

PAYING THE PRICE OF GARDEN ESCAPES

A snapshot of the work of bush regenerators and the weeds they encounter in Eastern Australia
August 2007

A report by the Australian Association of Bush Regenerators



Paying the Price of Garden Escapes: a snapshot of the work of bush regenerators and the weeds they encounter in areas of Eastern Australia

This paper draws on the results of a questionnaire-based study undertaken by AABR NSW during the fourth quarter of 2006. An unpublished detailed report of the study together with associated data files is archived by AABR NSW in CD ROM format (AABR NSW Archive 31 July 07). John Sands assisted AABR NSW in data compilation, desktop research and project reporting for the questionnaire-based study.

Access to some of the filed archived material is restricted for privacy reasons and as it may include commercially sensitive bush regeneration industry data.

The bulk of the work involved in the questionnaire -based study was undertaken by AABR NSW members and associates on a voluntary basis. WWF provided limited funding together with additional research and project management support.

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Cover image: Volunteers working in the Blue Mountains to remove Scotch broom, Himalayan honeysuckle and blackberry, which are invading *Epacris hamiltonii* (threatened species) habitat. These weeds have moved down from residential areas into bushland reserves and National Park areas that are regenerating post fire.

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Summary

This report by the Australian Association of Bush Regenerators (AABR NSW) aims to bring the issue of weeds that escape from gardens into public focus, from the perspective of practical bush regenerators that deal with weeds in their day-to-day work of restoring degraded natural areas to healthy, biodiverse and sustainable ecosystems.

This study provides a snapshot of the scale of the bush regeneration workforce in selected regions of eastern Australia, identifies the dominant weeds that they encounter and how they have changed over time. The study was conducted through questionnaires with bush regeneration workers.

The report found that the total labour value of bush regeneration work in the areas studied was \$18 million per year, 71 per cent of which is paid work. Of the total workforce of about 6,700 people (90 per cent) were volunteers. The total labour effort amounted to over half a million hours.

The bush regeneration workers identified a range of weedy garden plant species that were a problem in the study areas. Two groupings of plants stood out as being major weed problems – several members of the daisy family and plants with fruits such as asparagus ferns, murraya, sheena's gold (*Duranta erecta*) and olives. Madeira vine and asparagus ferns were reported as requiring the most time and effort to remove.

While many of the problem plants were reported as having first been observed in the study areas in the 1960s, even the weeds that emerged at this time were often reported as having emerged in later decades in other areas – including very recently. The fact that they are gradually spreading indicates that the control of declared weeds is not proving effective. In addition, many new problem garden plant species were reported as having recently arrived in the study areas. Furthermore it was found that while some of the species have been declared as noxious weeds in parts of NSW, many have not, and can still be legally sold as garden plants in NSW. It is evident from this study that the trend of garden plants becoming invasive species continues despite growing awareness of the problem.

The results are discussed within the wider context of the purpose and methodology of bush regeneration and the limitations and needs of the bush regeneration workforce.

AABR NSW makes a number of recommendations aimed at reducing the stream of garden escapes invading natural areas. Priorities include stronger legal requirements to prevent the importation, propagation and sale of potential garden escapes as well as better enforcement. Closer ties between stakeholders – including land management authorities, bush regenerators, weed scientists and the nursery industry – could produce cooperative bush-friendly garden projects that build on the efforts of the Nursery and Garden Industry Association's 'Grow Me Instead' promotional campaign.

The battle to reduce the impact of garden escapes will remain on the ground for decades to come. AABR NSW also makes recommendations in relation to providing quality training in on-ground vegetation management to all levels of personnel involved in management of degrading natural areas to ensure that all bush regeneration efforts contribute to positive and sustainable results.

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1. Introduction

The evolving practice of bush regeneration can be defined as “an ecological technique practised in Australia to restore remnant bushland ecological communities that have been invaded by weeds” (Wikipedia, 2006). More recently the term ‘assisted natural regeneration’ is being used to describe this technique as applied to a wide range of ecological communities.

The origin of bush regeneration is generally traced to the Bradley sisters who developed a technique to restore remnants of bushland in suburban Sydney in the 1960s because they observed that traditional methods of controlling weeds were not effective (Buchanan, 1989). Since the 1960s bush regeneration techniques and practices have been evolving in response to the different environments in which restoration work is increasingly being undertaken both around Australia and internationally.

The aim of bush regeneration is to stimulate and strengthen the natural resilience of local native vegetation to inhibit weed invasion and so restore the natural vegetation community of the area (Buchanan, 1989, Jack, 2007, and AABR site: (<http://www.aabr.org.au>)). Resilience of native vegetation exists as seed in the soil and on plants, and as vegetation stored as rootstocks.

Regeneration of the local native vegetation may be stimulated by:

- increased light through the removal of competing weeds
- fire
- deep ripping
- protection from stormwater, nutrients, grazing animals and other impacts

Planting (from locally-sourced native plants) is generally only necessary where the original soil profile has been destroyed. Regeneration requires a strategic approach that is based on ecological principles such as pollination and seed dispersal mechanisms, and habitat requirements of native fauna (including recognition of the habitat value of weeds). Skill in identification of local native species and weeds is essential. Bush regeneration now relies on extensive use of herbicides. This increases the importance of workers who are skilled in recognition of native plants and resilience indicators so as to avoid harm to remnant bushland.

Successful outcomes require a long-term approach to achieve a relatively self-sustaining, low-maintenance ecological community.

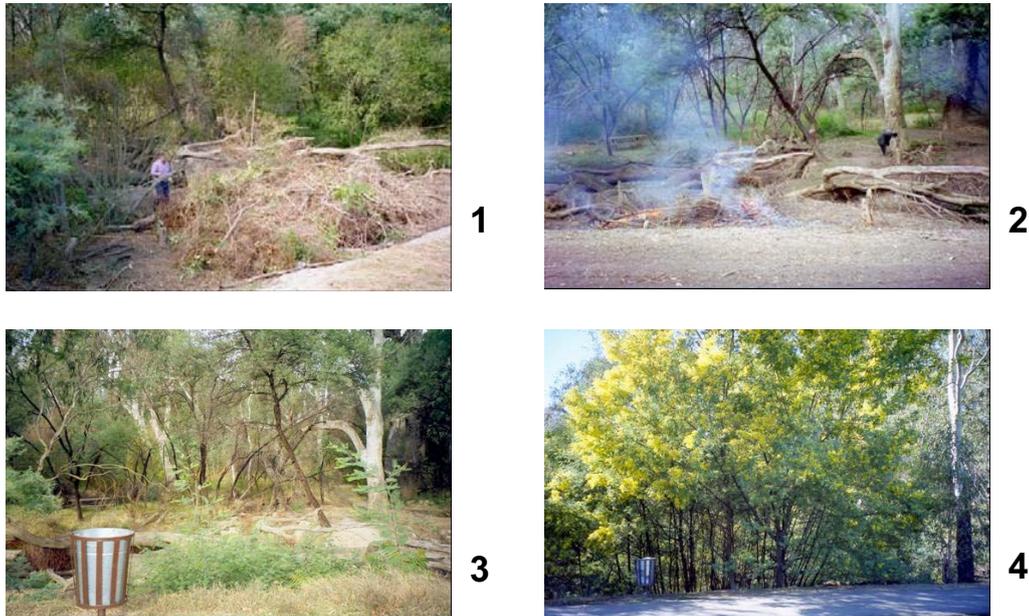


Plate 1: Series of photos of same view at Kaluna Park bush regeneration project to restore Sedgely Riverine Forest, an endangered ecological community containing river red gums near Wangaratta in north east Victoria.

- 1. April 1997, clearing hawthorns, privets and honeysuckle**
- 2. June 1997, burning debris to stimulate regeneration**
- 3. March 1998, regeneration of silver wattles (*Acacia dealbata*) -and garbage bin!**
- 4. August 2001, flowering of *Acacia dealbata***
(Photos: Helen Curtis)

1.1. The bush regeneration workforce

As with many innovative practices, bush regeneration grew slowly at first and was unpaid. In the last 30 years it has gathered recognition through tertiary courses, which have been introduced to train bush regenerators. Now it is an important and expanding industry with many private companies, cooperatives and local government bush regenerators working on public and private land. However, the volunteer contribution, working under supervised government programs such as *Bushcare*, and *Landcare*, and non-government organisations such as Conservation Volunteers Australia still forms a substantial part of the current workforce.

Contractors commonly undertake work outsourced by local government and other bodies, including projects funded through grants such as the Federal Government's Natural Heritage Envirofund. This work usually involves overall project management as well as supervision, briefing and training of volunteer

workers, including implementing appropriate occupational health and safety measures.

Qualifications in bush regeneration were originally acquired through a course provided by the National Trust and later through tertiary institutions, especially Technical and Further Education Training Colleges (TAFE). Now bush regeneration qualifications are attained through the nationally accredited Conservation and Land Management (Natural Area Restoration) Training Package.



Plate 2: Private bush regeneration trainer conducting a weed identification course with Community Development Employment Program and National Parks and Wildlife Service employees, Arakwal Community, Byron Bay, NSW, 2006.

(Photo: Mark Evans)

1.2. The Australian Association of Bush Regenerators: establishing good practice

With the growing interest in this new land management practice, a group of bush regeneration devotees formed the Australian Association of Bush Regenerators

(AABR NSW) in 1986. AABR aims to foster the application of sound ecological practices of bushland management by qualified people and to promote the study and practice of bush regeneration (AABR 2006a). AABR Far North Coast & South East Queensland was established a few years ago as a sub-group of AABR NSW. AABR WA is a sister organisation in Western Australia. It is hoped that further groups will establish throughout Australia as the industry grows.



Plate 3: Teaching a volunteer how to poison lantana using the stem frill technique in Ku-ring-gai Flying-fox Reserve, Sydney

(Photo: Nancy Pallin)

In eastern Australia where this study has focused, a large proportion of bush regeneration contractors are members of AABR. In a review undertaken in 2006, 19 bush regeneration contractors were registered with AABR in eastern Australia. Of these, the average number of staff employed by each contractor was 19 with a maximum of 64 and a minimum of two (AABR 2006c). 14 of the 19 contractors were small businesses (defined as businesses with fewer than 20 employees) and 5 were medium sized businesses (employing between 20 and 200 people) (ABS 2001).

1.3. The impact of garden escapes on bushland

Australia's 2006 State of the Environment Report identified weeds as Australia's second greatest threat to biodiversity after land-clearing. The State of the Environment Report defines weeds or invasive plants as:

“a plant species spreading beyond its accepted normal distribution as a result of human activities and which threatens valued environmental, agricultural or personal resources by the damage it causes.”

(Beeton et. al. 2006, p.122)

Weeds damage native ecosystems by competing with native species for space, light, and water as well as hybridising with them. Weeds can also change ecosystems by altering hydrology, fire regimes, nutrient cycling, fauna diversity and other ecosystem processes. Many native species, as well as entire ecosystems, have been irretrievably lost to weed invasions. Chemicals used to manage weeds can further degrade ecosystems (Wittenberg and Cock 2001). Weeds are also a severe threat to agricultural industries costing Australian farmers \$4 billion a year with \$1 in every \$7 of farm income lost to invasive weeds (Sinden et. al., 2004).

About 70 per cent of Australia's agricultural and environmental weeds are escaped invasive garden plants (Virtue et. al. 2004). Studies suggest that introduced garden plants will comprise an even greater portion of future naturalised species (Groves et. al., 2005).

In the report, *Impact of Weeds on Threatened Biodiversity in New South Wales*, the CRC for Australian Weed Management found that weeds threaten 341 NSW plant and animal species that are already declared as vulnerable or threatened species under NSW legislation. The report found that of the 127 weed species that directly threaten NSW biodiversity, 82 (65 per cent) were introduced to Australia for cultivation as garden plants and 56 (44 per cent) are still available for sale in Australia (Coutts-Smith and Downey 2006).

1.4. Study aim and objectives

AABR NSW's study is built upon the recognition that weeds are a large and growing threat to predominantly native vegetation communities. Global movement of species and worldwide commerce in plants, including their marketing, has increasingly accelerated since European settlement in Australia, accentuating the impact of weeds on natural areas.

This report provides a snapshot of the scale of the bush regeneration workforce in 2005 in parts of eastern Australia through questionnaires with AABR NSW-identified respondents who have provided data on industry practice in their geographic area. The study areas range across a variety of vegetation associations: sclerophyll, rainforest, riparian, wetland, grassland, arid and other ecosystems.

It is hoped that the availability of data assembled through this exploratory study will lead to a better understanding of the magnitude and composition of the current workforce, better protection of Australia's biodiversity from garden escapes and increased supply of an appropriately trained bush regeneration workforce to match the scale of the problem of degrading environments at national, state and local levels.

The objectives of the snapshot study are:

1. To quantify the bush regeneration workforce operating in the study areas in terms of number of people, hours worked, cost of work and the proportion of the workforce that is voluntary.
2. To document the garden escape weeds encountered in the study areas by bush regenerators and, where possible, to qualify the level of labour/effort involved in controlling weeds and the decades in which they emerged.

2. Methods

Thirty AABR NSW-nominated experts throughout Australia, from Perth to Lord Howe Island were asked to contribute to the study through a questionnaire. The nominees were people that were recognised as having a current working knowledge of the industry and the weed situation in their work areas. Eighteen of those nominated agreed to contribute. These respondents were employed by government, non-government and private sectors to perform on-ground bush regeneration work. Some performed managerial, supervisory or operational functions while others provided education and training for natural restoration and land management. Each respondent represented a discrete work area, which was either a local government area (LGA), a grouping of LGAs, or National Park service area. These study areas were concentrated along the NSW coast but included other areas in NSW and in Queensland and Victoria.

A list of the respondents and their localities that contributed to the project is in Appendix 1.

The respondents completed a questionnaire that requested information on the following points:

- Estimate the scale of voluntary and paid workforce engaged in bush regeneration in 2005 for the respondent's area.
- Identify and classify weeds encountered in the respondent's area on the basis of the time and effort taken to control them.
- Note the decade in which the weeds were first seen in the area by local bush regenerators.

The questionnaire is in Appendix 2.

Data obtained from the 18 respondents were analysed and aggregated into 9 study areas:

- Murray-Darling Basin, NSW & VIC
- Far South Coast, NSW
- Illawarra, NSW
- Sydney Basin, NSW
- Central Coast, NSW
- Hunter-Central Rivers, NSW
- North Coast, NSW
- Metropolitan South East, QLD
- Sunshine Coast, QLD

3. Findings

3.1. The bush regeneration workforce

The estimates gathered from bush regenerators from the nine different study areas are summarised in Table 1. These results indicate that in 2005 the combined workforce of paid and unpaid workers in the study areas came to nearly 6,700 people of which 6,000 or 90 per cent were volunteers. However based on total hours worked the trend was reversed – approximately 55 per cent of the nearly 540,000 hours worked was carried out by paid workers and 45 per cent by volunteers.

From data provided by respondents it was estimated that the overall paid and volunteer value of the bush regeneration work carried out in the study areas in 2005 was approximately \$18 million of which 72 per cent was for paid work (\$12.9 million) and 28 per cent was for volunteer work (valued by the respondents at \$5.1 million). Each volunteer worked an average of about 40 hours during 2005 but this average rose to 65 hours in the municipality-based areas which commonly have council bushcare programs that organise regular weekly or monthly work sessions.



Plate 4: Volunteers and Council staff together regenerating the understorey of Sydney Turpentine Ironbark Forest, a critically endangered ecological community at Killara Park, Sydney

(Photo: Nancy Pallin)

Table 1: Workforce estimates for 2005 in study areas

Region in which study area(s) located (Number of LGAs¹ covered by region)	Approx. population of region	Total bush regen. Workforce (No. people)	Paid hours	Unpaid hours	Total hours	% paid hours
Murray Darling Basin, NSW and Vic (3 LGAs)	121,000	39	0	1,353	1,353	0
Far South Coast, NSW (2 LGAs)	68,000	47	270	6,500	6,770	4
Illawarra, NSW (1 LGA)	280,000	150	6,250	20,000	26,250	23
Sydney Basin, NSW (4 LGAs)	719,000	1,694	38,050	31,400	69,450	55
Central Coast, NSW (1 LGA)	180,000	540	10,800	17,000	27,800	39
Hunter Central Rivers, NSW	na ²	70	500	850	1,350	37
North Coast, NSW (8 LGAs)	300,000	1,023	99,000	40,000	139,000	71
Metropolitan South East, Queensland (1 SD)	1,800,000	2,600	40,000	27,000	67,000	60
Sunshine Coast, Queensland (4 LGAs)	580,000	500	100,000	100,000	200,000	50
Total	4 million	6,663³	294,870	244,103	538,973	55

Notes:

1. Local Government Area (LGA)
2. sampled area is land managed by the National Parks and Wildlife Service
3. includes 6000 volunteers (90 per cent of workforce)

3.2. Weeds encountered in regeneration areas

The respondents identified 171 garden escape weeds that they encounter within their work areas (located within the nine study areas listed in Table 1). The respondents also identified which of these weeds occupy the most time and effort to control and, if known, when the weed was first noticed in the areas of bush in which they work. The list of all weeds identified along with their rankings and decade of emergence (where known) can be found in Appendix 3. The respondents were also asked to estimate the proportion of weeds identified as garden escapes as opposed to weeds that originated from other sources such as agriculture. It is important to note that the questionnaire assumed that the respondents were able to correctly identify the weeds and differentiate between weeds that were garden plants from weeds of a different origin.

Figure 1 shows that 13 of the 16 respondents estimated that 50-100 per cent of the weeds that they encounter in their bush regeneration areas were garden escapes. The highest percentage was reported in the Far South Coast of NSW, where the respondent estimated that 90 to 100 per cent of weeds dealt with were garden escapes.

The three lowest proportions of garden escapes were found in the Sydney Basin, the Central Coast, and the Hunter Central Rivers. The low proportion estimated by one respondent in the Sydney Basin appears unusually low as the other four respondents within the same area estimated that more than 50 per cent of weeds encountered were garden escapes. It should be noted that the respondent from the Hunter Central Rivers was reporting on land managed by the National Parks and Wildlife Service (NPWS), which was a combination of forested and rural areas rather than the other study areas that were either urban or peri-urban land.

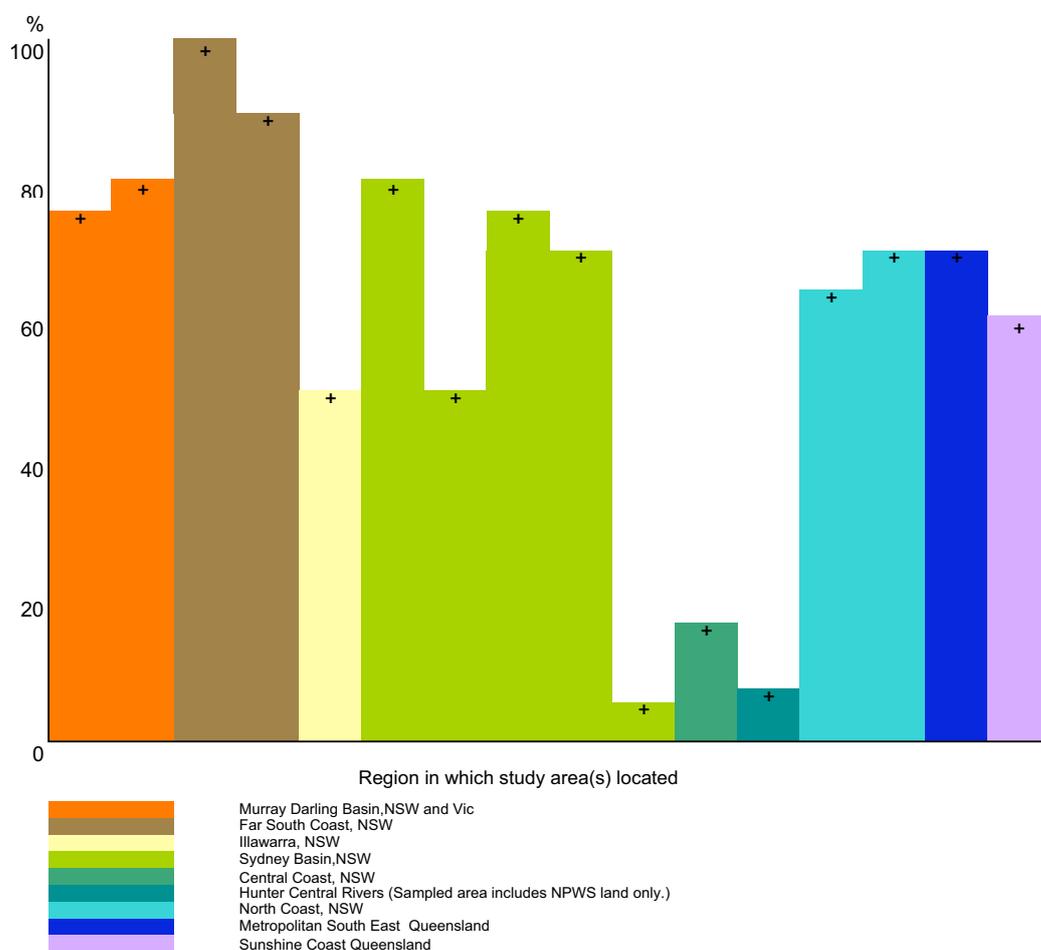


Figure 1: Estimates of proportion of weeds dealt with in on-site bush regeneration that are garden escapes

Table 2 lists the garden escape weeds that were identified by the respondents as requiring the most time and effort to control in their respective areas. Vines stand out as the main problem, identified in five of the 10 cases with madeira vine (*Anredera cordifolia*) being specifically named in three of the cases. Species of asparagus (*Asparagus* spp.) are identified as requiring most time and effort in two cases - on the Central Coast and Far North Coast of NSW. One of the main characteristics of madeira vine and asparagus that make them difficult to remove and control is that they both have persistent underground organs (these take the form of rhizomes in the case of asparagus and tubers in madeira vine). The effective removal of madeira vine is further complicated by the plant's abundant aerial tubers.

Three area-specific garden escapes were also identified as being high maintenance: the shrubs African boxthorn (*Lycium ferocissimum*) in the Central West region of NSW, broom (*Genista* spp.) in the Albury-Wodonga region and the grass kikuyu (*Pennisetum clandestinum*) on the Far South Coast of NSW.

Area	Weed
Central West, NSW	African boxthorn (<i>Lycium ferocissimum</i>)
Albury-Wodonga region NSW and Vic	Broom (<i>Genista</i> spp)
Far South Coast, NSW	Kikuyu grass (<i>Pennisetum clandestinum</i>)
Illawarra, NSW	Japanese honeysuckle (<i>Lonicera japonica</i>)
Outer Western Sydney, NSW	"Weed vines" various species
Coastal Sydney, NSW Metropolitan South East QLD Sunshine Coast, QLD	Madeira vine (<i>Anredera cordifolia</i>)
Central Coast, NSW	Asparagus ferns (<i>Asparagus</i> spp)
Far North Coast NSW	Ground asparagus (<i>Asparagus aethiopicus</i>)

Table 2: Weeds ranked as requiring most time and effort to control in different areas

Table 3 lists species which seemed to have appeared in certain bushland areas in a specific decade. Overall there is an indication that new weeds have emerged since the 1960s and that established weeds have spread from the areas in which they first appeared.

For example, the *Asteraceae* family, which includes many species of daisy, appears four times in Table 3. In the 1980s, bush regenerators encountered Singapore daisies (*Wedelia trilobata*) in the Far North Coast of NSW and Brisbane areas. The seaside daisy (*Erigeron karvinskianus*) was found in Sutherland bush areas in the 1990s and has newly arrived in both the Far South Coast of NSW and North Shore region of Sydney. Bush regenerators have also recently encountered the South African beach daisy (*Arctotheca populifolia*) as a new arrival in bush areas in the Far South Coast of NSW.

Species of asparagus appear to have emerged in three different decades. Respondents consider it to have emerged in the 1960s on the Far North Coast of NSW and Brisbane, in the 1970s within the Sutherland area of the Sydney Basin and in the 1990s on the Central Coast. Sheena's gold (*Duranta erecta*) was observed to emerge in the 1970s in Brisbane areas and is considered to have 'newly arrived' in the Sutherland area of the Sydney Basin. Orange jessamine (*Murraya paniculata*) was reported as emerging in the 1990s on the Far North Coast of NSW, in the 2000s in Brisbane and surrounding shires and as 'newly arrived' in Sutherland and the North Shore of Sydney.

Respondents recorded olives (*Olea europaea*) as an emerging weed problem in the 2000s within the Albury-Wodonga region, and the New Zealand cabbage tree (*Cordyline australis*) was reported as a 'newly arrived' weed on the Far South Coast of NSW.

One native plant was listed by two respondents as an emerging garden escape since the 1990s: bluebell creeper (*Sollya heterophylla*), which is originally from Western Australia, emerged as a problematic weed during the 1990s in Sutherland and a 'newly arrived' weed on the Far South Coast of NSW.

Plant species & common name¹	Work area(s) of respondent(s)	Decade of emergence
<i>Asparagus africanus</i> Climbing asparagus	Far North Coast, NSW Brisbane & surrounding shires, Qld	1960s 1960s
<i>Asparagus</i> spp Asparagus fern	Sutherland, NSW Gosford, NSW	1970s 1990s
<i>Arctitheca populifolia</i> South African beach daisy	Far South Coast, NSW	Newly arrived
<i>Cordyline australis</i> New Zealand cabbage tree	Far South Coast, NSW	Newly arrived
<i>Duranta</i> spp Duranta, Sheena's gold	Brisbane & surrounding shires, Qld Sutherland, NSW	1970s Newly arrived
<i>Erigeron karvinskianus</i> Seaside daisy	Sutherland, NSW Sydney, North Shore, NSW	1990s Newly arrived
<i>Lonicera japonica</i> Japanese honeysuckle	Central Coast, NSW	1960s
<i>Murraya exotica</i> Murraya	Far North Coast, NSW Brisbane & surrounding shires, Qld	1990s 2000s
<i>Murraya paniculata</i> Orange jessamine	Far North Coast, NSW Sutherland, Sydney, North Shore, NSW	1990s Newly arrived
<i>Olea europaea</i> Olives	Albury-Wodonga region	2000s
<i>Sollya heterophylla</i> Blue-bell creeper	Sutherland, NSW Far South Coast NSW	1990s Newly arrived
<i>Wedelia trilobata</i> Singapore daisy	Far North Coast, NSW Brisbane & surrounding shires, Qld	1980s 1980s

Notes:

1. The species names were provided by AABR interviewees.

Appendix 3 combines information for each area on all weed species listed, ranking weeds by effort needed to control them and their decade of emergence.

Table 3: Weeds identified as having emerged in bush regeneration areas in different decades

Case Study: Garden escape history in the making: MURRAYA

Names: *Murraya exotica*, *Murraya paniculata* (orange jasmine, murraya, Chinese box, orange jessamine), *Murraya paniculata* cv. *exotica*, *Murraya paniculata* (seeding form)

Origin: South and east Asia through to New Caledonia and Australia; probably domesticated in China.

1747 “*Murraya exotica*’ a form with rather small leathery leaflets ... was the cultivated *Camunium japonense* of Rumphius’s *Herbarium amboinense* (5:t. 18 f. 2, 1747)” (Mabberley, 1998). It was also a common garden plant in early colonial India.

1883 Recorded as *Murraya exotica* by Ferguson & Son, Double Bay, in their leading Sydney nursery catalogue. Described: “this beautiful plant forms a compact bush, and produces great numbers of orange-scented flowers; it requires a sheltered position.”

1990s Orange jessamine; first encountered in work of bush regenerators in NSW Far North Coast.

2000s *Murraya exotica*; first encountered in work of bush regenerators in metropolitan south east Qld.

2006 *Murraya exotica*; newly encountered in work of bush regenerators in Sutherland, NSW, area.

Murraya in its various forms has proved to be a versatile ornamental garden plant. In eastern Australia in recent years with a move back to compact formal gardens, it is again serving current landscaping needs and lifestyle fashions. Murraya has served a variety of other human functions over its long history. It has been used as a budding stock for citrus; a living fence or hedge capable of being clipped to meet functional architectural purposes and as an ornamental shrub or small tree.

However as reported by local bush regenerators in our study, it is also a serious invader of natural areas. It has been reported to have invaded the littoral rainforest habitat of the extremely rare, coastal fontainea (*Fontainea oraria*) that is restricted to a small number of trees at Lennox Head in north-east NSW.

<http://threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10334>



Photo: Weeds CRC website

3.3. Current legal status of weeds encountered in bush regeneration areas

The Act that governs weed management in NSW is the *Noxious Weeds Act* 1993. Table 4 indicates the legal status in NSW of the weeds that were identified by the respondents as requiring the most time and effort to control (Table 2). It is interesting to note that none of the weeds are banned across the entire state, which means that they can still be legally sold and planted in areas outside the local control areas (LCAs) for which the weeds have been declared as noxious. Considering the issues of garden dumping and low public awareness about weeds, it seems likely that there is a high risk that these weeds could spread from the areas where they are permitted into the areas where they are declared as a noxious weed. Furthermore nearly half of the species that were identified had no legal status under the Act, hence can be sold and planted throughout the state.

Weed	Legal Status in NSW*
<i>Anredera cordifolia</i> (madeira vine)	Declared as a noxious weed in 14 LCAs in NSW**.
<i>Asparagus aethiopicus</i> (ground asparagus)	Declared as a noxious weed in 14 LCAs in NSW.
<i>Asparagus</i> spp (asparagus ferns)	Respondents could be referring to any of 5 species of asparagus*** 2 of the 5 species are declared weeds in around 14 LCAs each. 3 of the species have no legal status in NSW.
<i>Genista</i> spp (broom)	There are 90 species of <i>Genista</i> , one of the most common <i>Genista monspessulana</i> is declared as a noxious weed in 12 LCAs.
<i>Lonicera japonica</i> (Japanese honeysuckle)	No legal status
<i>Lycium ferocissimum</i> (African boxthorn)	Declared as a noxious weed in 85 LCAs in NSW.
<i>Pennisetum clandestinum</i> (kikuyu grass)	No legal status

Notes:

* Legal information source: Australian Weeds Committee 2004 and 2006

** There are 128 Local Control Areas (LCAs) in NSW

*** *Asparagus aethiopicus*, *Asparagus africanus*, *Asparagus densiflorus*, *Asparagus scandens*, *Asparagus setaceus* are all invasive species of the same genus that are often referred to as asparagus fern and are found in NSW.

Table 4: Current legal status in NSW of the “high-maintenance” weeds identified by bush regenerators in Table 2

4. Discussion

4.1. The bush regeneration workforce

To borrow from the title of Robin Buchanan's (Buchanan 1989) seminal book, the business of "recovering Australian landscapes" is happening everywhere from pocket-handkerchief patches of remnant endangered ecological communities surrounded by suburbia to wide scale linkages of natural areas across the continent.

This study can only provide a glimpse of the overall picture of this effort but gives an indication of the bush regeneration work that is being carried out to varying extents all over Australia. In addition to the bush regeneration efforts are multiple efforts being put into the management of fauna, fire, pest species, and water, as well as numerous considerations of the threats imposed on natural areas by climate change.

Until the last 20 years, bush regeneration was purely voluntary, undertaken by people who were passionate about the bush. This same passion still exists but now more and more people are making it a career, learning the practical skills and gaining that vital hands-on experience which they can bring to the decision-making positions of land management.

The findings of this study confirm that volunteers still dominate the bush regeneration workforce in terms of number of workers (90 per cent). However, the study also indicated that the paid workforce performs more than half (55 per cent) of the total of 538,373 hours spent on bush regeneration in the study areas in 2005.

The extent to which this work is being carried out by volunteers may be a source of concern, in light of a recent comprehensive survey by Volunteering Australia (2007) which noted that some volunteers are considering either reducing their involvement or ceasing involvement altogether. Although this study has not analysed the adequacy of the current workforce to match the scale of the problem faced, it is important to discuss how this issue relates to the way forward to achieve successful outcomes of healthy, sustainable natural environments.

In order to achieve the very large increase in the magnitude of natural area restoration effort likely to be required at the local level, consideration needs to be given to bolstering the delivery of education, training and staff development of bush regenerators. Recent reduction in regional areas of the availability of training in basic practical bush regeneration skills has reduced the supply of base grade personnel with adequate skill to undertake weeding and related tasks in areas of significant remnant biodiversity. In addition, concern has been expressed within bodies seeking to outsource bush regeneration work and

potential contractors on the future supply of trained personnel, particularly at supervisory and other training levels of the workforce. Of particular concern among bush regeneration practitioners is the cessation of scientific units relating to biology and restoration ecology from courses available to students wishing to work in bush regeneration. Until recently such courses were provided by specifically targeted TAFE bush regeneration courses but have been replaced by sets of generic units within the Conservation and Land Management Training Package (AABR, 2007a), (Buchanan, 2007b), (Campbell, 2006).



Plate 5: Sue Brunskill (AABR member and TAFE teacher) and a group of her bush regeneration students from Albury TAFE engaged in plant identification and selective weeding at Kaluna Park, Wangaratta Victoria. March 2007

(photo Helen Curtis)

4.2. Garden escape weeds encountered by bush regenerators in their work

Overall, respondents identified approximately 171 garden escapes within the nine study areas in eastern Australia. It is clear that many of the weeds that first appeared in bush regeneration areas in the 1960s or before have continued to spread into new bush areas and that new species of garden escape species have emerged over the years since the 1960s up to the present day.

Australia has a long history of European settlement, particularly in eastern Australia and the Sydney Basin. This is likely to have been the point of first introduction for exotic and native plants to new localities, many of which have naturalised and become weeds (Coutts-Smith and Downey, 2006). For example, *Murraya* was a popular plant in Sydney gardens in the 19th century, and was first recorded as naturalised in Queensland in 1963 (Groves, Boden, and Lonsdale, 2005). *Murraya* has now been recorded as an invasive garden escape by bush regenerators in sub-tropical coastal Queensland.

No local investigations were carried out to assess links between weed emergence and when they became available through the local garden plant industry. Some respondents however noted relationships between increased local availability of new plants and their subsequent emergence as weeds in their working area. Respondents in sub-tropical coastal NSW and Queensland noticed a correlation between sales of *murraya* by nurseries during the late 1990s and early 2000s, with wild populations of *murraya* currently being dealt with by bush regenerators in these areas. There is a similar pattern emerging with many species in this area that have recently been promoted by the nursery industry including *cocos palm*, *Duranta* spp and *Syzigium* spp starting to emerge as a weed in subtropical areas (T. McDonald, pers comm. 2006).

The data showed that some species of weeds are perceived by bush regenerators to be more costly to treat compared with other weeds. It is difficult, if not impossible, to predict which species of weeds will be most expensive to treat in the future as some species can persist at low levels for decades prior to becoming weeds, e.g. sleeper weeds (Spencer, 2006). A New Zealand study by Sullivan et. al. 2004, found that plants generally take several decades to naturalise and become well distributed in all ecologically suitable areas. Factors determining potential problematic weeds may include the number of reproducing individuals (fruiting species) present in the landscape (Sullivan *et al.*, 2004; Werren, 2001). If this is the case, wider distributions of fruiting species by the nursery industry presents a potential threat of an unknown dimension. For this reason, field workers' observations of naturalising garden plants in bushland could be seen as a useful warning sign to determine the potential future costs of weeds to the community.

It is possible that high population growth and subdivision provide an opening for newly planted potential garden escapes to become invasive in natural areas. A New Zealand study found that the number of naturalised plant species increases with the human population of an area, and found that 97 per cent of problematic weeds were purposely introduced for urban horticulture (Sullivan, et. al. 2004). One characteristic that determines a popular garden plant is its ability to survive in local conditions (Sullivan et. al, 2004). Consequently, as noted by several respondents, invasive garden escapes could increase in high population growth and land areas such as sub-tropical coastal areas of NSW and Queensland as new residents may be influenced by garden fashion changes.

5. Conclusion

The data provided by AABR NSW-nominated respondents in eastern Australia illustrate that paid and unpaid bush regenerators make a highly significant contribution to local, national and global communities by their work aimed at reversing natural area degradation and maximising biodiversity outcomes. The workforce that was sampled is characterised by having a high proportion of volunteers, but this is not surprising when considering the beginnings of this land management practice. However 72 per cent of the total value of \$18 million of the work undertaken in the study areas in 2005 was by paid bush regenerators.

This paper confirms that garden escape weeds remain a major threat to biodiversity in remnant bushland. The two most readily identifiable groups of plants that are posing a major problem for bush regeneration are members of the *Asteraceae* (daisy) family and weeds distinguished by having a berry or drupe that is a suitable size for bird dispersal. The two weeds found to require the most time and effort to control were madeira vine and asparagus ferns which both have persistent underground organs.

Despite the present greater awareness of the problem of garden plants ending up as threats to the natural environment, species that are known pests can still be legally sold in NSW, and new garden escapes continue to appear.

National, state and local governments as well as industry, professional and local community-based organisations all have a role to play in stopping the spread of potentially invasive garden plants.

6. Recommendations

AABR NSW recommends the following:

1. Stronger action taken towards preventing entry to Australia of potentially invasive new plants.
2. Stronger action taken to prevent the propagation, circulation and sale of known garden escapes.
3. Stronger enforcement of weed regulations should be a priority. A problem for many regulators, especially councils, is that their own land is often awash with weeds so landowners may not feel obligated to comply.
4. Existing weed policies and legislation at all levels of government reviewed to meet environmental expectations. Legal control of environmental weeds is currently weak.
5. Greater formal cooperation is required between the nursery industry, bush regenerators, weed scientists, local councils and Catchment Management Authorities to develop a more strategic approach to weed management.
6. Programs such as bush-friendly nursery schemes (like 'Grow Me Instead') and plant 'weediness' labelling are encouraged.
7. Opportunities for tertiary education and training of bush regenerators are bolstered especially in areas away from the capital cities. Training is delivered via the nationally accredited Conservation and Land Management (Natural Area Restoration) Training Package.
8. Well-structured articulation between the various education and training pathways is developed to meet individual operator's education and training needs at various life and career stages.
9. Organisations increase the employment of bush regenerators to maintain natural areas, and encourage staff at all levels to gain bush regeneration qualifications.

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9. APPENDICIES

APPENDIX 1: Questionnaire participation list and the localities on which they commented

Name	Locality
Bristow, Carole	Metropolitan SE Queensland
Brunskill, Sue	Wodonga
Eaton, John	NSW Lakes Area & NPWS Central Coast
Guthrie, Christine	Sutherland Shire
Hirschield, Danny	Sydney Eastern Suburbs
Holloman, Deb	Gosford City
Kavanagh, Lynne	Wollongong
McDonald, Tein	NSW Far North Coast
Macintyre, Libby	Dubbo
Macrae, Marita	Pittwater
Michael, Tracey	Albury City
Miles, Jackie	Bega Valley Shire & Eurobodalla, Far South Coast, NSW
Pham, Tien	NSW North Coast - part Clarence Region
Potts, Christina	Mystery Bay, Far South Coast, NSW
Rannard, Janet	Sydney - Penrith
Shaw, Spencer	Sunshine Coast Queensland
Singleton, Janine	Manly
Yeomans, Rachel	Sydney North Shore

APPENDIX 2: Structured Email Questionnaire

AABR NSW Garden Escape Weed Report - Questionnaire

The Australian Association of Bush Regenerators (AABR NSW) is working towards strengthening its work towards the better management of the impact of garden escapes and the restoration of natural areas affected by invasive weeds. To this end it is undertaking a study with the objectives to outline:

1. Extent and types of escaped invasive garden plants encountered by Australian bush regenerators with a particular focus on documenting qualitatively the waves of new escaped invasive garden plants that follow a garden plant fad.
2. Effort/labour inputs of all bush regenerators employed by the private sector or the “non-government sector” together with professionally supervised volunteer bush regenerators engaged by any sector. The data to be

collected will include numbers of people, hours worked and numbers paid and unpaid.

AABR NSW, as a peak body for on-ground vegetation management of bushland, promotes best-practice management of bushland to reverse degradation and maximise biodiversity outcomes. The causes of bushland degradation are many but there is one major obvious symptom of degradation in remnant bushland – weeds.

It is expected that the study will highlight the enormous efforts that bush regenerators and volunteers (working under qualified supervision) contribute to maintaining healthy natural environments by removing weeds, which are predominantly, escaped garden plants.

QUESTIONNAIRE CHECK LIST

NOTE 1: For the purposes of this study, the term “bush regenerator” will be taken to include all persons known to be engaged in bush regeneration and/or natural area restoration under professional supervision (ie includes fully trained bush regenerators, trainees, unskilled workers, volunteers, etc).

A. Respondent background

1. Professional role or function in bush regeneration:
2. Area or region of working experience:
3. Years involved in bush regeneration and/or natural area restoration:
4. Other:

B. Extent and types of escaped invasive garden plants encountered

1. Estimate of percentage of weeds encountered by bush regenerators working to restore natural areas that are escaped invasive garden plants (including Australian natives):
2. Escaped invasive garden plants that have been found to take the most time and effort to control:

3. Waves of escaped invasive garden plants that were first seen by bush regenerators in natural areas in the decades following January 1960. (ie examples from 1960s, 1970s, 1980s, 1990s, 2000s):
4. Newly arrived escaped invasive garden plants that have been seen by bush regenerators in natural areas since January 2000:
5. Emerging patterns and trends:

C. Effort/labour inputs by private sector and volunteer sectors for respondent's area or region

1. Respondent's area or region (eg state, local government area, group of councils, landcare region, catchment authority, etc):
2. Estimate of total number of persons employed in supervised paid and unpaid work on bush regeneration projects in specified area or region during 2005:
3. Percentage unpaid:
4. Estimate of total number of bush regeneration business entities (eg sole proprietors, partnerships or companies) engaged in bush regeneration as a business (eg undertaking projects or supervising paid and/or volunteer bush regeneration work on at least one contract during 2005):
5. Estimate of total number of hours worked by persons employed in private sector and receiving remuneration for working in supervised bush regeneration during 2005. (Including managerial, experienced, fully trained, partially trained and unskilled workers):
6. Estimate of total number of hours worked during 2005 by volunteers on supervised bush regeneration (ie. Supervised by respondent, private or public sector bush regeneration expert, government agency, local council, catchment authority, landcare group, coastcare group, etc):

7. Estimate of dollar value of hours worked by persons employed in private sector and receiving remuneration for working in supervised bush regeneration during 2005:
8. Estimate of dollar value of hours worked by volunteers working in supervised bush regeneration during 2005:

D. Concluding remarks

1. Any suggestions for government and/or industry (towards their helping bush regenerators to stop the stream of invasive plants invading bushland and other natural areas)?
2. Other:

September 2006

Respondent:
Email:
Telephone:
Mobile:
Date:

APPENDIX 3: Garden Escape Weeds Identified by AABR NSW Respondents

Appendix 3 - Garden Escape Weeds Identified by AABR NSW Respondents

Species related descriptor	Common name descriptor	Other descriptor	Study area codes - refer below for key																							
			1	2a	2b	3a	3b	3c	4	5	6	7	8a	8b	8c	9	10	11	12	13	14	15	16	17	18	19
<i>Acacia baileyana</i>	Codiantandra wattle			X																						
<i>Acacia macrodonta</i>	Zig zag wattle																									
<i>Acacia saligna</i>	Port Jackson willow																									
<i>Acer negundo</i>	Box Elder		XX																							
<i>Acrotaea sagittata</i>	Rambling dock	Turkey rhubarb (vine)																								
<i>Agapanthus orientalis</i>	Agapanthus																									
<i>Ageratina adenophora</i>	Crofton	<i>Eupatorium adenophorum</i>																								
<i>Ageratina ripens</i>	Mist flower																									
<i>Allamanda cathartica</i>	Yellow allamanda																									
<i>Azoremaria psiliflora</i>	New Zealand Christmas Bells																									
<i>Albimartineria phloxeroides</i>	Albigator weed																									
<i>Antrobia spp.</i>	Ragwort																									
<i>Armi majus</i>	Queen Anne's lace		X																							
<i>Azoredera cordifolia</i>	Madeira vine																									
<i>Asopus sectoria</i>	Moth vine																									
<i>Asocistrum romanzoffianum</i>	Cocos palm																									
<i>Archontophoenix alexandrae</i>	Alexandra palm																									
<i>Arctostaphylos populifolia</i>	South African beach daisy																									
<i>Ardisia crenata</i>	Coral berry																									
<i>Asparagus africanus</i>	Climbing asparagus																									
<i>Asparagus asparagoides</i>	Brindal (weil) cressper		X	X																						
<i>Asparagus densiflorus</i>	Ground asparagus	<i>Asparagus aethiopicus</i>																								
<i>Asparagus scandens</i>	Asparagus fern																									
<i>Asparagus spp.</i>	Asparagus (various)																									
<i>Aschodebia filivivus</i>	Onion weed																									
<i>Bidens pilosa</i>	Bidens	Cobblers pegs																								
<i>Bryophyllum spp.</i>	Bryophyllum																									
<i>Bryophyllum delagoense</i>	Hybrid mother of millions																									
<i>Bryophyllum delagoense</i>	Mother of millions																									
<i>Buddleia</i>	Buddleia																									
<i>Cabomba caroliniana</i>	bomba																									
<i>Cassipouira decapetala</i>	Mysore Thorn																									
<i>Callisia fragrans</i>	Fragrant inch plant																									
<i>Canina indica</i>	Canina																									
<i>Cardiospermum grandiflorum</i>	Balloon vine																									
<i>Casimiroa edulis</i>	White sapote																									
<i>Catharanthus roseus</i>	Pink periwinkle																									
<i>Celtis australis</i>	nettle tree	Eur hackberry																								
<i>Celtis sinensis</i>	chinese elm																									
<i>Celtis spp.</i>	Chinese elm ?																									
<i>Cestrum nocturnum</i>	Night cestrum	Night-scented jessamine																								
<i>Cestrum pargu</i>	Cress cestrum		XX																							
<i>Chlorophyllum comosum</i>	Spider Plant																									
<i>Chrysanthemoides monnifera ssp rotundata</i>	Bitou	Bitou bush																								
<i>Cinnamomum Camphori</i>	Camphor laurel																									
<i>Coffea arabica</i>	coffee																									
<i>Colocasia esculenta</i>	Taro																									
<i>Commelina benghalensis</i>	Hairy commelina																									
<i>Cordyline australis</i>	New Zealand cabbage tree																									
<i>Coreopsis lanceolata</i>	Coreopsis																									
<i>Cortaderia selloana</i>	Pampas Grass																									
<i>Cymbidium terrellianum</i>	Callagh	<i>Eucalyptus terrelliana</i>																								
<i>Crotoneaster spp.</i>	Coloneaster																									
<i>Crocosmia X crocosmiiflora ?</i>	Montbrelia	Crocosmia																								
<i>Cuscuta spp.</i>	Cuscuta																									
<i>Cyathea Cooperi ?</i>	Australian tree fern ?																									
<i>Cynodon dactylon</i>	Bermuda grass																									
<i>Cytisus spp.</i>	Broom																									
<i>Delonix odorata</i>	Case Ivy																									
<i>Dielsia bicolor</i>	Dielsia																									
<i>Diospyros ebenum ?</i>	Black sapote																									
<i>Eugenia acida</i>	Duranta																									
<i>Euhartia spp.</i>	Euhartia																									
<i>Eichhornia crassipes</i>	Water hyacinth																									
<i>Eragrostis curvula</i>	African lovegrass																									
<i>Erica lusitanica</i>	Spanish heath																									
<i>Eriogon karwinskianus</i>	Seaside daisy																									
<i>Eriobotrya japonica</i>	Loquat																									
<i>Erythrina crista-galli</i>	cockspur coral	cockspur coral tree																								

