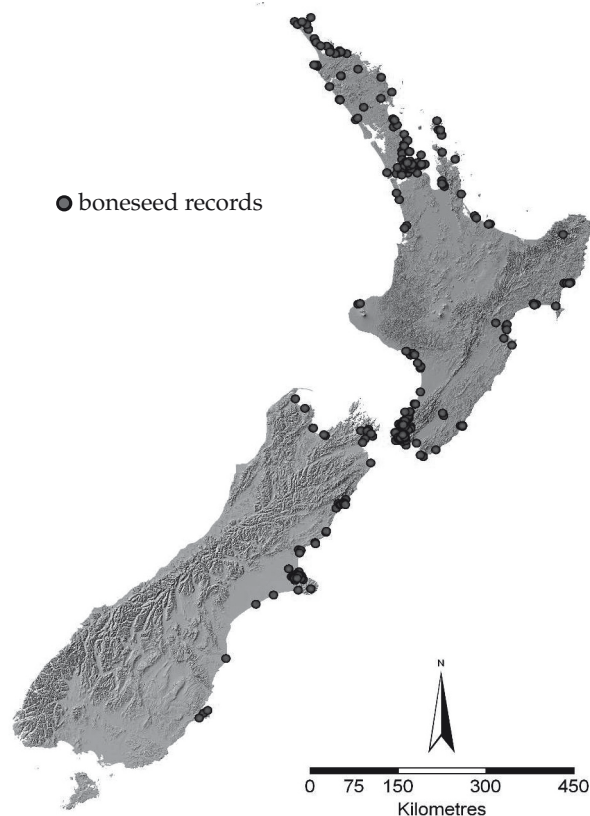


Figure 1. Distribution of boneseed (*Chrysanthemoides monilifera*) records, 2007.

Footnote

¹ Weedbusters New Zealand is a community awareness and education program modeled on the successful Australian Weedbusters initiative. www.weedbusters.org.nz provides information for the community on over 130 weed species they are likely to encounter. Information and images are provided for boneseed as well as control methods including herbicide formulations.

DoC has a legal mandate to protect natural values from environmental weeds, including boneseed. The main two pieces of legislation are the *Conservation Act 1987*, and the *National Parks Act 1980*. Regional Councils may prepare a Regional Pest Management Strategy under the *Biosecurity Act 1993*. If a weed species is included in its strategy, a Regional Council is then able to respond to that weed species within its boundaries.

Control strategies

A range of strategies are used in New Zealand to manage weed infestations including surveillance, weed-led control, site-led control, and biological control. DoC has developed a weed quality management system that includes a strategic weed policy, standard operating procedures, and a range of supporting tools to assist weed work. A quality approach to weed work enables effective and efficient use of scarce resources.

Surveillance is used to locate new infestations of boneseed in geographical areas where boneseed is not known to occur or occurs in very low numbers. Weed-led and site-led control strategies are defined in the DoC's Strategic Plan for Managing Invasive Weeds (Owen 1998). Weed-led programs aim to minimize the potential impacts of invasive weeds by managing priority weed species on land of any tenure before they become a major problem. The objective of weed-led control is to eradicate or contain new infestations. This strategy is used in parts of New Zealand where boneseed is not widespread and can be eradicated or contained. Site-led weed programs aim to protect the natural values of priority sites from weeds that are already widespread in an area. For example, boneseed is controlled at rare sand-dune systems in New Zealand to protect threatened plants and lizards.

A biological control program in New Zealand targeting boneseed is currently being undertaken by Landcare Research. The first biocontrol agent trialled is the boneseed leaf roller moth (*Tortrix* s.l. sp. *chrysanthemoides*). It was released in 2007 at Waiheke Island near Auckland and there are plans for additional releases of the leaf roller moth in 2008. Landcare Research is optimistic the boneseed leaf roller moth will have a greater chance to establish in New Zealand than it has in Australia because there is less likelihood of ant predation on the caterpillar stage (L. Hayes personal communication). Work on a second agent, a rust fungus *Endophyllum osteospermi* (Doidge) comb. nov., is also in progress.

Control methods

The main methods used to control boneseed in New Zealand are manual, chemi-

cal, and mechanical. In many instances, combinations of these methods are used. Once a site is cleared of boneseed, restoration and planting with native species can be carried out to reduce boneseed reinvasion. This paper covers a sample of best practice control methods, including those suitable for volunteer Weedbusters.

In New Zealand, manual control involves pulling boneseed seedlings and small plants by hand. Herbicides are used where a seed bank has established and high numbers of seedlings make manual control time consuming and expensive. In a Christchurch study, an area of 25 year old boneseed was cleared, opening up a site that had a considerable seed bank. After autumn rains, seedlings germinated at rates of up to 720 seedlings m⁻². The herbicide glyphosate 360 g L⁻¹ was applied at 10 mL L⁻¹ of water. This resulted in 100% control of boneseed seedlings, as well as 100% kill of all grasses. Use of the selective herbicide clopyralid 300 g L⁻¹ applied at 5 mL L⁻¹ of water also resulted in 100% control of boneseed seedlings, while retaining or improving the grass cover (Briden and Popay 2004).

Once boneseed plants are too large to be hand-pulled they are cut at ground level using a pruning saw. In New Zealand boneseed often recovers with multiple stems coppicing from the cut stump. To avoid this a herbicide must be applied to the cut stump immediately after cutting. Two suitable herbicide methods are (1) apply a 10% solution of glyphosate 360 g L⁻¹ to the cut stump, or (2) apply a gel herbicide containing picloram at 50 g kg⁻¹ (e.g. 'Vigilant® Gel'). Herbicide gels are easy to apply and can be used by volunteers in New Zealand without requiring approved handler certification.

Mature boneseed plants are also foliar sprayed with a range of herbicides. A suitable formulation using knapsack sprayers is to apply glyphosate 360 g L⁻¹ solution at 5 mL L⁻¹ of water when thorough coverage of foliage is possible, or 10 mL L⁻¹ of water where thorough coverage is not possible. Herbicides are also applied by approved handlers using motorized spray units and by aerial application using helicopters. Abseiling has also been used to gain access for herbicide control of boneseed at sites containing boneseed on cliff edges.

Mechanical shredding has recently been trialled by the Christchurch City Council in sand dunes north of Christchurch city (R. Chambers personal communication). A mobile mulcher was mounted on a small 'Positrack' machine with low impact rubber tracks. The machine moved through the undulating dune terrain with ease and caused minimal environmental impact. It was able to cut down and mulch entire boneseed plants, some of which were 3–4 metres in height.

Grazing can be used to suppress boneseed, but if stock is removed boneseed can rapidly recover. Stock movement may also aid the spread of weed seeds via sheep wool. A New Zealand study showed sheep were able to spread broom (*Cytisus scoparius* (L.) Link) seeds to new sites because the seeds had become entangled in their wool (Ledgard 2003).

Community control of boneseed

Boneseed is an ideal weed for the community to control. This is supported by the following observations made by the author, who has been controlling boneseed on a coastal headland near Christchurch since 2001;

1. Boneseed invades coastal sites that are often highly valued by the community, thus inspiring control actions,
2. Infestations often occur near population centres close to where potential volunteers live,
3. Boneseed is easy to control (seedlings and small plants can easily be hand pulled),
4. Boneseed usually has a single stem which is easy to cut and apply herbicide to,
5. Common and safe herbicides can be used to treat cut stems or spray mature plants without the need for volunteers to obtain approved handlers' certification,
6. Boneseed does not have prickles or spines and is non toxic,
7. In New Zealand there are no snakes or biting ants to deter volunteers,
8. Few New Zealand native plants have conspicuous yellow flowers which makes boneseed easy to find and identify as a weed,
9. Government agencies support community control of boneseed by providing funding, herbicides and tools,
10. Weedbusters' can see the results of their work because large areas can be quickly controlled and,
11. The effort required can decrease over time. Most effort is required in the first 1–3 years with initial boneseed removal and dealing with new seedlings. After 5–6 years of control, the seed bank is much reduced and ongoing maintenance takes little effort.

Summary

Boneseed is a weed that can be easily controlled to prevent impacts on biodiversity. Control programs will require; legislation, a strategic approach, raised awareness, knowledge sharing, funding, and interagency and community coordination.

References

- Briden, K.W. and Popay, A.I. (2004). Using clopyralid for controlling boneseed (*Chrysanthemoides monilifera*) seedlings. *New Zealand Plant Protection* 57, 337.

Ledgard, N. (2003). Gorse and broom dispersal: how to mitigate unwanted future spread. 'Weed ecology exposed' seminar. (Canterbury Agriculture and Science Centre, Lincoln NZ).

Owen, S.J. (1998) Department of Conservation strategic plan for managing

invasive weeds. (Department of Conservation, Wellington).

Webb, C.J., Sykes, W.R. and Garnock-Jones, P.J. (1998). Flora of New Zealand Volume IV. Naturalised pteridophytes, gymnosperms, dicotyledons. (Botany Division, Department of Scientific and

Industrial Research, Christchurch).

Weiss, P.W., Adair, R.J., Edwards, P.B., Winkler, M.A. and Downey, P.O. (2008). *Chrysanthemoides monilifera* subsp. *monilifera* (L.) T.Norl. and subsp. *rotundata* (DC.) T.Norl. *Plant Protection Quarterly* 23, 3-14.

Future directions for bitou bush and boneseed management in Australia

Paul O. Downey^A, Hillary Cherry^A, Andrew Crane^B, Dennis Gannaway^C, Margaret MacDonald^D, Clyde McGaw^E, Tom Morley^F, David Roberts^G, Bruce Thom^H, Peter Tucker^I and Ian Turnbull^J

^A Pest Management Unit, Parks and Wildlife Group, Department of Environment and Climate Change, PO Box 1967, Hurstville, New South Wales 1481, Australia.

^B Department of Primary Industries and Water, 134 Macquarie Street, Hobart, Tasmania 7000, Australia.

^C Department of Water, Land and Biodiversity Conservation, GPO Box 2834, Adelaide, South Australia 5064, Australia.

^D Anglesea and Aireys Inlets Society for the protection of flora and fauna (ANGAIR Inc.), PO Box 12, Anglesea, Victoria 3230, Australia.

^E Biosecurity Queensland, PO Box 864, Ipswich, Queensland 4305, Australia.

^F Department of Primary Industries, PO Box 48, Frankston, Victoria 3199, Australia.

^G You Yangs Regional Park, Parks Victoria, Branch Road, Lara, Victoria 3212, Australia.

^H University of Sydney, New South Wales 2006, Australia.

^I Trees for Life, 5 May Terrace, Brooklyn Park, South Australia 5032, Australia.

^J Bellingen Shire Council, PO Box 117, Bellingen, New South Wales 2454, Australia.

In August 2007, a national bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata* (DC.) T.Norl.) and boneseed (subsp. *monilifera* (L.) T.Norl.) forum was held in Geelong, Victoria, as part of the bitou bush and boneseed Weeds of National Significance (WoNS) program. The forum summarized the latest research and management of these two weeds. Approximately 70 people from throughout southern Australia and New Zealand attended the forum. Participants included community members, government agency staff, students, scientists, private contractors and non-government organization representatives. In addition to the forum talks and posters (also presented in this journal edition), a facilitated session was held to establish the future directions of the bitou bush and boneseed WoNS program in Australia.

Two national bitou bush and boneseed forums were held previously, with the last one being a decade ago (see Love and Dyason 1985, Holtkamp *et al.* 1997). In the intervening period, a significant amount of information has been published or collated, particularly for bitou bush. This is reflected in the recent revision to the Biology of Australian Weeds paper (see Weiss *et al.* 2008 – this edition). The WoNS program, supported by Australian Government funds, has assisted with the production of a large amount of this information, in part through the appointment of a dedicated bitou bush and boneseed coordinator and a national education and awareness campaign (see Holland Clift *et al.* 2006). Also, the increased understanding of both weeds has shown that the subspecies differ in ecological niches, distribution, impact and management techniques, and this has reinforced the need to separate

management and research efforts for each subspecies.

Here we present a summary of the outcomes of the facilitated forum session aimed at establishing future directions of the national bitou bush and boneseed WoNS program. The forum participants were asked to list the: (i) key management issues for bitou bush and boneseed and (ii) main areas where they would like to see action in the future.

(i) *Key issues.* There were eight key points as determined by forum participants being (in no order of priority), participants:

1. were impressed by the large number of people and organizations involved in the management of bitou bush and boneseed in Australia;
2. realized that individuals are not working alone and there is a well-established network to tap into;



Australian Government

Defeating the Weed Menace

**National
BITOU BUSH & BONESEED
management group**