
Eradicating bodies in invasive plant management

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Abstract. It is increasingly acknowledged that invasive plant management, although a significant global issue, is a matter of coexistence rather than control. Nevertheless an adversarial rhetoric dominated by discourses of war and winning persists. This paper focuses on the bodies of plants, the animals with which they become entangled, and the humans who are charged with eradicating them. Plants help to rethink bodily difference beyond the human, extending feminist theories that have contributed to increased recognition of nonhuman difference. Bodies are a barely acknowledged scale of invasive plant management, which is usually conceptualised in landscape terms. Our empirical focus is the eradication of three species in northwestern Australia: *Mimosa* (*Mimosa pigra*), Gamba Grass (*Andropogon gayanus*), and Neem (*Azadirachta indica*). By paying attention to plant difference and illuminating the experience of invasive plant managers, we show how eradication manages the intersecting timespaces of different bodies in order to stop plants becoming collectives. We identify contradictions in the regulation and application of borders, which are less permeable for some animals than for all humans. We also draw attention to the questions of risk—for humans and others—in the process of killing plants. For embodied geographies, a plant perspective opens up new ways of thinking about bodily boundaries: in particular the individual/collective divide. The implication for invasive plant management is that, even at the eradication end of the spectrum, effective management is an uncertain process that involves living in association with invasive plants rather than living separately from them.

Keywords: invasives, biosecurity, tropical weeds, embodied geographies, eradication, Western Australia

Introduction

The porous bodies, multiple spaces, and open futures now evident in the “multinatural geographies of the Anthropocene” (Lorimer, 2012) have been widely examined, not least in biosecurity and invasive species debates. We cannot appeal to a past or stable Nature, separable from human activity, as the basis of decision making. The degree of possible human control in processes previously encapsulated as ‘environmental management’ will be variable and sometimes illusory. However, this uncertainty does not relieve us from having to make political choices, notwithstanding that older ideas about justice as balance may not work anymore (Clark, 2011). In this paper we argue that closer attention to plants and plant bodies can help provide the new political tools for “deciding among multiple biodiversities” (Lorimer, 2012, page 9) in invasive plant management.

Invasive alien species are seen as a significant threat to global biodiversity and the viability of agriculture and other human enterprises (McGeoch et al, 2010; Wittenberg and Cock, 2001, page 1). Invasive plant management is projected to become an even bigger issue with climate change, requiring considerable economic and social investment. Perhaps because of the scale at which the problem is understood, even the modernist management paradigm acknowledges that choices have to be made among competing priorities, and that in many

situations accommodation and coexistence is the most viable choice. De facto recognition of coexistence is seen in the spatialisation of invasive plant management in Australia, which frequently distinguishes between spaces where exclusion, eradication, containment, or control are possible, different activities being recommended and resourced in each (NRMMC, 2007).

Plants pose a number of challenges to Western thought (Hall, 2011; Marder, 2011), including the conceptualisation of the body itself. As detailed below, we take inspiration from Grosz and other feminist scholars, understanding bodies as a continual process of becoming, simultaneously material and conceptual. Most writing about bodies tends to assume that the bodies under discussion are human or at least animal (Bissell, 2008; 2011; Longhurst, 2011). Here we extend the discussion of bodies to plants, both in their specific material expression and as a conceptual device to think about nonhuman difference. Plant bodies are both the same as and different from human and other bodies; they resist and move (as animals might) but they do these things differently. This paper focuses on the bodies of plants, the animals they interact with, and the humans who are charged with managing them, for two reasons. First, plants help to rethink bodily difference beyond the human (and the animal), extending explicitly feminist theories that have made significant ground in the recognition of nonhuman difference (Hird and Roberts, 2011). We examine the ways plant bodies challenge our understanding of individual and collective bodies. In attending to the rhythms and temporalities of plant mobility and reproduction, and the ways these intersect (or not) with the temporalities and movements of animal and human bodies, our empirical analysis aims to bring neglected plants into embodied geographies. Plant bodies challenge and energise human-centred concepts of the body by expressing different forms of collectivity, mobility, and agency.

Second, bodies are a barely acknowledged scale and space of invasive plant management, which is usually conceptualised at much larger landscape scales. Our empirical focus is the spaces of eradication of three invasive plant species in northwestern Australia: *Mimosa pigra*, Gamba Grass (*Andropogon gayanus*), and Neem (*Azadirachta indica*). Although invasive plant management is often framed as a continental-scale problem, using maps of frontiers and a discourse of war, eradication is undertaken at the micro scale, in spaces where human, animal, and plant bodies interact. At this scale, humans are trying to stop plants becoming collectives; it is the plant collective that constitutes the problem of invasiveness. As we will show, once the plants are already collectives, policy deems eradication not to be feasible. These are variable spacetimes—lines, outbreaks, patches, seasons—but they have in common that they host the material interaction of small groups of human and plant bodies, the former attempting to kill the latter. Analysing invasive plant management at the bodily scale highlights new political and ethical choices not otherwise visible.

The structure of this paper proceeds as follows. We first provide an overview of the spatial logics of invasive plant management in both scientific debates and Australian policy frameworks. This leads us to the scale and spaces of the body. We consider the conceptual challenges of understanding and managing bodies, including plant bodies. The empirical results of our study in northwestern Australia—at the border between the Northern Territory (NT) and Western Australia (WA)—follow. We understand invasion as a relational process in which many different lives—human and nonhuman—are embedded together, so our concern is to examine the lived experience of this process and what actually takes place. We use field observations and interviews from the dry seasons of 2011 and 2012 to examine how eradication is conceptualised and practised; how those lives are pulled about.

The spatial logics of invasive plant management

Here we draw attention to three intersecting dimensions of spatiality: scale, mobility, and spaces of belonging/exclusion. Although there is recognition that invasions are “neither novel nor exclusively human-driven phenomena” (Mack et al, 2000), from a global perspective biotic invasion is seen as a problem exacerbated by human mobility through trade (Hulme, 2009). Notwithstanding Hinchliffe and Bingham’s (2008, page 1534) call to “pitch discourses of biological immanence and emergence against forms of social science thinking which tend to trace overarching logics or seemingly unstoppable forces in matters of power and politics”, the social sciences have recently established rather well that biosecurity is a matter of living with the exuberant and the uncontainable. This life takes place in mobile and shifting spaces, where borders are not lines (Muller et al, 2009) and where “the focus is on good and bad circulation rather than on restricting movement per se” (Hinchliffe and Bingham, 2008, page 1535). Mobility is also viewed differently in relation to different species, our attitudes to human mobility contrasting starkly with the mobility we allow (or not) to other species (Clark, 2002). Studies have examined a variety of scales, from the international (Maye et al, 2012) to the molecular (Braun, 2007), while also acknowledging that any particular scale of activity is constituted by diverse everyday practices (Donaldson, 2008; Hinchliffe and Bingham, 2008; Law and Mol, 2008; Muller et al, 2009). Close examination has added nuance to blanket proscriptions of alien species, which may operate as invasives only in certain situations and certain places, mirroring other discourses of alien races, native peoples, and xenophobia (Barker, 2008; Head, 2012; Head and Muir, 2004; Warren, 2007). Together this body of work challenges prevailing national or continental scale discourses of defence, invasion, and fear (Muller et al, 2009).

Hinchliffe et al (2012, page 1) have examined the spatial assumptions around biosecurity, arguing for a shift in focus “away from defined borderlines towards that of borderlands” (page 1), and away from a geometry “that tends to conceptualise healthy life and disease as separate spaces, with biosecurity understood as a practice of demarcating and shoring up borderlines” (page 2). They critique the will to closure in policy, since “enclosing life is no guarantee of safety. That which is enclosed may be subject to threats from within” (page 5). The empirical cases of poultry disease in that study, and invasive plants in ours, are somewhat different. Like Barker (2008), we will show that a pragmatic acknowledgement of complexity is already present on the ground, in the borderlands. The work of eradication shows that some borders do work, although they may not be the most obvious ones.

Hinchliffe et al are also concerned to put forward a more topological conception of space, in which rearrangements leading to disease “are expressed through spatial intension rather than spatial extension; that is, they emerge through the intensity of the relationships that compose the spaces of which they are a part, rather than through their extended distribution in a networked space” (2012, page 8). Our focus has some things in common with the topological framing by Hinchliffe et al of “a landscape in which borders are detached from geographic territory” (page 8); the long-lived seed bank provides a parallel, or at least comparative, example to disease. However, our focus on nonhuman difference via bodily interactions emphasises a novel set and scale of relational intensions and risk around individuality and collectivity.

Spatial logics in Australian invasive plant management

For a variety of reasons including scarce resources, invasive plant management and policy in Australia are currently designed according to a species prioritisation process, a key feature being the list of Weeds of National Significance (WoNS), which arose out of the ‘National Weeds Strategy’ (1997), later rereleased in 2007 as the ‘Australian Weeds Strategy’ (NRMCC, 2007). Iterations of this strategy have drawn attention to the background of complex and often

inconsistent approaches to weed policy and legislation across the different state, territory, and local government settings, arguing that more effective coordination and collective effort were required (Thorp and Lynch, 2000). Although most of the statutory power and therefore responsibility in relation to weeds lies with state and territory governments [as outlined by Williams and West (2000)], the Australian federal government through this national prioritisation process can effectively direct natural resource including weed management through its funding processes. This is one in a series of Commonwealth natural resource management interventions which have been critiqued at length (Robins and Kanowski, 2011). In parallel to this process, most states and territories still maintain their own prioritisation process including prescribed management actions.

The criteria against which the national priority WoNS species were evaluated draw from the ecological literature in assessing factors such as invasiveness, impacts, and the potential for spread, although the determination process is arguably geared toward a legalistic framing, described by its authors as “objective, transparent and defensible, rather than scientific” (Thorp and Lynch 2000, page 1). Spatial belonging is denoted by the concept of nativeness, notwithstanding considerable critique of this concept (Davis et al, 2011). Whether such belonging leads to borderlines or borderlands, metaphors of invasion, competition, and war are pervasive (Downey, 2011; Larson, 2008). These framings “naturalise antagonistic ways of relating to the natural world” (Larson, 2008, page 169).

For each of the listed species, a national strategic plan outlines a set of desired outcomes including (in order of priority): prevention from spread; minimisation of adverse impacts in areas where already established; maintenance of national commitment; and provision of coordination at the national level. These national strategic plans guide the spatial and temporal logic abbreviated as PECA (prevention, eradication, containment, asset protection); first and foremost exclusion (or prevention) prevents the establishment of new outbreaks, and second eradication zones are established in conjunction with containment lines, beyond which sit the control zones. Eradication is generally agreed by biologists to be the most desirable objective, but its feasibility is spatially variable. Efforts are most successful at occupancy areas less than 1 hectare (Davis, 2009, page 139). Management zones are mapped out and articulated in the relevant state or territory weed legislation and accompanying statutory management plan. Goals and actions within PECA, including eradication and control zones, are said to follow the ‘typical’ invasion trajectory where options correspond to the ecological stages of invasion (Davis, 2009, page 134), see for example the *NSW Alligator Weed Strategy 2010–2015* (DPI, 2010).

Our approach focuses on these ‘highly significant’ spaces and processes of eradication in northwestern Australia, where there are coordinated efforts to contain various ‘incursions’ of nationally prioritised species. These efforts work in conjunction with management of species ranked via different (ie, state or territory) schemes, and species not ranked or prohibited at all but which are considered by local managers to be weedy or invasive. Somewhat paradoxically, parts of northern Australia are also noted for their ‘relatively unmodified state’; some Aboriginal lands, for example, ranked amongst the least weedy in a recent survey (Preece et al, 2010). In this context northern WA is commonly viewed as one of the last places free of species well established further east, and is increasingly seen by some as the ‘front line’.

Bodies, lines, and plants

In turning the focus from human bodies to those of plants, we draw on feminist approaches to the messy materiality of bodies, particularly the work of Grosz (1994). Aiming to ‘extricate’ the body from the Cartesian dualism of mind/body and subject/object, Grosz urged scholars towards a feminist corporeality, to take the specificity of bodies (in her case female human ones) seriously. Thus bodies are understood as “a series of processes of becomings,

rather than a fixed state of being ... both active and productive” (page 12). The individuality of bodies “is the consequence of their specific modalities, their concrete determinations, and their interactions with the determinations of other things” (page 11). Bodies have “the ability ... to always extend the frameworks which attempt to contain them, to seep beyond their domains of control” (page xi). Bodies have been a productive site of geographic enquiry for nearly two decades (Callard, 1998; Longhurst, 1997).

The notion of bodies as becoming, and as inextricable from the messy materiality of the world (Bennett, 2010; Haraway, 2008; Hird, 2009), is now a familiar theme in the more-than-human literatures of relevance to biosecurity debates (Amoore and Hall, 2009; Braun, 2007). For example, Muller et al (2009, page 785) argue that the “bodies of residents and bodies of mosquitoes” have agency, and discuss how the Quarantine Service aims to contain the spread of ‘risky bodies’. These perspectives differ from the way bodily metaphors have been present in invasion biology, for example when invasion is articulated as disease, or alternatively when it is thought of as war. Such metaphors work to demarcate species in the same way that invading soldiers or disease-bearing microbes might be quarantined (Larson, 2008; 2011). An underlying implication at work (extending into management and policy contexts) is that bodies are individual and bounded, separate, and containable.

Beyond questions of materiality and bodily boundedness lies the issue of whose bodies are being discussed. As Longhurst argued some time ago (1995; 1997), we still face the problem of paying attention to the *specificity* of matter and the bodies in question, or as Lulka (2009) argued, of paying attention to the differences in nonhuman difference.

Here we take seriously the bodies of plants. We suggest that a corporeal refiguring, examined through the relations of invasion and eradication, provides new insights into the kinds of things that plant life does, and how plants come together with other nonplant (including human and animal) bodies. Head et al (2012) confront the question ‘what is a plant?’, illustrating that no single characteristic captures ‘plantiness’. Instead, plants *emerge* as an assemblage of shared differences from other beings, where common capacities manifest in different material form. One example is the plant capacity for sporic meiosis, where two morphologically distinct bodies alternate in the life history (Graham et al, 2000). This is further complicated by growth and development; a process in plants not simply of enlarging juveniles (as with animals) but of building assemblies or ‘confederations’ of new and old members (Firn, 2004).

Plant bodies are also extremely variable. Ingold (2011) suggests that, if we were to begin our philosophy or understanding of life and relations as mycologist Rayner (1997) has, we might instead have begun “against the boundary of absolute and fixed forms ... [starting] from the fluid character of the life process, wherein boundaries are sustained on the continual flow of material across them” (Ingold, 2011, page 86). Like fungi and some invertebrates, plants have identity across ‘dynamic boundaries’; they have material form as both individual and collective, self and nonself, fixture and indeterminacy, versatility and degeneracy, balancing between associative and dissociative processes (Rayner, 1997). Plants thus provide yet another example of the diversity of individuations and groupings encountered in more-than-human studies (Bear and Eden, 2011). This is not to suggest that these tensions are unique to plants, as Hinchliffe (2001) has illustrated in the example of prion mutability and indeterminacy; rather, that all organisms including humans configure these tensions differently and a full account of the “other players at work” (Robbins and Marks, 2010) is required.

Hitchings (2003; 2007a) illustrated how plants are negotiated in the context of private London gardens and centres where they are consumed. Individual plants and plant collectives manifest in a range of complicated and, for the humans trying to commodify and purchase them, uncomfortable ways, all of which have direct implications for domestic

sustainability and well-being. A focus on bodies allows us to be attentive to the potentially different practices of plants—but it also takes us beyond landscapes. As Hitchings (2007b) argued, some kinds of plant agency are masked by a predominant focus at particular scales. In the case of invasive plant management, continental and landscape scales have been the predominant focus. Our results show what has been foregrounded at the landscape scale, as well as illuminating through bodies other kinds of plant agency taking place in the spaces of eradication.

In paying attention to the specificity of plant bodies, we also wish to interrogate the spatial ‘logic’ of invasive plant management as it is currently framed. That is, we take issue with the policy paradigm of managing this relation by applying the linear ‘ecological’ trajectory of invasive population stages on to flat topographic space via a process of making bodies separate—both individual plant from collective and plant from human. In doing so, we attend to Jones’s (2009, page 429) call for a “topological theory of space, place and politics as encountered, performed and fluid” in which the relations are seen as both spatial and temporal. Hinchliffe et al’s (2012) topological shift is achieved by questioning the spatial assumptions underpinning outbreaks. Similarly we question the spatial assumptions inherent in this ‘logic’ of bounding and quarantining bodies. It is our contention that by acknowledging what is actually and already happening, including what is uncertain, we may envisage a different biopolitics of living with these plants.

The bodies in question

Many plants were examined and discussed in the course of our fieldwork but the three plant species we focus on here are Mimosa (*Mimosa pigra*), Gamba Grass (*Andropogon gayanus*), and Neem (*Azadirachta indica*). Both Mimosa and Gamba Grass are formally declared weeds and WoNS species. Gamba Grass was listed in the 2012 additions, having been previously designated a declared plant under the NT *Weeds Management Act* (2010). Neem is undeclared but considered by many people to be both a weed and invasive. All three species are managed together within a range of management and land tenure contexts, including by the same people. In using and focusing on *species* we want to bring to light both their shared differences, as plants from other beings, and their species-specific capacities. This of course raises the question of what unit of analysis is relevant (species, populations, individual plants, or seeds). A focus on the body challenges these units, as we discuss below.

The shrub Mimosa was most likely introduced from central and south America into Australia via the Darwin herbarium sometime during the late 19th century, but was only discovered growing outside the city area in the 1950s and 1960s (Walden et al, 2004). Aided by unusually heavy and sustained monsoonal seasons as well as large populations of Asian water buffalo, it became established over large sections of more than seven tropical river and wetland systems of the NT during the 1970s. Mimosa now covers some 140 000 ha of the NT, with small outbreaks found in the last decade in Queensland and northern WA (Bailey, 2009). According to climatic and ecological models, between 4.2 to 4.6 million ha of Australia are at risk from Mimosa (Walden et al, 2004).

Mimosa establishes dense monospecific stands which double in area every 12–18 months, converting sedgelands and wet grasslands into dry shrubland. It poses a range of ecological, social, cultural, and economic threats, including to wetland biodiversity, and to the productive capacity of the pastoral and tourism industries (Walden et al, 2004). Mimosa’s ecological success and potential for invasiveness is complex but (briefly) is underpinned by its ability to distribute its seeds over great distances, facilitated by seed pods covered in hairs. These pods fracture into individual watertight seed casings which can float, and so are widely distributed in aquatic settings away from the parent plant. They also get very effectively stuck in animal hair, human clothing, and machinery (Walden et al, 2004). A mature tree can

produce up to 220 000 seeds per year, and while viability varies according to environmental conditions, seeds may be viable for up to twenty-five years. Mimosa can flower and set seed as quickly as four months after it first germinates. It is also resistant to fire, herbivory, aridity, and flooding. A range of chemical, mechanical, fire, and biological control techniques are used to kill Mimosa; the success of these is variable (NRETAS, 2010a).

Gamba Grass (*Andropogon gayanus*) was introduced from Africa to Australia as part of a Commonwealth government pasture improvement programme in the 1930s. It is now widely established in savanna ecosystems in the NT. A perennial tussock growing to four metres, Gamba Grass produces large amounts of seed (70 000 per m²) and grows in a wide range of environments (Flores et al, 2005). It outcompetes native grass species and thus alters grassland species composition, hydrological function, and nutrient composition (Rossiter-Rachor et al, 2009). The main threat posed is its potential to radically alter vegetation structure in the ecosystems it invades, by promoting hotter more intense fires, which reach up into the tree canopy and often result in tree death. This risks transforming the savanna to grassland (Rossiter et al, 2003). Its ability to radically alter fire regimes also threatens a range of human activities, including those on the periurban bushland fringes of Darwin and Palmerston. Gamba Grass currently covers between 100 000 and 150 000 ha in the NT and about 60 000 ha in Queensland (DEEDI, 2011), but is thought to have the potential to cover 380 000 ha of the NT (NRETAS, 2010b). It is still used as a pasture species in some cattle operations. A number of incursions have recently been recorded in northern WA.

Neem (*Azadirachta indica*) was introduced to Australia from Asia as a garden and ornamental plant in Darwin, possibly during the 1940s (DPI, 2008). It has now become established in urban bushland fringe areas of towns across all three states of the north, including Kununurra and the NT–WA border area (Groves et al, 2005). At various times Neem has been promoted as a quick-growing shade or amenity tree, for its medicinal and anti-insecticidal properties, and as a timber and fodder crop in a range of forestry plantation initiatives between the 1960s and 1980s (DPI, 2008). Some plantations have since been abandoned, and populations of Neem have been observed spreading away from these sites (DPI, 2008). Adult trees produce fleshy fruit, between 44 000 and 200 000 seeds per tree per year (DPI, 2008), and are attractive to a range of bird and mammal species which aid dispersal.

Neem remains undeclared in any legislative setting within Australia and continues to be available for sale in commercial nurseries. This is primarily due to a lack of formal claims about its impact, detrimental or otherwise (DPI, 2008). There is anecdotal evidence that Neem threatens Boab (*Adansonia gregorii*) (DPI, 2008).

Although taking different bodily forms (grass, shrub, tree), these three species share the characteristic of prolific seeds. The seedy bodily proliferations are abundant, built to travel and together with the mature plants are active agents in creating the plant collective, hiding in the soil for decades. We observed these ‘planty’ bodies in the literature, in the herbarium, in the field, and in the ways that human bodies talked about them. We are wary of claiming to speak for the plants themselves and recognise the partial and problematic rendering, but our aim remains to illuminate the associations of which they are a part by paying close attention to their distinctive character and capacities. Our interviews were undertaken with: weed managers in the NT and northern WA in 2011 and 2012; state government agency officers; regional managers; contracted Aboriginal trainees and rangers; local and state community environment groups; and a pastoral station manager. Both men and women were well represented. Our qualitative analysis of interview transcripts includes generating and interrogating descriptive and thematic codes within NVivo (QSR NVivo, 2011), as per Cope (2005), Dunn (2005), and Waitt (2005). The three dominant themes provided the structure for the following sections, within each of which we highlight one of the three species.

Seeds, seedbanks, and stock—the individual and the collective: *Mimosa*

“You know, it only started with one plant initially.”

Dennis (weed manager, WA)

On the NT/WA border, pastoral station managers regularly transfer horses and cattle between their operations located on either side. Brahman cattle are rounded up by helicopters and patient stock horses, herded into trucks, and hauled along dusty roads in search of greener feed. The men, pilots and stockmen, camp at night alongside the trucks in their rollout swags.

Stuck in matted gritty tails and manes, or perhaps between the grimy canvas sheets, a seed hitches a ride. Not long ago, *Mimosa pigra* ‘turned up’ in WA in just this way, probably transferred with cattle, horses, and camping equipment from a station just over the border. Some time elapsed before WA biosecurity officer Trudy, on her regular inspection round, found the single fully grown *Mimosa* plant in the station transfer yards. But when she found the plant she “jumped right on it”. Trudy was able to kill the existing plant immediately, but eradication will take another twenty-five years. A *Mimosa* seed is potentially viable for this time, so requires a lengthy period of constant monitoring.

Weed managers in the border area consistently and frequently refer to both individual seeds and seed banks; more so than any other plant part(s) or plant collective. In such a vast space, it is perhaps odd to be looking for seeds, but the seeds of invasive plants are quite literally stuck to and threaded through the bodies of cattle, horses, feral donkeys, trucks, helicopters, tents, shoes, socks, and humans. Individual seeds (also referred to as burrs for some species) are acknowledged in three ways. First, because they are often sticky or hairy, they are ingested by animals or become attached to the bodies of animals or to human belongings. Second, due to their size, they (all too easily) evade human attention and then ‘turn up’ unexpectedly as a germinated plant. For Trudy, a single adult *Mimosa* plant is itself proof that individual seeds move about and escape attention. This single seed hitched a ride (possibly for hundreds of kilometres), germinated, and grew for at least three years before the adult plant was discovered. Its discovery set in train a national weed emergency response involving helicopter and fixed winged aircraft surveillance, ministerial briefings, DNA profiling, herbarium collections, media releases, preparation of management plans, and monitoring for the next twenty-plus years (Lloyd and Vinnecombe, 2010).

Third, seeds are acknowledged as part of the daily work of managers such as stock inspector Dave. An animal quarantine holding facility operates 40 km inside WA, on the outskirts of the town of Kununurra, for all movements coming into the state. All stock must be driven to this site and held for a period after which, if they pass inspection, they can be shifted to their new localities. We were told the main purpose of the facility is to check for animal disease; it is really just happenstance that occasionally the really nasty plants turn up here in that process. The inspectors, however, check the hair on tails and manes for suspect seeds in a forensic and systematic manner. They also probe or monitor fresh dung throughout the yards. Dave described to us how he rubbed the horse and cattle tails between his fingers and hands, rolling it around to feel for the seeds. Six seeds on a horse from Katherine last week, two seeds on another horse from NSW, and eight seeds in another load of horses from NT the previous week.

Seed banks, as a collective of seeds stored in the soil, were regularly referred to in our discussions with weed managers. Managers spoke about different intersections of seed banks with time. They might, for example, represent something that must be ‘chipped away’ though regular and consistent attention, via killing of germinating seeds, or as something that builds up over time (either suddenly or gradually) without human attention. Seed banks are something that must be managed separately and in addition to the other plant life stages that are present. Management may take place on an annual or seasonal basis. For example,

relatively predictable spraying occurs at the correct time of year to kill whatever emerges from the seed bank; but an unexpected or untimely seed set, which establishes or adds to an established seed bank, must also be monitored.

Accounting for seed banks is a long-term concern, due to the persistent and durable nature of some plant seeds such as *Mimosa*. The longevity of seeds was most commonly referred to to explain the perceived inadequacies of the current (often short-term) funding arrangements for weed management work. A community land-care coordinator, Dennis has been managing weeds in this region for over ten years. As the following quote from Dennis shows, this discordance can engender a palpable sense of frustration.

“So you race out there and you charge and you do this, do this, do this, get it all done and then you’ve got to find money for the other years. So if they changed their tack on that and said decade or thereabouts, you’d be able to control your weeds a lot better. It may not be the same amount, it’d be a little bit more but it’d give those people a lot more flexibility in how they did their weed work. Most of the work, the first two or three years, this is where it falls down, the first three years is where you do most of your work. The remaining seven years it’s a quick visit, you know half an hour ... but you’ve still got to have that funding to do that, to pull those three plants out or two or ten, get rid of them before they become seeders and then within two or three years the whole lot’s turned back to where you started again” (Dennis, weed manager, WA).

So, the micromateriality of individual seeds calls attention to connections with other bodies, both human and animal. It also raises temporal questions, particularly with regard to how seed banks and plant life cycles intersect (or not) with human management cycles. The tension between being individual and being collective is not simply the difference between one tree and a forest, because the multiple material expressions of ‘plant’ extend to seeds, seed banks, resprouting branches, subterranean roots, and so on. Any of these brings with it the possibility of other and multiple plants. Any singular expression of plant entity is underlain by uncertainty between the point at which it can be said to be individual and the point at which it is understood as collective. A single *Mimosa* tree is never the entirety of the *Mimosa* plant entity—a biologist, for example, might call a tree just one alternation of the generations. But a single *Mimosa* tree signifies also the possibility of seeds lying dormant in the soil beneath and the prospect of more plants to come. This scale of analysis highlights inherent uncertainty and possibility. In the section below we bring this focus to other quarantine practices taking place at the border.

Weeds and ‘wilderness’ spaces—differential permeability: Gamba Grass

Compared with monitoring stock movements, the logistics of searching for seeds on human bodies is a much more difficult task. Quarantine inspection officers at the state border stop all vehicles entering WA, searching for fresh fruit and honey, with the aim of keeping Kununurra’s agricultural area fruit fly free. Invasive plants and seeds are certainly on their list of things to look out for, and a small wash station is provided for muddied vehicles. Most people are reasonably compliant with this process, even as officers collect and seize declared foodstuffs. Occasionally individuals go to great lengths to smuggle their tomatoes and oranges in, and voice their complaints. But as the tourist season gets busy in June and July, the queue at the border gets longer and longer, and there are not enough personnel or time to inspect every single belonging, every shoe and swag for tiny seeds.

According to weed managers we spoke to, tourists are a tricky bunch to capture via weed extension work. They are casual about the potential risks—and also transitory. Some stay a few weeks, others a few days; they come and go in predictable seasonal waves but do their own thing when they arrive. Details on signs at the border checkpoint are vague and unhelpful, simply asking travellers to ‘watch’ for ‘unusual weedy plants’ (figure 1). In some

ways the sheer number of potential plants that might come across deters officers from giving people any detailed information that would help them.

Plants which distribute their seed by air have the potential to blow across vast distances. They are also small and light and disperse in other ways. Gamba Grass was recently discovered on El Questro station, a large pastoral property complex and tourist operation several hours drive southwest of Kununurra along the Gibb River Road. The road, once



Figure 1. [In colour online]. Border checkpoint sign asking travellers to ‘keep a top watch’ for unusual weedy plants (photograph taken by J Atchison).

remote and difficult to access, is now a destination for four wheel drive tourists on their route across Australia's 'top end'. El Questro caters to budget and luxury ends of the market, both seeking the wilderness experience. Self-contained with pocket glove-box guides, GPS, and satellite mobile phone coverage, tourists can now access the 'remote and pristine Kimberley' advertised in glossy tourist magazines. As Trudy recounted, Gamba Grass has recently been found growing along the roadside and creek line at El Questro, picked up and carried from the NT as seeds in the mud on vehicle tyres, and then washed out through water crossings as their occupants stopped to take photographs or cool off for a swim.

While tourists might be oblivious to the presence of this new grass on the roadside, it really worries Andrew, a weed officer with one WA state department, who has been working in the district for twenty years. Andrew is motivated to manage weeds because he thinks particular outcomes are possible, but he is also pragmatic, recognising some weeds are performing a valuable function. Andrew deferred to 'expert ecologists' when asked questions about particular plants. At the same time, his observational experience of what different plants do and how things have changed incrementally is undeniably detailed and nuanced.

"I remember tourists in the early nineties, 'oh what's that hillside of purple?' You don't see it anymore ... your ... top canopy layer of trees is thinning out. So it's very simple, the index of biodiversity, you don't see any squashed lizards on the road. Years ago you used to, now you don't. It's not quantifiable but it's certainly an index. *Calotropis* [*Calotropis gigantea*] ... holds a lot of the eroded country together. This was cattle-caused erosion. So if it's doing a good job you actually want that plant there, so in certain places a species can either be wanted or unwanted so, you know, horses for courses. You can't just label a species, it's got to be put into context" (Andrew, weed officer, WA).

Andrew had been asked by his boss to do something about the weeds at one tourist camping ground, a response he thought typical of a reactive politics: the need for his agency to be 'seen to be doing something' about weeds. He put this in perspective by comparing the work at the campground with the more 'serious ecological' risks posed by Gamba Grass. Andrew expressed his concern by representing its arrival as a tipping point—not just another weed to add to the growing list, but indicative of larger and possibly irreversible changes to come, through the contribution of Gamba to increased fire intensity.

"It's really going to influence the landscape and once they [grasses Gamba and *Pennisetum*] get into the landscape, then we'll see an acceleration of the decline in the Kimberley environment. Having said that, if we don't get our fire regime right within the next five years it's all over red rover anyway, so we'll wait and see. We're right on the edge. There's species out there, both plants and animals that are just holding on by their fingernails and yeah, things are dropping off the perch literally" (Andrew, weed officer, WA).

As we can see in these examples, the 'front' of plant invasion is more likely to be a seed or highly fecund individual rather than advancing millions. Plants invade both independently and through contact with people. Seeds, animals, and tourist bodies move differently across and through the WA–NT border. The practices of quarantine at the border focus differently on these different bodies, with clear contradictions. The border is less permeable for some animals than it is for all humans. The consistency of effort directed at the dung and tails of cattle and horses contrasts with the permeability of the borders for human plant and seed carriers. Some invasive plants are subsumed into larger, more generic categories of 'unusual plants' or 'weeds' when it suits management or quarantine purposes. They require specific knowledge and experience to be identified as significantly different and worthy of attention. This is a question not only of where scarce resources are best applied, but also of whose bodies can be invaded. Humans would not tolerate detailed probing of their bodily borders, and they are more likely to resist if the probing of their vehicles and contents

becomes too intimate. Other nonhumans—kangaroos and birds, for example—are just as likely to facilitate plant movements, but are less amenable to bodily surveillance due to their different patterns of mobility.

Sweating it out—risk and the politics of killing: Neem

“The information that we need already exists on how to kill the plants that we need, what control methods we need. What we need is to somehow slot that into a works programme but once it’s slotted into a works programme weeds are generally the first thing that will get dropped off as other priorities come up and other priorities always come up. Weeds are not sexy, they get dropped off very quickly and the blokes don’t say anything because it’s a shitty job”

(Andrew, weed officer, WA).

In searing heat and humidity, it is a seriously difficult task to suit up a human body in thick protective clothing and respirators, and then walk into rugged terrain carrying heavy backpacks loaded with chemical spray. Of the multiple responsibilities that weed managers are juggling, the least favoured job on the list of things to do is killing weeds. This is not because the work is without its own satisfactions, or because progress is not perceived as possible, but because of the extreme conditions that human bodies must work in to kill plants.

During the northern dry season, many plants do not actively grow, or else grow slowly. At this time conditions are not conducive to the plants’ taking up or absorbing the chemicals applied to them, and kill rates are poor. Although the dry season is a better time for human bodies to work outdoors, the kill rates are so poor that any effort expended is effectively a waste of time. Towards the ‘build up’, in September and October, plants are so stressed from the preceding six to seven months without rain, that no amount of applied chemicals will have any effect.

When the first flush of germination and plant growth appears in the early wet season, weed work begins in earnest. Mechanical grubbing and stump-cut-spray methods are used for larger trees and vines, but in order to kill significant numbers, herbicide treatments must be applied during a plant’s growing season. Chemical spraying can treat both the larger plants in their periods of growth and the potentially millions of germinating seedlings. Instead of having to laboriously pull each plant out by hand, herbicide spraying allows people to move through large areas quickly, treating perhaps a hundred times more plants in a working session.

For weeks at a time during the wet season, individuals like Dennis spray many different weeds—but his passion is Neem. Here, this means working in temperatures over 40°C and up to 95% humidity. In stoic fashion Dennis described the work as “not so comfortable”. Andrew described it as “seriously oppressive”. We were told that few people could actually work when both heat and humidity were high; this is a job no one really wants to do.

Dennis described being suited up—almost beyond our imagination—in heavy-duty cotton clothing, long sleeves, long pants, and thick leather boots. It is a scratchy, abrasive bodily environment. Dennis’s hands are covered in heavy-duty rubber watertight gloves, and he chooses to wear a breathing respirator to avoid inhaling chemical vapours. Other individuals we spoke to simply could not bear the restriction on breathing that wearing full respirators involved, and resorted to using simple, although probably less protective, face masks. After suiting up at the vehicle entry point, Dennis must then carry the backpack of chemspray into the treatment site. This may involve walking a few kilometres on rugged or difficult terrain, wading through mud, or climbing across steep rocky hill slopes, and crossing streams.

Once work is under way, it is then not possible to drink without removing all the gear and having a full wash down. At this point, the risk of dehydration and heat stress becomes significant. Dennis described to us being turned around a number of times with heat stress.

“I’ve actually looked at my GPS and said, no, this is wrong, this GPS is telling me lies, I’m supposed to be going that way there, and wandered off that way there and got bushed and then realised that, no, something’s wrong so I had a bit of a slow down for a while and got myself back together. I can now recognise those heat stress symptoms fairly early and can manage my body to suit that, but it’s a trap” (Dennis, weed manager, WA).

This work is so exhausting that work usually finishes after an hour and they plan to do little else for the rest of the day.

Kill rates of plants in these conditions are above 70%, which seemed to Dennis well worth the effort. Without the wet season work, “you come back in the early dry season, oh it’s just so hard. You’ve created 10 times the amount of work.” The plant has grown, flowered over the wet season, seeded, and dispersed a new generation. Occasionally, often with unseasonal rain, plants will unexpectedly flower and set seed for a second or even third round in a season. Each of these events must be monitored, with Dennis chasing storms around, and setting residual soil herbicides in place in order to capture and take out any additional germination from the seed bank triggered by the rain. If an event is missed, an entire new generation of plants might then become established.

Whether Dennis is winning against *Neem*, and whether this particular battle is worth fighting, is certainly debated among the weed managers we spoke to. Its previous active promotion and undeclared status create difficulties in mobilising resources. Dennis stoically acknowledged the battles he wages, using the metaphor of “bashing [his] head against a brick wall” to explain his persistence and perseverance in the face of the longer term war going on, and the contingency of the ‘wins’ that he thinks are possible.

“they’re only a plant, but I like to win, I always like to win and whether I’m battling a veggie or I’m battling a human in a sporting endeavour or something like that, I never like being beaten. But I’m aware that I’m bashing my head against a brick wall, I killed millions yesterday. Millions more will grow in their place but I can’t wait to get back there and kill all them ones as well.

Oh, I suppose you have to be philosophical about it and say ... 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. They’ll be different weeds but there will always be an issue with weeds I believe. You’ll be managing them different but there will always be an issue with weeds” (Dennis, weed manager, WA).

The (human) bodily experience of chemical spraying to kill plants, and the intersection of spraying with phases of (plant) bodily growth and stasis, highlight different questions of risk in addition to the ecological risks commonly emphasised in invasive plant management. Effective weed management in this region, as for many parts of the tropics, involves serious risks to human health because the best time to get a ‘good kill’ is the worst time for human bodies to work. There are challenges here for generic safety management processes, which pay insufficient attention to human bodies and effective seasonal windows in which management work must take place. But there are also implications for the way in which weed management work is prioritised and funded, including over the longer term. What kinds of risks are acceptable? What are the social and economic implications for those individuals bearing that risk and for how long should they do so? Further, the ethics of killing plants remain completely unexamined in this process.

Conclusion

We have analysed the process of invasive plant eradication in northwestern Australia at the bodily scale. Attention to plants and to bodies—plant, animal, and human—offers new perspectives on the process and spaces of invasion and management. In particular, we have shown that even eradication—usually thought of as a separationist process, a process of pulling apart individual plants, and pulling apart plants and people—is rather a process of living, and dying, together. These bodies are not demarcated and separate, but already and intimately in relation, albeit not always comfortably. If this is the case in the eradication or frontier zone, where the control of invasive plants is still possible and the ‘war’ may still be ‘winnable’, how much more is it the case in those parts of the landscape designated as control or containment areas, or in places where invasive species are so well established as to be undeclared for that reason?

While eradication may be possible, it is also a process whose outcomes are uncertain. We have shown that this uncertainty is not only an outcome of short-term funding regimes, regulation, and the risk to human bodies, it also an outcome of the shared capacities of plant bodies themselves. The sense of certainty around killing an individual is constantly overridden by uncertainty about whether and when there will be more. Uncertainty operates and is intensified in plants at the nexus between individuals and collectives, further dismantling the bounded and containable body. In addition to the multiple human collectives applied to plants, this tension operates through the bodies of the plants—where seeds become seed banks, or where a mature plant becomes an emissary of underground seeds. Once a plant has more obviously become a collective, as in the case of *Neem*, the effort and energy required to remove it is deemed, at best, questionable.

The tension around the individual and collective is inflected in species-specific ways, resulting in differential permeability; the *Mimosa* ‘front’ is not composed only of plant bodies, but also of seeds in (and moving through) animal and human bodies. The pace and trajectory of Gamba seeds, carried by seasonal tourist movements in mud and on vehicle tyres, are different from when they blow in the wind, and different again from *Neem* fruit dispersed by native birds. Each gives us different analytical tools to monitor and think about the spread of plants under different circumstances, as well as make choices about their management.

Additionally, different temporal frames are inflected through plant bodies: the long duration of *Mimosa* seed dormancy, its opportunistic sprouting, and its seasonally confined growth periods all have consequences for invasive plant management. These other plant agencies are masked by a persistent landscape focus in invasive plant management which hides—or risks ignoring—the quiet agency of differential permeability, durability, or punctuated growth. In doing so, a persistent management focus on the tendencies of invasive plants to be highly mobile brings some kinds of relations (eg, a war footing) to the fore and obscures others (eg, long-term coexistence). *Mimosa* seeds in combination with stock are more likely to be detected but do require longer term funding commitments. Gamba Grass in combination with tourists requires a different kind of human effort and commitment, indicating that scarce resources are deployed in potentially contradictory ways, or at least with operational effectiveness as only one of the influencing variables. If human persistence can be effective only in particular windows of opportunity, it is important to understand what these are and make this matter within the management framework; in combination with mobility and mobilisation, where might resource allocation recognise persistence, stability, and flexibility?

Policy guidelines and rhetoric based on notions of hard-edge containment lines and zones of engagement contribute to and reinforce the notion of a war against weeds, suggesting a clear and potentially winning strategy. On one hand, the war footing is oddly appropriate,

obscuring individuals within an enemy collective. Like other wars whose current context no longer matches their initial objective, it is hard to withdraw from, and is partly being waged to mobilise resources from a fearful public. On the other hand, management approaches should acknowledge the realities of living in a long-term relationship with invasives, we contend. This is not necessarily a comfortable relationship, the pace and scale of ecological transformation taking place in this eradication zone are clearly a source of risk and concern, but it is one that must involve negotiation—give and take with plenty others. It involves risk and death, and demands more attention to the politics and ethics of plant killability than is usually acknowledged (and than we have scope to discuss in this paper). Coexistence with invasives will involve killing individuals and ongoing monitoring of potential germination from seed banks, but it may also mean leaving plants in place where they are the only thing holding up the river bank, or even walking away if the task is too risky or not funded commensurately with a species' longevity. The experiences of weed managers already immersed in the pragmatic, contingent task of living with invasive plants provide an important resource that should inform policy.

For embodied geographies, plenty perspectives open up new ways of thinking about bodies and their boundaries. Plant bodies challenge human-centred concepts of the body by expressing different forms of collectivity, mobility, and agency, as the examples presented in this paper show. The question of the relationship between the individual and the collective must be considered an empirically open question to be investigated rather than answered on the basis of assumptions. For example, our case of invasive plant management leads us to very different engagements with plant individuals and collectives from those illustrated by Hitchings (2007a). We are challenged to consider further the appropriate unit of ethical engagement—when and where should we worry about individuals, collectives, and species? The examples in this paper show that the relations of power and agency between humans and plants are extremely variable; control is not exerted in one direction only. Plants have the potential to energise our thinking about new ways of living in the world, but this will require increased recognition of the plenty subjects with whom we cohabit, as well as greater ethical engagement with questions of our mutual living and dying.

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