

Living with Invasive Plants in the Anthropocene: The Importance of Understanding Practice and Experience

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Abstract

The role of humans in facilitating the rapid spread of plants at a scale that is considered invasive is one manifestation of the Anthropocene, now framed as a geological period in which humans are the dominant force in landscape transformation. Invasive plant management faces intensified challenges, and can no longer be viewed in terms of 'eradication' or 'restoration of original landscapes'. In this perspectives piece, we focus on the practice and experience of people engaged in invasive plant management, using examples from Australia and Canada. We show how managers 1) face several pragmatic trade-offs; 2) must reconcile diverse views, even within stakeholder groups; 3) must balance competing temporal scales; 4) encounter tensions with policy; and 5) face critical and under-acknowledged labour challenges. These themes show the variety of considerations based on which invasive plant managers make complex decisions about when, where, and how to intervene. Their widespread pragmatic acceptance of small, situated gains (as well as losses) combines with impressive long-term commitments to the task of invasives management. We suggest that the actual practice of weed management challenges those academic perspectives that still aspire to attain pristine nature.

Keywords: invasive plant management, policy, pragmatism, social science, stakeholders, Anthropocene, Canada, Australia

INTRODUCTION

As increasing evidence of human influences is amassed, the Anthropocene has emerged as a broad discourse—both

scientific and popular—in which humans are understood as a dominant force in earth surface processes (Steffen et al. 2011). The Anthropocene offers particular challenges to invasion ecology and management practices, which tend to aspire to a purist ideal (Robbins and Moore 2012), implying that we can—or should—somehow live without invasive plants. This exclusionary view treats them as a self-evident category, and implies that they can be controlled and eradicated. In contrast, we draw upon the extensive literature in the social and ecological sciences that critically examines how weeds, and non-native and invasive species are conceptualised in different cultural contexts and their implications for decisions

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about when and how to manage them (Pfeiffer and Voeks 2008; Head 2012; Shackelford et al. 2013). For example, Foster and Sandberg (2004: 178) propose that in urban areas, in particular, “intelligent action veers toward... measured cohabitation” with invasive species. In this perspectives piece, we focus on the practice and experience of invasive plant managers to show what it means to live with invasive plants.

Although traditional biogeography and ecology would in theory claim a holistic remit that includes humans as part of earth’s biota, their usual practice has reinforced the separation between humans and the rest of nature (Robbins 2001; Larson 2007; Head 2012; Head et al. 2015). As Ellis and Ramankutty (2008: 445) have argued an outdated view of the world as “natural ecosystems with humans disturbing them”... remains the mainstream view. Two influential bodies of recent work have reconfigured biogeography and ecology to systematically include humans, and are particularly relevant to the discussion of invasive plants—novel ecosystems (Hobbs et al. 2006, 2013) and anthropogenic biomes (Ellis and Ramankutty 2008). The former, in particular, refers to ecosystems which “have departed entirely and irreversibly from their historical analogs” (Hobbs et al. 2014: 1), often at least partly due to intransigent invasive species, and which may now resist or exceed human intervention. Both these concepts help to dismantle the notion of a clear division between culture and nature (Castree 2014). A further important characteristic of the Anthropocene—as the example of climate change vividly illustrates—is that it is characterised by surprise and uncertainty. Processes set in train by human activity now escape human management and control, and significant thresholds may be crossed.

In the context of the Anthropocene, it seems quite clear that we often have to live with invasive species because the scale of change is now beyond complete human control or available resources. As an indicator of the scale of change, a recent book provides several sober assessments that the impacts of invasive species in protected areas around the world will continue to grow, with ecologists Meiners and Pickett (2013: 56) concluding that “we should expect and plan for plant invasions within protected areas”. Economic growth relies on agricultural trade and the expansion of cultivation into new areas; these activities simultaneously contribute to the spread of invasive species (Wittenberg and Cock 2001; Levine and D’Antonio 2003; McGeoch et al. 2010). As an example of the inadequate resources for the task, the costs of fire management in Australia’s Northern Territory have increased nine-fold in a decade due to Gamba grass (*Andropogon gayanus*) invasion (Setterfield et al. 2013). If anything, invasive plant management is projected to become an even bigger challenge under conditions of climate change (Hellman et al. 2008; Walther et al. 2009).

Environmental managers already accept invasive plants as a recurring theme in everyday life. Invasive plants have long been part of everyday activity for farmers and pastoralists, and few ever assume that they could live without them (Blanc-Pamard and Milleville 2004). As a local council weeds

officer from New South Wales (NSW) stated “Living without weeds is not an option. Weeds are here to stay. How we manage the situation determines to what extent we must share the environment with weeds”. Managing invasive plants is often just one part of a wider set of land management responsibilities, and needs to be incorporated into ongoing routines. It is a job that is never finished.

Too often, though, living with invasive plants is interpreted to mean mere apathy, that is giving up on attempts to prevent their spread. However, managers must continue to make complex decisions about when, where, and how to intervene, which we seek to document for the purpose of fleshing out precisely what it means to live with invasive species in the Anthropocene. Managers’ experiences vary in space, time, scale, and context, and are worth documenting because they offer critical insights into the basis of contemporary priority-setting and pragmatic decision-making.

Our perspective in this paper derives from two sources. First, we draw upon our own individual and collaborative research projects in Canada and Australia. For these projects, we used semi-structured interviews and participant observation methods to provide in-depth perspectives on everyday practice among various types of environmental managers (Figure 1). Full discussion of the methods is provided in the respective studies (Klepeis et al. 2009; Gill et al. 2010; Atchison and Head 2013; Rangan et al. 2014). These projects include work in peri-urban and changing land-use contexts as well as projects working across pastoral, government, and Aboriginal land tenure.

Second, we draw on discussions from a researcher-practitioner workshop in Wollongong, NSW, in February 2013 (Head et al. 2013). This transdisciplinary workshop assembled academics from Australia and Canada from a variety of disciplinary traditions (geography, anthropology, history, and ecology) as well as practitioners from across Australia managing weeds in



Figure 1

J. Atchison discusses gamba grass (*Andropogon gayanus*) and mission grass (*Pennisetum polystachion*) management on an urban site with members of the volunteer organisation Ludmilla Creek Landcare Group, Darwin, Northern Territory, Australia
Photo credit: L. Head

contexts such as state and local government, non-governmental organisations and Aboriginal land councils (about 20 people in total). Amongst other issues, the workshop examined whether there was a disjunction between the theoretical or policy ideal that some places be free from weeds and the practical experience of managers.

We acknowledge that the management of invasive species and the cultural responses to them change from region to region. Our perspectives from the colonial contexts of Australia and North America may be very different, for example, from those that stakeholders in tropical Asia might present. However, to date we have a much better understanding of these issues in the context of North America, Europe, and Australia, because little research has been conducted elsewhere. Nonetheless, Australia is often seen to be a leader in invasive species management, so we hope that this perspective piece will be useful more generally. Although we refer to ‘Aboriginal communities’, we recognise their great diversity and we do not intend to generalise (whether in Australia and Canada or elsewhere).

THE LABOUR AND PRACTICE OF INVASIVE PLANT MANAGEMENT

Our use of the term ‘managers’ is deliberately broad, and includes diverse people who seek to control invasive species, including government employees, landholders, Indigenous communities (whose title to land may or may not be formally recognised) and volunteers working in community groups. Our research and that of others analyses the experience of diverse invasive plant managers working in a variety of land-use contexts—agricultural and pastoral management, life-style oriented rural ownership, protected area conservation and restoration, Indigenous land co-management, and volunteerism in both urban and rural areas. Although we provide some cases from North America, most are from Australia, not least because Australia is so often put forward as a model of effective invasive plant management to be emulated around the world. Yet our results suggest that the experiences there provide limited support for international aspirations.

What kind of work does it take to manage invasive plants? Engaging with plants on the ground is only one aspect of the labour involved. Like many other aspects of environmental management, invasive plant management is a complex achievement requiring a network of scientific, bureaucratic, regulatory, and technological practices (Figure 2). The killing of plants requires a bodily engagement between individual people and plants, but this process cannot be effective without a strong infrastructure to support it. Research participants in state and local government bureaucracies consistently identified the importance of the following kinds of work—writing funding applications, reporting on funded grants, establishing and running community education programs, negotiating among adjacent landholders, and undertaking occupational health and safety training. To be effective, invasive plant management



Figure 2

Filling the helitorch with gelled petroleum ready to burn rubber vine (Cryptostegia grandiflora), Einasleigh River, Queensland, Australia
Photo credit: J. Atchison

strategies, declarations, and programs also require a strong connection to on-ground engagement.

A key practical challenge for managers is the scale of the problem versus the resources available to deal with it. Although some would argue that resourcing is thus the fundamental constraint, our evidence supports those who counter that this is a battle that can never be ‘won’ in a conventional sense (Larson 2005), and that we need to find different ways of dealing with issues because what we have now is not working. For example, pastoralists in Queensland recounted an instance where the cost of treating a particular invasive plant infestation was greater than the value of the property. If it is not possible to live without invasive plants, it is important to document—in order to improve, through social learning—the diverse ways in which we are living with them.

In what follows, we advance five themes that emerge from managers’ reflections on their labour and practices. We provide quotes from managers as exemplars of wider trends identified in our research. Our argument seeks to identify tensions between regulatory frameworks and pragmatic experience to help with future priority-setting.

Invasive plant managers face several pragmatic trade-offs

The typical experience of longstanding invasive plant managers is an acknowledgement of the impossibility of the task, and the necessity of making pragmatic trade-offs given the limited resources and time. Scientific debate (Davis et al. 2011; Simberloff 2011) often focuses on the trade-offs between native and non-native/invasive species, but the trade-offs we emphasise here are rather those between different invasive species. There is a real danger of trying to manage all species even when this is unrealistic, as documented for South Africa’s Working for Water program (Van Wilgen 2012). It is critical to prioritise species for control (Shackelford et al. 2013). For

example, in the Illawarra region of NSW, south of Sydney, ninety noxious weeds have been declared (DPI 2013), but it is not feasible for all of them to be controlled. In our workshop, one local officer acknowledged only being able to make a difference with management of one or two species, and he observed that “declaring a weed has never made it go away”. What declaration does is mobilises some resources and gains publicity that enables officers to coordinate efforts and make some headway.

The scarcity of time also forces managers to compromise and make tradeoffs in invasive plant management. For example, Aslan et al. (2009) found that more than half of Californian ranchers were ‘satisficers’ with respect to invasive plants—they find one or two control methods that work well enough and persist with these rather than invest further time and money in improving management. Similarly, an Australian grazier spoke to the unrelenting demands of invasive plants and his unwillingness to sacrifice other aspects of his life to their management: “You fight them, have a rest, and go and fight them again. I can’t spend my life chasing [serrated] tussocks (*Nassella trichotoma*)”.

In southeastern Australia, Lake (2009) found that people who moved to rural regions as a lifestyle choice made decisions about invasive plants based on what they thought was achievable in terms of a range of social and cultural factors related to both plant characteristics and their own land ownership aspirations. For example, in forested areas landholders otherwise engaged in restoration and invasive plant management had left large patches of lantana (*Lantana camara*) that would require significant additional resources to manage, instead focusing their attention elsewhere. Further tradeoffs in plant choices were made in not removing invasive plants believed to be relatively easy to control and in removing native plants that didn’t accord with landholders’ vision of ‘rural’ nature. For example, they removed native (and painful) giant stinging trees (*Dendrocnide excelsa*) and native vines for fear they would bring down tree branches.

Invasive plant managers must reconcile diverse views, even within stakeholder groups

Land managers and other stakeholders have a diversity of preferences, aspirations, and behaviours towards invasive plants. Council weeds officers in southeastern Australia administer the Noxious Weed Act and associated regulations in a region where there is a complex mixture of urban, industrial, and agricultural land uses that is a breeding ground for invasive plants. They are also likely to encounter different cultural meanings of weeds; what is a major pest plant to one person may be a desirable garden ornamental to another (Head and Muir 2006).

Even within a single stakeholder group there is often a diversity of sociocultural experiences and views. This is seen clearly in landscapes characterised by lifestyle-oriented rural ownership. In such areas, farmland is sold to new landholders who usually do not depend on land-based incomes and instead

buy land for a variety of lifestyle reasons, often including a desire to practice nature restoration (Abrams et al. 2012). The management choices of these new landholders take place within varying aspirations and senses of environmental stewardship (Gill et al. 2010; Klepeis et al. 2009; Wyborn et al. 2012). In a high amenity area in NSW, for example, Gill et al. (2010) identified three different stewardship orientations among lifestyle landholders. These included ‘lifestyle agrarian’ landholders who tend to oversee grazing and other agricultural activities, and have attitudes about land and plants that have more in common with farmers than other lifestylers. Such agrarian lifestylers are more likely to be worried about agricultural weeds than landholders representing the other two types, which are more conservation-oriented (Alam 2012). Highlighting the significance of scale, further complexities are evident *within* properties because lifestylers’ aspirations to create new homes and gardens on their land provide a significant avenue for new invasive plant introductions. Cooke (2013) and Cadieux (2011) found that lifestylers’ attempt to use the same species from their previous urban homes to build a sense of familiarity in a new place. At the property scale, lifestylers maintain a clear distinction between planting native plants outside the garden and both native and non-natives in their gardens (Gill et al. 2010).

Studies of environmental learning among lifestylers illustrate the dynamic and active formation of environmental knowledge and stewardship—with implications for the treatment of invasive species. In urban-to-rural migration or exurbanising rural Colorado, for example, such processes encompass debates among landowners around basic concepts, such as what counts as a “native grass” (Larsen et al. 2011). Further, stewardship ‘dispositions’ are not only *a priori* orientations brought to bear on a rural property, but they also evolve over time as landholders experience, work on, and observe their land (Gill 2013; Cooke 2013). Cooke (2013), for example, identified ‘active’ and ‘passive’ stewardship dispositions among lifestyle landholders in southeastern Australia. He showed how the behaviour of native or non-native plants themselves influenced landholders’ dispositions and provided a focus for their consequent management actions. For example, when plants behaved in a ‘weedy’ way (such as native colonising shrubs) they were more likely to be removed, especially if such behaviour did not conform to landholders’ existing understanding of the ecology and aesthetics of their land.

Aboriginal engagements with invasive species also provide an instructive example here. Previous overviews of Aboriginal attitudes emphasised the differences between Indigenous peoples and colonial stakeholders (Rose 1995; Trigger 2008), with subsequent discussion of how western scientific knowledge is privileged over Indigenous knowledge in land (including weed) management programs (Barbour and Schlesinger 2012). Views can be as divergent within Aboriginal communities as any other, and recent research also shows how their views about invasive species can be

revised through a process of engagement (Vaarzon-Morel and Edwards 2012).

Invasive plant managers must balance competing temporal scales

Our work draws attention to several temporal elements in addition to the prioritisation and juggling mentioned above. Environmental managers employed by state or federal government departments often combine invasive plant management with other tasks, intersecting cycles of time include funding cycles, seasonal cycles, and the longer time spans of seed banks (Atchison and Head 2013). Accounting for seed banks, in particular, is a long-term concern, due to the persistent and durable nature of some plant seeds (e.g., *Mimosa pigra*, whose seeds can survive in the soil for up to 25 years). The longevity of seeds—and the failure of funding programs to recognise their longevity—was commonly referred to by managers when explaining the inadequacies of the current (often short-term) funding arrangements for weed management. Many funding mechanisms for invasive plant management are now tied to fixed-term grants from different sources; programs that match the lifespans of plants are rare.

The discrepancies between the temporalities of the plants themselves and the social processes which seek to manage them is also seen in relation to prosecutions against those who fail to address invasive plant problems on their land. As another NSW local council weeds officer said “Taking people to court doesn’t stop weeds setting seed”.

Whether long-term battles are being won or are even worth fighting, is certainly debated amongst weed managers. One weed manager from Western Australia used the metaphor of “bashing [his] head against a brick wall” to explain his persistence and perseverance, and the contingency of the ‘wins’ that he thinks are possible: “this job will go on forever, whether it’ll be me or someone else, and in 200 years’ time your descendant will be interviewing my descendant about weed control”.

Invasive plant managers encounter tensions with policy

Managers are not all government professionals, but most have to interact with government at some point with regard to regulation and/or funding. Even government employees can find themselves, through their practical experience, in tension with legislative and policy processes. One example is when legislation frames particular understandings of non-native and invasive species that seem inadequate on the ground. A weeds officer with one Western Australian state department, for example, had concerns about the listing of calotropis because he recognised that some invasive plants are performing a valuable function, describing how calotropis (*Calotropis gigantea*) “holds a lot of the eroded country together... You can’t just label a species, it’s got to be put into context”.

Another example is when weed policy contradicts other kinds of land management policies, or when ‘best practice’ of one

industry conflicts with that of another. Extractive industries like sand mining, for example, are required to rehabilitate sites after mining is finished. Common rehabilitation practices include stockpiling topsoil during mining and then respreading it across a site to return the local indigenous seedbank and encourage revegetation. Stockpiling soil, however, is a disturbance and can lead to weed infestations. Miners reported to us that weed infestation is minimised if they dispose of topsoil and leave the site denuded, which is against best practice in their industry (not to mention ecological intuition).

Most managers with long experience recount changes in government and scientific priorities. The prickly acacia (*Acacia nilotica*) in Queensland provides a good example (Rangan et al. 2014). It was promoted as a shade and fodder tree in grassland zones with seed distribution by the Department of Primary Industries from the 1920s to the 1980s. The government’s attitude towards this plant began changing in the 1970s (in other departments), and since the 1990s it has been the focus of a major control program. Such changing priorities and shifts in funding mechanisms can become wearying for practitioners as well as a source for scepticism and tension if the government is perceived to be inconsistent. Cook and Dias (2006) have argued that weed policy needs to more explicitly recognise the history of plant introductions, including in particular where government has been the introductory agency, if trusting relationships are to be built between land managers and government in the future.

Invasive plant managers face critical and under-acknowledged labour challenges

The mostly short-term and contractual nature of funding for invasive plant management raises issues of training, capacity-building, and long-term labour availability. There are also significant issues of risk and chemical safety; in tropical Australia the scale of the invasive plant problem is such that, almost without exception, invasive plants are managed with a variety of chemical treatments. Workers thus face several forms of human health and safety risks, apart from the need to wear the necessary protective clothing and respirators in searing heat and humidity; further the secondary ecological effects of herbicides are often unknown (Atchison and Head 2013).

Within Australian government departments, it was not unusual for us to interview weed managers responsible for managing weeds across vast tracts of land, especially in the north of Australia. For example, one major land management agency within the Northern Territory maintains one person to coordinate weed management across the entire Northern Territory. Where agencies have access to recurrent funding, one response has been to outsource or engage contractors to manage weeds on public lands; while key contractors are perceived to be providing a good service, others are well known to be poor operators who have an inconsistent approach to the work. The availability of quality contractors willing and able to take on weed management is a key limiting factor in northern Australia and a source of concern for many managers. Beyond

staffing issues, managers commonly report problems related to the discontinuity of employment and the ensuing challenge of maintaining knowledge when there is high turnover. These labour issues are not unique to weed management, but create additional challenges in responding efficiently where ecosystems are transforming rapidly.

There are particular challenges for invasive plant management on Indigenous lands (Bhattacharyya and Larson 2014). In Australia, where Indigenous people now own or control 23% of the land area (Altman 2011), communities have highly variable socioeconomic capacities to undertake such work, properties handed back are often in very poor condition, and there is a lack of clarity around who is obliged to manage weeds on native title lands (Duff and Weir 2013). In practice, much focus is on those species that have radically altered or restricted access to hunting and gathering grounds, especially wetlands (Figure 3). In some instances, management can have a disproportionately negative influence on Indigenous peoples, which raises issues of environmental justice. In California, USA, for example, Norgaard (2007) documents how members of the Karuk tribe face greater exposure to herbicides used to control invasive species.

More broadly, in community or volunteer management contexts, the assemblage of skills and resources needed for weed control is often too informal and tenuous. Meesham and Barnett (2008) describe the role of volunteering in Australian Natural Resource Management programs, such as Landcare or Bushcare, arguing that there is a fine line between community education and abuse of volunteers (*cf.* recent studies of the efficacy of poverty reduction in the Working for Water program in South Africa, e.g., McConnachie et al. 2013). Our research suggests that there are important motivational drivers and opportunities

for the people involved, beyond the labour of weeding, including opportunities for local social engagement and physical activity. We have also encountered contexts where ‘work-for-the-dole’ (working for unemployment benefits) and prison labour are included under the ‘volunteer’ category. Maintaining, developing, and resourcing such groups so they can engage in, and sustain, the labour of invasive plant management is not a trivial task.

CONCLUSION: LIVING WITH INVASIVE PLANTS

We have provided a number of examples of how people are living with invasive plants in the Anthropocene. In many respects, they have already moved beyond the argument about whether we can or should maintain a ‘pure’ state of nature untrammelled by non-native and invasive species. Yet none of these managers have given up; in fact they maintain a shared sense of pragmatism and a long-term commitment to ‘hang in there’. The documented capacities, practices, and experiences of invasive plant managers provide not only an important and under-acknowledged resource, but also a corrective to unfeasible policy.

In summary, we argue that scientists need to recognise what on-ground managers are doing with invasive plants, and that their adaptive strategies to establish the boundaries of cohabiting with these plants reflect a sensible approach to living in the Anthropocene. We have documented considerable experiential depth and contextual subtlety in the accumulated record of managers’ practices towards invasive species, but it is not visibly drawn upon in most policy making. The specifics of what that cohabitation looks like will vary with geographical and social context. In contrast to traditional risk management of invasive species, we thus require adaptive governance that incorporates the views and perspectives of a range of different stakeholders (Cook et al. 2010), especially those charged with dealing with invasives on the land.

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REFERENCES

- Abrams, J., H. Gosnell, N. Gill, and P. Klepeis. 2012. Re-creating the rural, reconstructing nature: an international literature review of the environmental implications of amenity migration. *Conservation & Society* 10: 270-284.
- Alam, M. 2012. Invasive plant management in complex social landscapes: a case study in coastal New South Wales in Australia. M.Sc. thesis. University of Wollongong, NSW, Australia.



Figure 3

Malak Malak Ranger on a wetland of the Daly River, Northern Territory, Australia with three Weeds of National Significance (*Salvinia molesta*, *Mimosa pigra*, and *Hymenachne amplexicaulis*).
Photo credit: J. Atchison

- Altman, J.C. 2011. Alternate development for Indigenous territories of difference. Canberra: Centre for Aboriginal Economic Policy Research, Topical Issue No. 5/2011.
- Aslan, C.E., M.B. Hufford, R.S. Epanchin-Niell, J.D. Port, J.P. Sexton, and T.M. Waring. 2009. Practical challenges in private stewardship of rangeland ecosystems: yellow starthistle control in Sierra Nevada foothills. *Rangeland Ecology and Management* 62: 28-37.
- Atchison, J. and L. Head. 2013. Eradicating bodies in invasive plant management. *Environment and Planning D: Society and Space* 31: 951-968.
- Barbour, W. and C. Schlesinger. 2012 Who's the boss? Post-colonialism, ecological research and conservation management on Australian Indigenous lands. *Ecological Management and Restoration* 13: 36-41.
- Bhattacharyya, J. and B.M.H. Larson. 2014. The need for indigenous voices in discourse about introduced species: insights from a controversy over wild horses. *Environmental Values* 23: 663-684.
- Blanc-Pamard, C. and P. Milleville. 2004. Cultiver avec, cultiver contre... Les mauvaises herbes. In: *Agro-tribulations* (eds. Blanc-Pamard, C., J.-P. Deffontaines, S. Lardon, C. Raichon, and S. Zasser-Bedoya). Pp. 21-27. Paris: Quae Publishing.
- Cadieux, K.V. 2011. Competing discourses of nature in exurbia. *GeoJournal* 76: 341-363.
- Castree, N. 2014. *Making sense of nature*. Abingdon and New York, NY: Routledge.
- Cook, G.D. and L. Dias. 2006. It was no accident: deliberate plant introductions by Australian government agencies during the 20th century. Turner review No. 12. *Australian Journal of Botany* 54: 601-625.
- Cook, D.C., S. Liu, B. Murphy, and W.M. Lonsdale. 2010. Adaptive approaches to biosecurity governance. *Risk Analysis* 9: 1303-1314.
- Cooke, B. 2013. The practice of conservation management in rural-amenity landscapes: a dwelt human-environment perspective. Ph.D. thesis. RMIT University, Melbourne, Australia.
- Davis, M.A., M.K. Chew, R.J. Hobbs, A.E. Lugo, J.J. Ewel, G.J. Vermeij, and J.C. Briggs. 2011. Don't judge species on their origins. *Nature* 474: 153-154.
- DPI (Department of Primary Industry, NSW, Australia). 2013. *Noxious weed declarations for Illawarra District Weeds Authority*. <http://weeds.dpi.nsw.gov.au/>. Accessed on September 28, 2013.
- Duff, N. and J. Weir. 2013. *Weeds and native title: law and assumption*. Canberra: Rural Industries Research and Development Corporation, Publication No. 13/078, ISBN 978-1-74254-571-574.
- Ellis, E.C. and N. Ramankutty. 2008. Putting people in the map: anthropogenic biomes of the world. *Frontiers in Ecology and the Environment* 6: 439-447.
- Foster, J. and L.A. Sandberg. 2004. Friends or foe? Invasive species and public green space in Toronto. *Geographical Review* 94: 178-198.
- Gill, N. 2013. Making country good: stewardship and environmental change in Central Australian pastoral culture. *Transactions of the Institute of British Geographers* 39(2): 265-277.
- Gill, N., P. Klepeis, and L. Chisholm. 2010. Stewardship among lifestyle oriented rural landowners. *Journal of Environmental Planning and Management* 53: 317-334.
- Head, L. 2012. Decentering 1788: beyond biotic nativeness. *Geographical Research* 50: 166-178.
- Head, L., J. Atchison, and N. Gill. 2013. *Living with, living without weeds: bridging theory and practice*. Australian Centre for Cultural Environmental Research (AUSCCER) discussion paper 2013/01. Available at <http://www.uow.edu.au/content/groups/public/@web/@sci/@eesc/documents/doc/uow150608.pdf>
- Head, L., J. Atchison, and C. Phillips. 2015. The distinctive capacities of plants: insights from an adversarial relationship. *Transactions of the Institute of British Geographers* 40(3): 399-413.
- Head, L. and P. Muir. 2006. Suburban life and the boundaries of nature: resilience and rupture in Australian backyard gardens. *Transactions of the Institute of British Geographers* NS 31: 505-524.
- Hellmann, J.J., J.E. Byers, B.G. Bierwagen, and J.S. Dukes. 2008. Five potential consequences of climate change for invasive species. *Conservation Biology* 22: 534-543.
- Hobbs, R.J., S. Arico, J. Aronson, J.S. Baron, P. Bridgewater, V.A. Cramer, P.R. Epstein, et al. 2006. Novel ecosystems: theoretical and management aspects of the new ecological world order. *Global Ecology and Biogeography* 15(1): 1-7.
- Hobbs, R.J., E.S. Higgs, and C.A. Hall. (eds.). 2013. *Novel ecosystems: intervening in the new ecological world order*. Oxford: Wiley-Blackwell.
- Hobbs, R.J., E.S. Higgs, and J.A. Harris. 2014. Novel ecosystems: concept or inconvenient reality? A response to Murcia et al. *Trends in Ecology and Evolution* 29(12): 645-646.
- Klepeis, P., N. Gill, and L.A. Chisholm. 2009. Emerging amenity landscapes: invasive weeds and land subdivision in rural Australia. *Land Use Policy* 26: 380-392.
- Lake, E. 2009. *Restoration on private land: management practices and motivation of landowners. A case study of Jamberoo valley, NSW*. Honours thesis. University of Wollongong, NSW, Australia.
- Larsen, S.C., M. Foulkes, C.J. Sorenson, and A. Thompson. 2011. Environmental learning and the social construction of an exurban landscape in Fremont County, Colorado. *Geoforum* 42: 83-93.
- Larson, B.M.H. 2005. The war of the roses: demilitarizing invasion biology. *Frontiers in Ecology and the Environment* 3: 495-500.
- Larson, B.M.H. 2007. Who's invading what? Systems thinking about invasive species. *Canadian Journal of Plant Sciences* 87: 993-999.
- Levine, J.M. and C.M. D'Antonio. 2003. Forecasting biological invasions with increasing international trade. *Conservation Biology* 17: 322-326.
- McConnachie, M.M., R.M. Cowling, C.M. Shackleton, and A.T. Knight. 2013. The challenges of alleviating poverty through ecological restoration: insights from South Africa's "Working for Water" program. *Restoration Ecology* 21: 544-550.
- McGeoch, M.A., S.H.M. Butchart, D. Spear, E. Marais, E.J. Kleynhans, A. Symes, J. Chanson, et al. 2010. Global indicators of biological invasion: species numbers, biodiversity impact and policy responses. *Diversity and Distributions* 16: 95-108.
- Meesham, G. and G.B. Barnett. 2008. Environmental volunteering: motivations, modes and outcomes. *Australian Geographer* 39(4): 537-552.
- Meiners, S.J. and S.T.A. Pickett. 2013. Plant invasions in protected landscapes: exception or expectation? In: *Plant invasions in protected areas: patterns, problems and challenges* (eds. Foxcroft, L.C., P. Pyšek, D.M. Richardson, and P. Genovesi). Pp. 43-60. Springer: Netherlands.
- Norgaard, K.M. 2007. The politics of invasive weed management: gender, race, and risk perception in rural California. *Rural Sociology* 72: 450-477.
- Pfeiffer, J.M. and R.A. Voeks. 2008. Biological invasions and biocultural diversity: linking ecological and cultural systems. *Environmental Conservation* 35: 281-293.
- Rangan, H., A. Wilson, and C. Kull. 2014. Thorny problems: industrial pastoralism and managing 'country' in Northwest Queensland. In: *Rethinking invasion ecologies from the environmental humanities*. (eds. Frawley, J. and I. McCalman). Pp 116-134. London: Earthscan for Routledge.
- Robbins, P. 2001. Tracking invasive land covers in India, or Why our landscapes have never been modern. *Annals of the Association of American Geographers* 91: 637-659.
- Robbins, P. and Moore, S.A. 2012. Ecological anxiety disorder: diagnosing the politics of the Anthropocene. *Cultural Geographies* 20: 3-19.
- Rose, B. 1995. *Land management issues: attitudes and perceptions amongst aboriginal people of Central Australia. Report for the Cross Cultural Land Management Project*. Central Land Council, Alice Springs.

- Setterfield, S.A., N.A. Rossiter-Rachor, M.M. Douglas, L. Wainger, A.M. Petty, P. Barrow, I.J. Shepherd, et al. 2013. Adding fuel to the fire: the impacts of non-native grass invasion on fire management at a regional scale. *Public Library of Science (PLoS) ONE* 8(5): e59144.
- Shackelford, N., R.J. Hobbs, N.E. Heller, L.M. Hallett, and T.R. Seastedt. 2013. Finding a middle-ground: the native/non-native debate. *Biological Conservation* 158: 55-62.
- Simberloff, D. 2011. Non-natives: 141 scientists object. *Nature* 475: 36.
- Steffen, W., J. Grinevald, P. Crutzen, and J. McNeill. 2011. The Anthropocene: conceptual and historical perspectives. *Philosophical Transactions of the Royal Society Series A* 369: 842-867.
- Trigger, D.S. 2008. Indigeneity, ferality, and what 'belongs' in the Australian bush: Aboriginal responses to 'introduced' animals and plants in a settler-descendant society. *Journal of the Royal Anthropological Institute (N.S.)* 14: 628-646.
- Vaarzon-Morel, P. and G. Edwards. 2012. Incorporating Aboriginal people's perceptions of introduced animals in resource management: insights from the feral camel project. *Ecological Management and Restoration* 13: 65-71.
- Van Wilgen, B. 2012. Evidence, perceptions, and trade-offs associated with invasive alien plant control in the Table Mountain National Park, South Africa. *Ecology and Society* 17: 23-37.
- Walther, G.R., A. P.E. Hulme, M.T. Sykes, P. Pysek, I. Kühn, M. Zobel, S. Bacher, et al. 2009. Alien species in a warmer world: risks and opportunities. *Trends Ecology and Evolution* 24: 686-693.
- Wittenberg, R. and M.J.W. Cock. (eds.). 2001. *Invasive alien species: a toolkit of best prevention and management practices*. CAB International: Wallingford.
- Wyborn, C., S. Jellinek, and B. Cooke. 2012. Negotiating multiple motivations in the science and practice of ecological restoration. *Ecological Management and Restoration* 13(3): 1-5.

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