Introduction: Conceptualising Weeds

Some weed species are so widespread and insidious that they have become of national significance (Thorp & Lynch, 2006)

At what scales does the concept of 'weed' really make sense? When and where does a garden plant become a weed, rather than just a garden plant? On a recent trip to the UK, one member of the project team (DK, a trained horticulturist and ecologist from Melbourne, Australia) was drawn to a sign beckoning passers-by to weed a meadow garden hanging on the wall (Fig. 1). At home, it is pretty obvious which plants 'belong' and which are weeds, both in gardens and in the bush. But in England it was not obvious at all. Which plants are weeds in this place where the rules are different from home? When and where does a plant become a weed?

To take another international example, Monterey Pine (*Pinus radiata*) is a ubiquitous weed in the forests and woodlands of south-eastern Australia, but is also listed on the IUCN Red List of Threatened Species as Endangered in its home range in central coastal California (Farjon, 2015). Weeds can be threatened species, and sometimes threatened species are weeds. It depends both on the biogeography of the place and the perspective of the weeder (Robbins, 2004).

[FIGURE 1 NEAR HERE]

In Australia there is a particular anxiety about plants from gardens becoming environmental weeds fostered through official rhetoric: for example, the well-publicised World Wildlife Fund report, *Jumping the Garden Fence* (Groves *et al.*, 2005). 'Escaped' garden plants are a federally listed Key Threatening Process: '*Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants'* (Threatened Species Scientific Committee, 2008). Groves *et al.* (2005) details many species that were originally imported for the purpose of ornamental gardening, which are now invasive in 'the bush' (including areas of remnant native vegetation including forests, desert and grasslands). Such reports provide or cite evidence that suggests that the *majority* of exotic plant species that have naturalised or spread in the bush in Australia were introduced as ornamental horticultural plants. Much of the concern is focused on the fact that many of these invasive species continue to be available for sale in nurseries, and that they threaten native species and ecological communities.

The 'national' framework of the report disguises important differences between ecologies: the northern tropics and savannahs, the arid inland and the temperate south host different weeds, and the weeds themselves invade these landscapes differently. Take for example, Prickly Acacia (*Vachellia nilotica*). For the last two decades it has been regularly declared one of Australia's worst

weeds, targeted as a Weed of National Significance (WONS) and is now one of the two focal plants in the Queensland Government's program 'War on Western Weeds' (Queensland 2016). It is a weed not of gardens, but of the pastoral economy in northern Australia, originally providing essential shade for sheep. While sheep destroy the seed in their digestive process, cattle do not, so Prickly Acacia spreads rapidly in response to shifts in the pastoral industry, particularly when cattle replace sheep. (Egan 2009) It is a weed because of, and in relation to, the development of an industry, not a choice in home gardens. This tree is only a weed in relation a very specific, 'foreign' industry, and of a very particular (tropical savannah) ecosystem. Some landholders accept the plant as being just as much at home in the landscape as their cattle, and this has led them to creative solutions for new industries, including farming a thriving feral animal, the camel, alongside cattle. (Egan 2009; Wilson *et al.* forthcoming; Robin forthcoming). Other pastoralists who have joined the well-organized 'fight' to stop the growth of this tree on their land, not because of competition between the trees and available pasture, but because Prickly Acacia interferes with an activity they love, mustering. Thus, just as 'weeding' is an important element in this eradication story, some landholders are motivated by their enthusiasm for mustering. The rich relationships that most pastoralists enjoy with their land and animals are created by all the activities they undertake, not just weeding. Mustering is a particular source of great pride, and modern mustering methods, using quad bikes and helicopters, are more hindered by the Prickly Acacia growth than the traditional horseback approach, as quad bike tyres are punctured by the tree's prickly seeds and cattle in thickets are hard to see from a helicopter. Restoring the Mitchell grasslands, the ecosystem present as the industry developed, often features as the prime goal in industrial control programs. Such restoration goals are often considered 'noble' but they hide the far more economic motivations (Egan, 2009; Rangan, Wilson & Kull, 2014). Not all weeds can be treated as garden villains, and even industrial weeds like Prickly Acacia need to be understood simultaneously from the perspectives of history, ecology and practical context.

Framing garden plants as a threat to biodiversity has developed out of the scientific invasion biology literature. Garden plants are a ubiquitous topic for invasion biologists internationally; a Google Scholar search for 'invasive ornamental garden plants' returns highly cited papers with titles such as 'Horticulture as a pathway of invasive plant introductions in the United States' (Reichard & White, 2001), 'The horticultural trade and ornamental plant invasions in Britain' (Dehnen-Schmutz *et al.*, 2007) and 'Ornamental plants as invasive aliens: problems and solutions in Kruger National Park, South Africa' (Foxcroft *et al.*, 2008). There is a growing consensus in conservation research and policy that garden plants are 'bad': a threat to native biodiversity. However, to date there has been relatively little critical examination of the assumptions that underpin this position, nor exploration of

the reality of plant movement from gardens into the bush at specific and local scales. Blaming the colourful and easily identifiable garden plant because it is conspicuous does not reflect ecological understanding of invasive processes at landscape scale. It is simply a short-cut to finding 'culprits' suited to national policy planning, rather than implementing principles of sound environmental management.

This paper arises from a collective project bringing together perspectives from the humanities and the sciences to explore the *culture* of weeds, and individual projects examining the floristics of gardens and nearby 'bush' on a fine scale (Robin *et al.*, 2011, Wilson, Kendal & Moore forthcoming), while others deal with international developments in the idea of biodiversity (Robin 2011; Wilson, Wilson & Robin forthcoming).Together this has given us a range of scales and perspectives from which to critically examine the rhetoric surrounding garden plants as environmental weeds in Australia. Environmental weeds are a serious issue with significant ecological costs, and framing of plants in residential gardens as a threat to biodiversity is shaping public policy and academic research, and directing significant on-ground resources. A critical examination of this framing will help better direct public policy and limited resources towards positive outcomes in managing the Australian environment, for both people and plants.

Evidence of plants 'jumping the garden fence'

One part of our project draws on previously collected data to compare plants growing in gardens with those growing in nearby bushland reserves in Ballarat, Australia. This fine-grained Victorian example demonstrates a practical case where gardens, agricultural landscapes and bush co-exist closely, and where the history of each is well documented. As the focus of gold-rushes in the 1850s, Ballarat sits in a disturbed mining landscape which includes pastoral country, some ongoing mining, a major city with public and private gardens and bushland reserves. Kendal *et al.* (2012) conducted a comprehensive survey of the species planted in front gardens, streetscapes, neighbourhood parks and revegetation sites found over 500 mostly exotic species of plants [AUTHOR REF]. These species were compared with those found in surrounding bushland by searching a government database (The Flora Information System or FIS) across all land zoned Public Conservation and Resource (PCRZ) within 25 km of Ballarat's town hall. A total of 248 exotic species were recorded in the bush. Of these, 22 species were also recorded in our cultivated flora surveys (Table 1). These 22 species could be grouped into three categories. The first contained species that were widespread in the bush, and also found in a few garden sites, including Gorse (*Ulex europaeus*) and Montpellier Broom (*Genista monspessulana*). While it is possible that these individual plants had been planted in gardens, it is possible that they had actually 'jumped the garden fence' the other way - from the bush into

gardens (as can be seen by their strong representation in revegetation sites, where they clearly had not been planted). The second group were common in gardens but infrequent in the bush, and the last group were infrequent in both the bush and in gardens. In the second and third cases, species had indeed apparently spread from gardens into the bush at some point. There were no non-native species common in both gardens and the bush.

There were some species widely considered 'garden plants' that were widespread in the bush but not recorded in the gardens we surveyed, including *Crataegus monogyna* (Hawthorn), *Rosa rubiginosa* (Briar Rose), *Erica lusitanica* (Spanish Heath). There were also some plants abundant in Ballarat's gardens that are listed as actual or sleeper environmental weeds in the *Jumping the Garden Fence* report, including *Agapanthus praecox* (Agapanthus)*, Pittosporum tenuifolium* (Kohuhu)*, Pelargonium spp.* (Pelargonium, Geranium)*, Ulmus procera* (Elm)*, Fraxinus ornus* (Manna Ash) and *Phormium tenax* (NZ Flax) . However, we found no evidence that these species were spreading from gardens.

These data show that plant movement between gardens and the bush is more complex than the simple metaphor of plants 'jumping the garden fence' suggests for the Ballarat case. While there was some evidence that plants were spreading from gardens into the bush, there were also 'invasive garden plants' that were both recorded in the bush but not in gardens, and in gardens but not the bush. There was even some suggestion of plant movement from the bush into gardens. 'Invasive' behaviour differs in temperate and tropical contexts, and one close study of a gardens/bush interface cannot hope to reveal all, but even within these constraints the Ballarat case challenges the idea of a 'national' narrative of weed sources.

[TABLE 1 NEAR HERE]

Our second case explores some anecdotal comments from ecologists with a long term interest in grassland conservation. Melbourne, the capital of the state of Victoria, Australia, is the home of much of the remaining estate of the Natural Temperate Grassland of the Victorian Volcanic Plain, a nationally threatened ecological community. Given the proximity and density of surrounding residential gardens, they expected Melbourne's many grassland reserves to be invaded by garden plants. A survey of the plants growing in 76 native grassland conservation reserves in Melbourne, Australia, found numerous exotic species. (Zeeman *et al.* 2015) Thirty-nine of these reserves are located in residential neighbourhoods and surrounded by gardens with a rich diversity of garden plants – sometimes 'protected' by a road or buffer strip, but often separated only by the ubiquitous garden fence. Grasslands are notoriously 'invadable' (Tilman, 1997). This would seem to be a prime opportunity for plants to literally jump the garden fence; yet almost all the most frequently

occurring exotic plants (Table 2) were cosmopolitan weeds associated with disturbance and the expansion of European agriculture (e.g. Brome - *Bromus hordeaceus*, Plantain - *Plantago lanceolata*, Cocksfoot - *Dactylis glomerata* and Canary Grass - *Phalaris aquatica*). *Lolium perenne* (Rye grass) is a widespread pasture grass that is also used in ornamental turf, and *Cynara cardunculus* (Artichoke thistle) has cultivated siblings in the edible Globe Artichoke. Couch (*Cynodon dactylon*), a common lawn species in residential gardens, comes in at number 35 in the list of most frequently occurring species, although its status is uncertain and it may be native to Victoria (Walsh & Stajsic, 2015). It is not until the 74th most frequently occurring exotic species that a common garden plant appears – *Gazania linearis* (followed much later by *Aeonium haworthii, Cotyledon orbiculata* and *Gladiolus spp*). Again, this was not a simple case of garden plants invading adjacent bushland. Rather, perhaps it is a case of a 'default' bush (Arthur 2003), that is all about trees rather than being inclusive of grasslands.

[TABLE 2 NEAR HERE]

Why aren't plants jumping the garden fence here?

These case studies provide some evidence that plants are spreading from gardens into the bush, yet plants growing in current gardens are clearly not the major source of weeds in nearby bushland. This was despite the high levels of 'propagule pressure' from garden plants, one of the key mechanisms underpinning invasion biology theory (Catford *et al.*, 2009). We are not arguing that plants do not spread from gardens into the bush; it is clear that in some places they are very important weeds, but weediness is an intensely local process (Head & Muir, 2004; Egan 2009; Rangan *et al.* 2014), and it is important to focus on all mechanisms that underpin the spread of environmental weeds, not just gardens. There are a few reasons that may explain the apparent disconnect between our fear of 'invasive' garden species and patterns observed in our case studies.

Mismatches in geographic and temporal scales

Gorse is instructive as it suggests that the scale and historical preferences of gardening are important. When Gorse was planted around Ballarat, it was done on a vast scale. In October1895, Mark Twain visited Ballarat and observed:

> The approaches to Ballarat were beautiful. The features, great green expanses of rolling pasture-land, bisected by eye contenting hedges of commingled new-gold and old-gold gorse.(Twain, 1899)

Gorse was probably never a common plant in Ballarat's small urban gardens, but historically it was widely used in windbreaks and as agricultural hedges. It was planted on a large scale near bushland,

in an echo of the British Enclosure Acts. Other Weeds of National Significance (WONS) such as Blackberry and Willow, were also plants of rural landscapes, rather than choices for small private or pleasure gardens. Windbreak hedges were part of 'improvements' required by legislation for those taking up agricultural land in nineteenth century Victoria, just as shade trees were important for sheep in northern Australia (Egan 2009). The present weed invasion was led by the landscape-scale imagination of Capability Brown, rather than the preferences of the twenty-first century suburban gardener.

Some 'escaped garden plants' may no longer be garden plants at all. While patriotic Scots settlers planted gorse hedges as reminders of home and as practical windbreaks on farms in the nineteenth century, neither gorse nor boneseed have been the choice of residential gardeners or farmers for well over 100 years, and have long been listed on Noxious Weed lists that control their sale. It is important to disconnect the current drivers of expansion from historical reasons for a plant's introduction. For example, there is no point in listing acclimatisation societies as 'key threatening processes' in 2016 as they have been inactive since the nineteenth century in Australia.

This is not to diminish the importance of historical ornamental plant introductions as a source of environmental weeds. It is rather a call for clarity in present and future assessment of the spread and classification of weeds, and particularly, to use understandings of historical plantings in a more nuanced way. History is an additional tool crucial to environmental management when it is used properly, and not isolated as a footnote.

As conservation biologist Richard Kenchington once commented 'We don't manage the natural environment, rather we manage the human behaviours that affect its processes' (Kenchington 1994: 250; Stork 2016). While the presence or absence of particular species tells us something about what has happened in both gardens and the bush, human behaviours associated with problem plants are also constantly changing and their historical context is important too.

Maybe it is the perception (not the garden plants) that changes the bush?

> *Ever since the first human settlements 10,000 years ago, weeds have dogged our footsteps* (Mabey, 2010).

The definition of 'garden plant' is important, although often absent from many key reports and papers. Where definitions are provided, they are broad: 'Invasive garden plants can be defined as plants that are currently *or were historically* used in gardens, primarily for ornament or utility, which have escaped or threaten to invade natural and other areas ' (Threatened Species Scientific Committee, 2008, our emphasis). It seems that once a garden plant, always a garden plant, and a

garden plant alone. In contradistinction to what? The alternative implicit categories are native plants (bush) and agricultural commodities.

In the 1980s, Alfred Crosby proposed a thesis of ecological imperialism. He argued that the cultural, political and economic imperialism of the expansion of Europe was only possible because European colonisation was accompanied by a 'portmanteau biota' of crops, pasture grasses and ruderal weeds, as well as domestic animals, rats and disease (Crosby, 1986). While this thesis has been revised to acknowledge the complex and multidirectional flow of plants through space and time (e.g. Beinart & Middleton, 2004), the list of exotic plants in Melbourne's grasslands is clearly dominated by this European portmanteau biota of cosmopolitan ruderal species (Table 3).

A closer examination of invasive garden plant lists suggests that there is surprisingly broad definition of 'garden plant' that includes many of these agricultural/ruderal weeds. For example, the most common weed in our grassland survey, *Plantago lanceolata* (Plantain), appears on the garden weeds list (Groves et al 2005). Yet it is more widely known as an agricultural weed and has even been used as a paleo-botanical indicator of agricultural grazing (e.g. Hjelle *et al.*, 2006). This pattern is repeated for many of the top 20 weeds of the grasslands (Table 3): *Sonchus oleraceus* (3rd), *Romulea rosea* (6th), *Brassica fruticulosa* (11th)*, Briza maxima* (12th) *and B. minor* (13th)*, Nasella neesiana* (14th) *and N. trichotoma* (15th)*, Dactylis glomerata* (16th) and *Lactuca serriola* (17th). These weeds are not horticultural plants found in the western suburbs gardens near the Melbourne grasslands (although they may be weeds in those gardens). While the presence of agricultural weeds in native grasslands is clearly no surprise to practitioners, the use of general lists of weeds is increasingly important in research and policy, where people are increasingly distant from the ecosystems they are working with. These general lists are used in combination with spatial occurrence data to determine threats for endangered species and ecosystems, and to model the extent of invasion by garden (and other plants). This distance from common-sense understanding of local weed issues can distort the framing of problems and allocation of resources.

The agricultural identity of many invasive garden plants is easily lost in this debate. Agriculture is so important to western civilization in Australia it is easy for policy to overlook or downplay its role in 'harming' the environment (Muir, 2014). With an insignificant utilitarian value, an 'ornamental' garden is expendable, so a soft target for criticism. Cultural prejudices - such as omitting wheat acreages from vegetation maps (Head *et al.,* 2012) – may drive the classification of all weeds as weeds from gardens. Describing agricultural and ruderal species as 'garden' weeds confuses categories and reinforces the idea of gardens as a source of environmental weeds, even when they are not.

Be careful with metaphors – they might start being taken literally

The concept of plants jumping the garden fence provided a way of thinking or metaphor that shapes weed management. Brendon Larson's call to look closely at our metaphors is relevant here, in particular, his scrutiny of the militarism embedded in the language of invasion biology (Larson, 2005). Garden plants variously 'invade', 'escape', and need to be 'eradicated' (Mack & Lonsdale, 2001; Dehnen-Schmutz *et al.*, 2007). The metaphor of weed as psychopathic killer is also prevalent: 'it gradually revealed its true character – that of a killer, a smotherer, a choker-to-death of native woodland species and no plant for polite society. In its search for new victims it also spread along railway embankments' (M. Campbell–Culver on *Rhododendron ponticum* in Dehnen-Schmutz & Williamson, 2006: 341). The militarism of the human behaviours is reinforced by the framing of the 'enemy'.

Strong metaphors can simplify human-environment relationships and obscure complex mechanisms that contribute to environmental issues. Larson argues that there is a danger that the use of these metaphors leads to all members of the category (e.g. garden plants) being considered equally 'bad' – which is demonstrably false. There are thousands of relatively innocuous garden plant species that are guilty by association with 'invasive garden escapees'. Metaphors can play a constructive role in thinking and communicating within disciplines, they can become a major problem when they become 'constitutive' (Klamor & Leonard, 1994), entrenched and taken literally by practitioners and researchers within disciplines. These constitutive metaphors obscure real mechanisms that underly issues. In the case of 'escaped' garden plants, many mechanisms lead to the spread of weeds directly and indirectly, often with reciprocal effects: land use change, transport, climate change, changing fire regimes (Vitousek *et al.*, 1997).

Matching the scales of response and problem

Weeds have scales of relevance. So does public policy. In Australia environmental management operates at local, state and national scales. Weediness is often defined nationally by policy makers responding to international concerns about biodiversity, as mediated by Red Lists (IUCN) and other global policy agendas. Australia coordinates its response to weeds at national level too. Since 1999, Federal and State Governments have agreed on a list of Weeds of National Significance, or 'WONS'. These are plants that an expert committee assessed as highly invasive and have the potential to cause significant negative social, economic and environmental impacts. The current list of 32 WONS includes many plants considered to have 'escaped' from gardens including Lantana (*Lantana camara*), Gorse (*Ulex europa*), Blackberry (*Rubus fruticosus* spp. agg) and Willow (*Salix* spp.). The national approach exemplified in the WONS was developed in response to weed control strategies

focussing on ‘short-term solutions … directed at control or eradication of specific weeds in a particular area, without fully understanding the reasons for the continued spread of weeds’ (Thorp *et al.*, 2006: p2). However, working on such large scales often requires abstraction and synthesis, and locally relevant detail can be lost. How often are these WONS the most serious weeds in particular places?

Is gardening a way to manage the bush?

There is an important distinction between weeds and weeding. The noun ‘weed’ is always bad: a plant growing out of place, or a thin, ungainly or wretched person or animal. The verb, ‘to weed’ (or even more common ‘to weed out’ – that is, to remove absolutely) carries the opposite moral spin to the noun. A weed is negative. To weed is positive. To remove bad things is an act of virtue. The medieval world clearly demarcated places that were ‘inside’, subject to human influence, from places that were ‘outside’ and wild, beyond human control. Gardens have traditionally been ‘inside’ (the word ‘garden’ originally referred to all enclosed spaces), and the natural areas such as the bush were ‘outside’. Until we could perceive the bush or ‘the environment’ as garden, that is, ‘inside’ society rather than outside, surrounding it, there was no need to weed there. In the pre-industrial era of environing, the ‘wilds’ were outside society and social practices, beyond the human-nature partnership afforded the garden or the agricultural plot (Warde 2016).

A more nuanced distinction needs to be made between garden plants and gardening. In the right context, garden plants and gardening can both be good: around houses and in city parks. However, in the bush, garden plants are bad reflecting the prejudice about cities contaminating the bush in Australia (Robin, 2012). Some conservationists see gardening the bush as a bad outcome – a sign that we have gone too far and created ‘an artificial and potentially unsustainable system’ (Hobbs, 2007: 371). Yet perhaps gardening is not as antithetical to conservation as some believe. All ecosystems on earth have been touched by humans (Vitousek *et al.*, 1997), and the state of many ecosystems is now largely the culmination of human desires and actions. Now, paradoxically, as Emma Marris argues, we need to garden the bush by constantly weeding to maintain what we humans define as its wild-like state:

> The Garden of Eden story says that the world was a garden and fell to become a wilderness. The North American conservation story says that the world was a wilderness and fell to become a garden. I say that the world is a garden now, has been a garden for thousands of years, and will be a garden for the foreseeable future. Now we must ask ourselves what kind of garden we want, and what kind of gardeners we will be (Marris, 2015: 259).

In fact, we have been weeding the bush for a long time. 'The Bradley Method' was popularised more than 50 years ago by Joan and Eileen Bradley, as a slow and manual method of bush regeneration informed 'by trial and error over the years' in their local bush (Bradley 1988:16). Instead of being motivated by warlike demolition of introduced species, the Bradley method focused on nurturing natives: working from the least-affected areas to most-affected areas, reducing opportunities for re-establishment of weeds caused by unnecessary disturbance, and setting the pace of weed clearance by the pace of regenerating native plants. The Bradley Method moved at the pace of nature through space, from the most intact bush out to the most degraded areas. Weed eradication using The Bradley Method 'is all very subtle and requires a great deal of patience' (ANPS, 2015). Joan Bradley spoke of 'the delight we felt in helping the bush to help itself', and yet the Bradleys also planned their approaches to optimise visible results, aware of the risk of people 'giving up' if they did not see improvement. Joan Bradley stated: 'Nobody likes weeding the same piece of ground over and over again with precious little to show for it' (Bradley 1988:21). This sort of weeding is common ground between gardeners, conservationists, and other natural resource managers. In some cases, such techniques are being applied on private land, either in isolation or in partnerships with neighbours and natural resource managers. Yet the agricultural scale and industrial style adopted in the extermination of weeds, using spraying, slashing and mowing, is the antithesis of the Bradleys' philosophy of care for the bush.

[FIG 2 NEAR HERE]

Could weeding the bush be good for us?

By weeding, the weeder is herself 'improved'. The moral development of citizens is tied up with the flourishing of chosen garden plants, and the hard work entailed in eradicating weeds is a virtuous step towards the perfect garden. The perfect garden of course is a goal not a destination. The journey is the point of it all, and the need to weed is constant. Historically the fundamental purpose of weeding in gardens was to develop children's appreciation of the living world, not to direct gardens towards any particular long-term ecological outcome. Weeding brought children close to nature, and encouraged them to grow up as moral citizens (Robin 2001). In the 21st century era where new ideas about 'biophilia' shape educational endeavour, proximity to the earth is still touted as important for the psychological development of both children and adults in a world now considered 'nature-deficient' (Louv, 2005; Wilson, Kendal & Moore forthcoming).

As nature has moved from being awesome and overwhelming to being fragile and in need of protection, it has become socialised and normalised as part of the everyday world (Robin, 2011). The gorse hedges that once protected the agricultural land from the 'wilds', are now themselves invasive. Perhaps weeding the bush is one of the ways that ordinary people feel they can contribute to the 'global' problem of species loss, but it is also an intensely local practice. Weeding is an important yet seldom scrutinised part of planetary anthropogenic change. How we define our weeds is part of how we define boundaries between social and ecological systems. The thousands of species listed on national weed lists may provide ample scope for moral improvement when all are tackled, but they are not fine-scaled enough to tell us what weeds are important in any given place.

Broad-scale weeding activity and many of the technologies used in vast outback and northern Australian areas, suggest not an agricultural, but rather an industrial revolution (Muir, 2014). Weeding in suits with chemicals is very different from the traditional personal relations between people and nature built through hand-weeding. Is it still 'weeding' if chemicals or agents of biocontrol undertake the task, and people are screened from the process by fences or suits? Fighting an increasingly military-style battle against invasive plants could be viewed as an example of 'violent care' (van Dooren, 2014). Our efforts to conserve and foster the species we want sometimes comes at great cost: in this case, to agricultural workers, to myriad non-target species, and to the unwanted species themselves. In becoming industrial to deal with the perceived scale of degradation, we are now beginning to lose the human benefits (Wilson, Kendal & Moore forthcoming) of traditional weeding practices.

Conclusions

While 'invasive garden plants' have been recognized as a national problem, weeds are locally specific phenomena. There is tension between the local and national in the rhetoric of weeds (Head & Muir, 2004). Weeding out 'national' imaginaries may help target weed reduction. Indeed, national ideas about weeds may not make a substantial difference in local situations at all. The 'national' scale is suitable for politics and policy making, but it is rarely right for environmental management. Ideas based on a whole continent are not fine grained enough for ecologically sensitive units such as weeds, which differ greatly from biome to biome. Nor do they capture the different local human behaviours that shape the history of plant invasions. The national approach lacks both common sense and a historical understanding of human behaviours in particular places.

While some weeds were clearly imported for the purpose of ornamental horticulture over the last 250 years, if we understand garden plants spreading into the bush solely through the metaphor of

plants ‘jumping the garden fence’ we obscure the real processes underpinning the spread of weeds. The dominant invasion pathways are not necessarily via gardens today, but are more complex and multi-directional. ‘Garden’ plants and even gardens themselves are maligned in the invasion biology literature, in an effort to create an enemy to ‘fight’ and a rhetoric of war. (Larson 2005). Aclearer separation of current and historic garden practices, and understanding what is (and is not) a garden plant, are needed to understand the mechanisms that underpin the movement of plants between gardens and the bush. Weeding is an important process that helps shape the kind of bush weprefer. Weeding locally may have the social, environmental and cultural benefits as we cultivate our particular sense of place in the environment. Demonising weeds may be part of making removing them virtuous, but that is the only reason to ascribe them with moral values. Environmental management is better guided by strong ecology and history, than by negative rhetoric.

References

ANPS (Australian Native Plants Society Australia) 2015, ‘Bush Regeneration’, Accessed 5 July 2015 <http://anpsa.org.au/weeds4.html>

Arthur, JM, 2003. *The Default Country: A Lexical Cartography of Twentieth Century Australia.* Sydney: UNSW Press

Beinart, W & Middleton, K 2004, ‘Plant Transfers in Historical Perspective: A Review Article’, *Environment and History*, vol 10, pp. 3-29.

Bradley, J 1988, *Bringing Back the Bush: The Bradley Methods of Bush Regeneration*, URE Smith Press, Willoughby NSW.

Catford, JA, Jansson, R, & Nilsson, C 2009, ‘Reducing redundancy in invasion ecology by integrating hypotheses into a single theoretical framework’ *Diversity and Distributions*, Vol 15, pp. 22–40.

Crosby, A 1986, *Ecological Imperialism: The biological expansion of Europe, 900-1900*. Cambridge University Press, Cambridge.

Dehnen-Schmutz, K, & Williamson, M 2006, ‘Rhododendron ponticum in Britain and Ireland: Social, Economic and Ecological Factors in its Successful Invasion’, *Environment and History*, Vol 12 No. 3, pp. 325–350.

Dehnen-Schmutz, K, Touza, J, Perrings, C, & Williamson, M, 2007, ‘The horticultural trade and ornamental plant invasions in Britain’, *Conservation Biology*, Vol 21, pp. 224–31.

Egan, A 2009. *Doing Right by Country: Cattle, Camels and Prickly Trees in Northwest Queensland*, Berlin: Lambert Academic Publishing.

Farjon, A 2013, 'Pinus radiata'. *The IUCN Red List of Threatened Species*. Version 2015.2. Viewed 8th August 2015, <www.iucnredlist.org>.

Groves, RH, Boden, R, & Lonsdale, WM 2005, *Jumping the Garden Fence*. World Wildlife Foundation. Ultimo, NSW.

Head, L, Atchison, J, Gates, A 2012, *Ingrained: A human bio-geography of wheat,* Ashgate Publishing, Farnham

Head, L & Muir, P 2004, 'Nativeness, invasiveness and nation in Australian plants', *Geographical Review*, vol. 94, pp. 199–217.

Hjelle, KL, Hufthammer, AK, & Bergsvik, KA 2006, 'Hesitant hunters: a review of the introduction of agriculture in western Norway', *Environmental Archaeology*, vol. 11, no. 2, pp. 147–170.

Hobbs, R 2007, 'Managing plant populations in fragmented landscapes: restoration or gardening?', *Australian Journal of Botany*, vol. 55 no. 3., pp. 371–374.

Hu, R, & Gill, N 2015, 'Movement of Garden Plants from Market to Bushland: Gardeners' Plant Procurement and Garden-Related Behaviour', *Geographical Research*, vol. 53 no. 2, pp. 134–144.

Kenchington, RA 1994. 'Conservation and Coastal Zone Management', In Moritz, C and Kikkawa, J (eds), *Conservation Biology in Australia*, Chipping Norton, Surrey Beatty, pp. 245–250.

Klamor A, & Leonard TC 1994, 'So what's an economic metaphor?' In: Mirowski P, (ed.) *Natural images in economic thought: markets read in tooth and claw*, Cambridge University Press, Cambridge pp. 20-51.

Larson, BMH, 2005, 'The war of the roses: Demilitarizing invasion biology', *Frontiers in Ecology and the Environment*, vol. 3, no. 9, pp. 495–500

Louv, R 2005, *Last Child in the Woods: Saving Our Childern from Nature-deficit Disorder*, Algonquin Books, Chapel Hill, NC.

Mack, RN, & Lonsdale, W. M. M. (2001). Humans as Global Plant Dispersers: Getting More Than We Bargained For. Bioscience, 51(2), 95–102. Retrieved from http://www.bioone.org/doi/abs/10.1641/0006-3568(2001)051[0095:HAGPDG]2.0.CO;2

Marris, E 2015, 'Gardening the Earth with Joy', in Giesecke, A, & Jacobs, N (eds) *The Good Gardener: Nature Humanity and the Garden,* Artifice, London, pp. 254—9.

Mabey, R.2010. Weeds: *How Vagabond Plants Gatecrashed Civilisation and Changed the Way We Think about Nature*. Profile, London

Muir, C 2014, *The Broken Promise of Agricultural Progress: an Environmental History*, Routledge, Abingdon and New York.

Queensland Australia 2016, https://www.business.qld.gov.au/industry/agriculture/land-management/health-pests-weeds-diseases/weeds-and-diseases/war-on-western-weeds

Rangan, H., Wilson, A. & Kull, C. (2014) 'Thorny problems: industrial pastoralism and managing 'country' in northwest Queensland' in Jodi Frawley & Iain McCalman, (eds.) *Rethinking Invasion Ecologies from the Environmental Humanities*. Abingdon: Routledge

Robbins, P 2004, 'Comparing Invasive Networks: Cultural and Political Biographies of Invasive Species', *Geographical Review*, vol. 94, no. 2, pp. 139–156.

Robin, L 2001, 'School Gardens and beyond: Progressive conservation, moral imperatives and the local landscape', in *Studies in the History of Gardens and Designed Landscapes,* vol. 21, no. 2, pp. 87-92.

Robin, L 2011, 'The rise of the idea of biodiversity: crises, responses and expertise', *Quaderni* (*Journal of l'Institut des Sciences Humaines et Sociales du CNRS*); vol. 76, no. 1, 25—38.

Robin, L 2012, 'Australia in Global Environmental History'. in McNeill, JR & Mauldin, ES (eds), *A Companion to Global Environmental History*, Wiley-Blackwell, Oxford, pp.182-195.

Robin, L forthcoming, 'Culling and Care: Ferals, Invasives and Conservation Icons in Australia, *Australian Zoologist*

Robin, L, Moore, J, Willoughby, S & Maroske S 2011, 'Aliens from the Garden', *Proceedings of the State of Australian Cities Conference*, Melbourne. 30 November—2 December 2011.

Stork, N 2016, 'Preface: Professor Roger Kitching' *Austral Ecology* 41, 117–119

Thorp, JR & Lynch, R 2006, The Determination of Weeds of National Significance.

Threatened Species Scientific Committee, 2008, *Advice to the Minister for the Environment, Heritage and the Arts from the Threatened Species Scientific Committee (the Committee) on Amendment to the list of Threatened Species under the Environmental Protection and Biodiversity Conservation Act 1999,* pp. 1–13.

Tilman, D 1997, Community invasibility, recruitment limitation, and grassland biodiversity, *Ecology*, vol. 78 no. 1, pp. 81–92.

Twain, Mark (1899) *Following the Equator: A Journey Around the World,* New York: Harper and Row. Online: http://www.classicbookshelf.com/library/mark_twain/following_the_equator/ (Chapter XXIV discusses Ballarat)

van Dooren, T 2014, *Flight ways: Life and loss at the edge of extinction*, Columbia University Press, New York.

Vitousek, PM, D'antonio, CM, Loope, LL, Rejmanek, M, & Westbrooks, R 1997, 'Introduced species: a significant component of human-caused global change'. *New Zealand Journal of Ecology*, vol. 21 no. 1, pp. 1–16.

Vitousek, P, Mooney, H, Lubchenco, J, & Melillo, J 1997, 'Human domination of Earth's ecosystems' *Science* vol. 277, p. 494.

Walsh, NG & Stajsic, V 2015, *A census of the vascular plants of Victoria*, 8th edition, Royal Botanic Gardens Melbourne.

Warde, P 2016 'The Environment', in Coates, P, Moon, D & Warde, P, (eds) *Local Places, Global Processes* Oxbow, Oxford, pp. 32—46

Wilson, A, Wilson D & Robin, L forthcoming. 'The Ethics and Ought-Ecology of Ferals: An Emerging Dialogue in Science and Humanities', *Australian Zoologist*

Wilson, A, Kendal, D. & Moore, J forthcoming 'Humans and Ornamental Plants: A Mutualism?' *Ecopsychology*

Woodward, F, & Williams, B, 1987, 'Climate and plant distribution at global and local scales'. Plant Ecology, vol. 69 no. 1, pp. 189–197.

Tables

Table 1 – Garden species also found in the bush around Ballarat

	The Bush	'Gardens'			
Species	**Number of FIS sites (rank)**	**Number of Parks**	**Number of Home Gardens**	**Number of Streetscapes**	**Number of Revegetation sites**
Group 1 - Species common in the bush and recorded in gardens					
Ulex europaeus	106 (1)	1			6
Pinus radiata	48 (4)	3			3
Genista monspessulana	44 (7)		5	2	4
Group 2 - Species common in gardens and recorded in the bush					
Hedera helix	3 (102)	3	25		
Prunus spp.	1 (171)		10		
Zantedeschia aethiopica	1 (171)		9		
Cotoneaster glaucophyllus var. *serotinus*	2 (134)		8	1	2
Group 3 - Species uncommon but recorded in both gardens and the bush					
Myosotis sylvatica	8 (53)		2		
Vinca major	7 (61)		2		1
Cytisus multiflorus	7 (61)		1		
Acacia baileyana	6 (67)	2		2	1
Cupressus macrocarpa	3 (102)	2			
Prunus cerasifera	3 (102)		1		
Foeniculum vulgare	2 (134)			1	1
Ilex aquifolium	2 (134)		2		
Mentha spicata	2 (134)		2		
Ligustrum vulgare	1 (171)		2		
Salix spp.	1 (171)				1
Tradescantia fluminensis	1 (171)		1		
Robinia pseudoacacia	1 (171)	1	1		
Sedum spp.	1 (171)		1		

Table 2 – the most frequent weed species found in 76 grassland reserves

Rank	Species	no. reserves
1	*Plantago lanceolata*	74
2	*Hypochaeris radicata*	72
3	*Sonchus oleraceus*	72
4	*Helminthotheca echioides*	67
5	*Avena barbata*	65
6	*Romulea rosea*	63
7	*Aira caryophyllea*	62
7	*Vulpia bromoides*	62
9	*Lolium perenne*	59
10	*Bromus hordeaceus*	57
11	*Brassica fruticulosa*	56
12	*Briza maxima*	54
13	*Briza minor*	53
14	*Nassella neesiana*	52
15	*Nassella trichotoma*	49
16	*Cirsium vulgare*	45
16	*Dactylis glomerata*	45
18	*Lactuca serriola*	44
18	*Paspalum dilatatum*	44
20	*Cynara cardunculus*	43

Figures

Fig 1 – A wall hanging garden in the UK beckoning passers-by to weed. Photo: [AUTHOR], August 2015

Fig 2: A long history of gardening the bush is affected in this sign at the You Yangs State Park. Photo: [AUTHOR], July 2015.